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Compact Hyper-Eye-ID

BIRDF Project Proposal

Project Proposal Cover Page
Proposal

To: Israel-U.S. Binational Industrial Research and Development Foundation

From: Israeli Company: Green Vision Systems Ltd. ["GVS"]

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Project Title: Incident Scene HAZMAT Detection for the First Responder: Capability for First Responders to analyze and identify, automatically and in real time, passive & active threats and hazards at an incident scene using a Hyperspectral Imaging Microscopic System for biological and chemical Hazardous Material (HAZMAT) [Optional Radiological/Nuclear].

Project Duration: 20 months **Project Budget: 1.91M USD**

	Israeli Company Authorized Company Official	U.S. Company Authorized Company Official
Submitted by:		
Signature:	_____	_____
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Title:	CEO & President	Managing Partner
Date Submitted:	April 11, 2016	April 11, 2016

Preferred date (month / year) for start of project funding [(1)] _____

[(1)] Do not request a start date prior to the date of the final proposal submission.

Table of Contents

Annexes

Abbreviation:

RMS	Root Mean Square
ATR	Automatic Target Recognition
BAA	Broad Agency Announcement
c/b	Chemical Biological
CFM	Cubic Feet per Minute; 1CFM [ft^3/min]=0.472 liter/sec
CFU	Colony Forming Units
GVS	Green Vision Ltd. – Israeli Firm
HASARPA	Homeland Security Advanced Research Project Agency
HSI	Hyper Spectral Imaging
HSIS	High Speed Hyper Spectral Imaging Scanner
IBADS	Instantaneous Bio-Aerosol Detector Systems
IP	Intellectual Property
LOD	Level Of Detection
NN	Neural Networks
PFU	Plaque Forming Units
PIP	Proposal Information Pamphlet
PM	Particulate Matter
ROI / AOI	Region / Area Of Interest
Tauri	The Tauri Group LLC– US. Firm
SFP	Spectral Finger Prints
USPS	United States Postal Service
Virtual Agent	Smart Sensor

A. Executive Summary of Project Proposal

	Israeli Company	U.S. Company
Company name	GreenVision Systems Ltd. ["GVS"]	The Tauri Group, LLC ["Tauri"]
Company locations (headquarters and relevant division address, including full street address, city, state)	27 Habarzel St., Ramat Hachayal, Tel Aviv 69710, Israel +972-3-649-5664	6361 Walker Lane, Suite C130 Alexandria, VA 22310 USA +1-703-683-2883
Company website	www.greenvs.com	www.taurigroup.com
Year established	1996	2001
Revenues*: recent fiscal year 2015 * includes its related companies & subsidiaries	$3,000,000 USD	$20,000,000 USD
Increase / (Decrease) over previous year	5%	flat
Number of employees * including its subsidiaries	18*	110
Ownership (Public / Private)	Private	Private
Percentage ownership of the company by the other company	0	0
Program Leaders	Danny Moshe (danny@greenvs.com)	Jerome Holton (jerome.holton@taurigroup.com
-		
Number of previous BIRD projects	1	0

Israeli Company Registration Number	512349606

Expected project title	Hyperspectral Imaging Microscopic System for Chemical/Biological HAZMAT Detection at an Incident Scene
Estimated project budget	$ 1,930,000 [65%-67%] to be allocated to GVS; rest to Tauri]
Expected project duration	20 months

1. ABSTRACT

Utilizing GVS' HSI sensing technology in the NextGen First Responder Technologies Program will improve First Responder Situational Awareness and safety by providing highly accurate, relevant, near real-time, HAZMAT detection/identification information (including TICs/TIMs and C/B materials). During this project the team will adapt and repackage the core HyperEye-ID system to enable a 24/7 routine inspection/monitoring asset that will provide customers [e.g., federal, state, and local first responders, other government organizations and entities]:

(i) The ability to identify rapidly any hazardous agents and contaminants and;

(ii) The ability to monitor, detects, and analyse passive and active threats and hazards at an incident scene in near real-time.

Rapid improvement of First Responder situational awareness and force protection capabilities requires a widely available asset to provide early warning and continuous monitoring. Any First Responder has limited time to survey a site after arrival and before deployment of personnel and equipment. The HyperEye-ID system will allow detection of aerosol and surface hazards, but additionally, it will allow rapid analysis of any effluent from windows, doors, and chimneys to warn of the presence of dangerous materials and/or any dangerous reactions under way.

HyperEye-ID can provide this capability enhancement. Moreover, the applicability of this tool to parallel missions of other groups (Customs and Border Protection, Federal Bureau of Investigation, Centers for Disease Control and Prevention) will allow for economies of scale in production and commensurate reduction in cost and increase in product liability.

2. COMPANY BACKGROUNDS

GreenVision Systems Ltd

Green Vision Systems Ltd. (GVS), founded in 1996, is an Israeli company that provides a comprehensive product suite to enable real-time monitoring, detection and tracking of bio-chemicals based on the Company's patented and field-proven Hyper-Spectral Imaging (HSI) technology and its proprietary database. The company's product suite analyzes and identifies the bio/chemical composition of substances within the scanned images, in near-real-time.

The Tauri Group, LLC, US Partner

The Tauri Group, LLC (Tauri) is a US company that provides analytical, advisory, and engineering support services to its clients. It specializes in the detection, analysis, mitigation, response, and recovery associated with man-made and naturally occurring threats against populations and infrastructure, with particular expertise in biological and chemical threats. Tauri works with federal, state, and local governments, as well as the private sector, academia, and national laboratories.

3. THE INNOVATION

Both parties aim to develop HyperEye-ID inspection, tracking, and diagnostics system for the NextGen First Responder Technologies Program. Together we will introduce versatile, adaptive, and compact real-time systems using GVS Hyper Spectral Imaging modules.

The prototype unit will be designed to work as a three-stage monitoring and alert system according to the following principles:
   i)   Modifications and development, as needed, of database applications based on HSI FT technology
   ii) Monitoring and classification of selected priority substances using selective markers and dedicated light sources
   iii) Developing a master monitoring database and event management platform

The entirety of this developmental effort will be executed in parallel with a First Responder partner (currently planned to be the Fairfax County HAZMAT unit) in order to ensure both the operational relevance and interoperability of the prototype with the targeted First Responder end user.

Although dispersion-based Hyper Spectral sensors may record hundreds of bands, they lack spatial sensitivity and accuracy in terms of their spectral characteristics due to the physical limitations of the method. This is due to narrow bandwidth and the contiguous nature of the spectral band measurements, but not the absolute number of measured wavelength bands which qualifies a sensor as Hyper Spectral. Moreover, dispersion-based approaches do not support both spatial resolution and real-time area scanning; either greater spatial resolution or faster scene updates are possible, but not both simultaneously. Due to a high signal to noise ratio of FT based systems, the number of spectral bands and HSI data mining capabilities can be optimized to yield sensitive and rapid biochem detection, identification, and material tracking in a continuous fashion.

Currently available Bio and Chem PM Devices and technologies may be able to detect and classify a general category of biological/chemical objects; however, the potential to quantitatively assess actual physical-chemical characteristics of the scanned objects using multiple dedicated light sources and/or precise spectral markers is limited.

Current technologies and products in the market simply do not offer the flexibility and reliability of GVS' technology and solutions. With a proven technology platform and test-ready applications, both parties aim to become a leader in the biological/chemical HAZMAT particulate, aerosol, and effluent sensing markets

The HyperEye™ enables the following advantages:
- Detection and classification of CB HAZMAT aerosols
- Versatile system that unlike a DNA-based system can detect genetically modified organisms
- Fast response time – analysis report within minutes
- Detects multiple hazards simultaneously (i.e., mixtures or multiple species)
- Low operational costs resulting from no or few consumables and no external database
- High sensitivity and short sample processing while reducing the potential of sample contamination
- Statistical background handling leading to high reliability with low false alarms
- Effective adjustment of performance characteristics adapting to rapidly changing conditions
- No sample transfer to or through separate instruments
- High adaptability and learning capabilities
- Unique capability to detect anomalies in specific scenes (distinguish agents / dust that are not set as targets in the database)
- Optional capability of detecting radionuclides and emission particles (RN)

4. COLLABORATIVE RELATIONSHIP

GVS and Tauri will enhance current applications of GVS and will develop applications using the HyperEye-ID [F] [PM] [based on GVS' HyperEye microscopic unit, marker unit and s/w] in order to provide sensitive biological and chemical agent detection and identification capabilities in multiple packaging configurations.

PROGRAM PHASES:

The project will include three phases to develop and confirm that HyperEye-ID [VISNIR range] has the needed performance [sensitivity, dynamic range, SNR, cycle time] for sensing, detecting and identifying materials of interest:

Phase 1: GVS will develop a Particulate Matter ["PM"] sampling unit, compact, low-power HSI FT prototype unit with an 8mm optical beam size with sufficient processing power, memory and connectivity. During this phase, Tauri will support the integration effort and will also conduct the requirements analysis derived from our operational First Responder partner to validate the approach, gather additional operational requirements, and assess limitations of technology to be delivered.

Phase 2.1: With Tauri assistance to accommodate user requirements, GVS will conduct modifications, engineering and development of a hardened compact prototype unit to meet application specifications to sense air at different flow rates [liters/min] to detect HAZMAT particulate matter and selected agents (Spores) by fluorescence techniques implemented with the HSI unit.

Phase 2.2: Tests and validation will be done by both GVS and Tauri in accordance with the program milestones. GVS will develop the database (based on its current IPP), using the units from Phases 1 and 2.

5. COMMERCIAL POTENTIAL

GVS will develop a rapid and versatile early warning system for outdoor and/or indoor applications, the HyperEye- ID [F]] , with versatile air collector unit, using a High Volume controlled pump. Collected particulates are concentrated and trapped on a target plate (several configurations are available, optimized according to the target materials of greatest interest). Those particles are then processed in near real-time using GVS' HSI (Hyper-Spectral Imaging) platform using GVS' massive proprietary database containing spectral fingerprints used to identify the collected material. The system has optional capabilities to detect radionuclides, as well. Expansion of the spectral database is continuously possible, depending upon the requirements of the end user.

GVS and Tauri with Strategic Partners (operational and financial partners) will co-develop and commercialize the use of hyper-spectral imaging (HSI) equipment and services in Target Markets for HAZMAT detection, as already noted. In addition, the core technology is also applicable to HAZMAT contamination monitoring, early warning and tracking over time of indoor-air in selected buildings. To date, only the US Postal Service has installed such a system because of the high cost; HyperEye provides a similar capability at a fraction of that cost, expanding the target market to high throughput government buildings as well as large commercial buildings.

The *U.S. Homeland Security & Public Safety Market: 2013-2020* report is the most comprehensive review of the U.S. Homeland security and public safety market available today. Homeland Security Research Corp. provides the only detailed and reasoned roadmap of this complex market. The analysis combines Homeland Security and Public Safety markets since, in many cases; products have dual-use applications and present the same business opportunities, for example:

- First responders respond to a variety of public safety and homeland security incidents, including human distress (e.g., injury and disease), accidents (e.g., fires), terrorist attack (e.g., release of hazardous PM), criminal activity (e.g., hostage situations and / or illicit drug manufacture), technological hazards (e.g., release of toxic industrial chemicals and materials), and natural disasters (e.g., floods and earthquakes). Our proposed technology could have applicability across many of these areas.

- Annual investments by the US Federal Government and private sector in Homeland Security and Public Safety products and services increased from $48 Billion in 2011 to $51 Billion in 2012, and is forecast to increase to $81 Billion by 2020. [1]

- The total US Homeland Security, Homeland Defense, Homeland Security related Counterterrorism, and Public Safety Markets grew from $74.5 Billion in 2012 to $107.3 Billion in 2020 at a CAGR of 4.7%.

Calendar Year	2017	2018	2019
Target market size for developed product (M$)	$50M	$53M	$57M
Estimated market share (%)	50%	50%	50%
Estimated sales quantity (units)	12	36	72
Estimated representative unit price ($/unit), Ex Work End User Prices	$90,000	$84,000	$72,000
Estimated sales revenue (K$)	$1,080K	$3,024K	$7,200K
Estimated cumulative sales revenue (K$)	$1,080K	$4,104K	$8,208K

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[1] ; ; http://homelandsecurityresearch.com/2014/03/decontamination-equipment-of-cbrn-hazmat-incidents-industry-technologies-and-global-market-2014-2020/

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B. The Innovation

Introduction

The end of the cold war has reduced international tension between the super powers. However, ironically enough, this has resulted in regional instability due to a resurgence of nationalistic, religious, and ethnic strife, which presents a real threat to peace in all regions of the globe.

Additionally, there has been a remarkable increase in the production and availability of chemical and biological contaminants throughout the world. The combination of these factors has significantly increased the possibility of an attack on the western world involving the use of such contaminants. Chemical and Biological agents are often considered to be psychologically more threatening than conventional conflict, therefore providing more appeal to the terrorist for initiating a conflict. GVS' Hyper-Eye^{TM} enables the optimal detection of these hazardous PM agents for emergency first responders.

The threat of a terrorist chemical or biological attack and the risk of chemical and biological accidents in the USA, Israel, EUROPE and all over the world are on the rise. Hence, First Responder needs abroad continue to grow as government authorities' sense of urgency to develop effective chemical and biological detection sensors to mitigate these threats also grow, while also providing an ability to detect and identify common HAZMAT.

Presently, the standards and protocols used to evaluate such detection systems are old and inadequate for today's expanding First Responder needs. These needs can be met with highly performing technologies that are efficient, reliable, easy-to-use and readily integrated into the current concept of operations. While simple in concept, achieving such requirements is becoming exceedingly difficult when considering the vast number of possible mission scenarios and technology applications.

The ultimate goal is to reduce substantially the possibility of HAZMAT smoke/clouds/PM [biological and chemical] exposure as first responders enter a scene and discharge their responsibilities to protect people and infrastructure during an event. A secondary objective is to support response and restoration operations and minimize the overall economic impact of a biochemical hazardous material (HAZMAT) event.

Chemical HAZMAT.   Hazardous chemical agents are gaseous, liquid, or solid chemical substances that have direct toxic effects on man and animals. There are several classes of chemical agents, many of which can kill through poison or by causing severe damage to one's respiratory system. In defending first responder teams and the public against chemical HAZMAT events, the role of sensors optimized for these chemical agents is principally to detect when an attack/accident has occurred and to identify which agent has been used in order to take appropriate protective posture, evacuation, containment, and medical treatment steps.

Biological HAZMAT.   Hazardous biological agents are disease-causing organisms, or toxins produced by living organisms, that incapacitate or kill human beings and animals or destroy crops. Biological HAZMAT, with the exclusion of toxins, generally have delayed effects, because they cause particular diseases to develop in the body over a period of days or weeks. As is also the case with Chemical HAZMAT, passive sensors have relatively little chance of detecting a biological agent prior to its release into the atmosphere or food supply.

Biological sensors can detect the presence of disease-causing organisms and can, in some cases, identify the organism. With adequate warning, the range of post-exposure treatment

options is far greater for biological agents than for chemical agents, due to the relatively long incubation periods of biological agents and their susceptibility to medical countermeasures.

Biochemical Detection Systems and current technologies on the market

The desired detection system should be capable of rapid integration into existing system architectures to meet the broadest possible range of user requirements. User requirements will vary according to the perceived risk, false alarm tolerance and cost sensitivity. It is also likely that the perceived risk may vary over time, creating a need for systems that allow for the effective adjustment of performance characteristics in order to suit these varying conditions.

Analytical chemistry is the science of experimentally determining the elemental, chemical and physical characteristics that make up a particular sample. Analytical instruments are used to perform analytical chemistry, detecting, identifying and measuring the changes in the properties of solids, liquids, and gases.

Today, a range of both traditional and modern next-generation methods are being employed in analytical Automatic-Controlled Real-Time Learning Instruments to perform separation, identification and/or examination of samples. The next-generation methods are powered by Networked Dynamic Analytical Technologies (NDAT), defined as systems for the analysis and control of manufacturing processes based on timely measurement of critical quality parameters and performance attributes of raw materials and in-process materials. They aim at encouraging the concepts of quality by design, use of computerized data gathering and evaluation techniques, and process- and product-monitoring methods through advanced instrumentation and data evaluation.

The performance of a HAZMAT and C/B agent sensor is most properly characterized by a number of interrelated parameters such as sensitivity, probability of correct detection, false positive rate, and response time. The operation of sensors should allow for the trade-off of one or more of these parameters in order to optimize sensor performance for specific applications. For instance, in some circumstances one might be willing to accept a higher false positive rate in order to obtain a better sensitivity. The sensor's Threshold Operating Parameters (TOP) set the performance balance between sensitivity, probability of correct detection, and false positive rate.

There are several variables that affect a sensor's performance, but for continuously operating detection sensors, it is useful to consider TOP curves that relate sensor sensitivity rates to false positive rates at a given detection confidence. The ability to be dynamically alerted by a distributed sensor system (connected to a network of sensors) and to adjust those sensors via a tunable TOP enables peak performance at all times.

The leading current analytical chemistry technologies on the market today are:

- Polymerase Chain Reaction (PCR)
- Immunoassay
- Basic Microscopy
- Gas/Liquid Chromatography and Mass Spectrometers
- Fourier Transform Infrared (FTIR)
- Raman Laser Spectroscopy (RLS)

GVS' and TAURI's joint solution

During the past months GVS and TAURI management teams have been examining the joint business opportunity to address first responders' HAZMAT detection, warning, and tracking applications. TAURI has already established key-contacts and is already supporting CB HLS and First Responders in US markets. Our joint solution can provide a rapid response rate for relatively low cost because it doesn't require expensive consumables and intensive labor resources. The GVS and Tauri solution will also require minimal annual maintenance costs to make it an affordable option for first responders.

The product concept

GVS and Tauri propose to develop a novel product based on the HyperEye-ID but tailored to the operational requirements of the first responder. The technical approach will include modification of collector technology and development of a flexible collector interface that provides a concentrated HAZMAT sample to the imaging detection system for autonomous and continuous monitoring. This approach builds off of existing collector technology by providing a revolutionary interface compatible with multiple detector systems.

Through the integration of GVS technology and Tauri's understanding of first responder needs, (both described in more detail below), we will develop a rapid, adaptive, open architecture, real-time hyper-spectral imaging solution.

The proposed system consists of Two Major Units (presented in the figure below) and an additional unit (3), which will be developed and presented in a later stage after starting the marketing and sales of the **Hyper-Eye-ID** joint solution.

1) **The GVS air sensing, PM collection, and sample handling unit includes three basic components:**
   a. an air inlet and fan to move the incoming biological and chemical aerosols
   b. a Teflon filter roller, steps motors with full control to collect the P.M.
   c. The Teflon Tape will then be replenished by new Teflon Tape [the old Teflon Tape can be used for further investigation and for archival records].

HyperEye™ is equipped with a pre-filtering mechanism that enables the filtering out of particles that are larger than 10um in diameter (controlling the background particles). To reduce "noise" the database will include Spectral Fingerprints (SFP) of dust/background particles. Background SFPs that are recorded in the database will not appear in the detection phase. GVS developed a method (to fit GVS' Hyper Spectral Imaging system) to reduce dust background signals, applicable when using the metal pallet version [adding specific additives that reduce fluorescence signal from background PM --
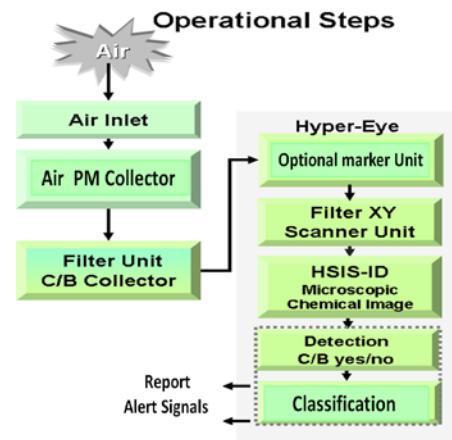
For the Teflon filter version (main objective of this program, part of phase-I &II) the air sampler will be designed to fit the first responder detection requirements and to be integrated into daily operation for the first responder and HLS organizations. Air sampling unit will includes (i) versatile pipe with dedicated filters and air inlet (ii) mechanical unit to collect on Teflon filter (coated or non-coated Teflon filter roller) the samples of particles, which are scanned by HyperEye™ scanner.

For the Metal plate version (secondary objective, part of phase-II of this project (i)by controlling the air inlet speed, air outlet speed and the static electricity value on a specific matrix HyperEye is

able to control particle density collected on the Sample Plate unit and enhance the signal to noise ratio (SNR). (ii) A pins matrix mechanism ensures that the collected particles are uniformly spread on the sample plate, and (iii) the "Marker" unit enables the system to extract PM [e.g. spores] from the lower layers of particles to the upper layer/s, which are scanned by HyperEye™ scanner.

2) **The <u>GVS</u> Hyper-Eye-ID Unit cycle of operation**:
Filter Roller [F] [CB] Main version includes:
   a. Air Sampler with control high volume pump and versatile pipe air inlet system, fit to First responder mission: ;
      i) Air inlet system with pre filter unit ; Teflon roller filter.
      ii) An optional coated filter [not part of this project] - mechanism can be integrated with the hyperspectral imaging capabilities to enhance the probability of detection (PoD) and significantly reduce the false alarm rate (FAR) to the needed level.
   b. Light sources unit, the source light unit is target-specific, selected for a class of target materials to measure the unique spectrum of those target materials.
   c. optional coated Teflon filter (this is not yet available and is not applicable for this project) will carry a specific dry marker that with the air flow enables better SNR on the target agents by reduction of specific back ground particulate matter (based on the region vs. events vs. scenario
   d. Automatic filter scanning stage with XY movements mechanism
   e. The HSIS - Hyper Spectral Imaging Microscopic Technology.
   f. Automatic detection and classification with co-sharing SFP database s/w:
      i) The particles on the sample plate are scanned by the HyperEye™, generating a spectral image.
      ii) Each pixel on this image has its Spectral Fingerprint.
      iii) The system applies an active adaptive learning phase on the SFP dynamics for tracking and data base updating.
      iv) The system will have a pre-filtering process to remove particles > 10/20 micron
      v) Dynamic noise reduction database will include Spectral Fingerprints of dust/background particles (Background SFPs that are recorded in the database will not appear in the detection phase).
      vi) optional RN sensor (from ROTEM Industries)

[Part of phase-II and phase-III tasks] The Metal Plates with four rotated stage [M] [CB] base version includes:
   a. Air Sampler with control high volume pump and metal plate. The PM will be collected on the metal plate using high voltage static effect;
   b. A bio marker & pumps unit and a light sources unit;
      i) The Marker is a target-specific designed protein that connects to the detection target upon encounter and reflects a unique spectrum that is collected by the system.
      ii) A very small amount of Marker is required for each cycle. A Multi-Marker mechanism can be applied using the Hyper Spectral capabilities with imaging capabilities to enhance the probability of detection (PoD) and significantly reduce the false alarm rate (FAR) to the needed level.
      iii) Enhanced detection allowing for dual markers method, (i.e., chemical and biological, or two different chemicals with different SFP) are currently under development.
   c. Passive and active sample handling as necessary, including automatic feed-in / feed-out (carrying specific dry markers to enable better SNR on the target C/B agents)
   d. Automatic filter scanning stage with XY movements mechanism
   e. The HSIS - Hyper Spectral Imaging Microscopic Technology.
   f. Automatic detection and classification with co-sharing SFP database s/w:

i) The particles on the sample plate are scanned by the HyperEye™, generating a spectral image.
ii) Each pixel on this image has its Spectral Fingerprint.
iii) The system applies an active adaptive learning phase on the SFP dynamics for tracking and data base updating.
iv) The system will have a pre-filtering process to remove particles > 10/20 micron
v) Dynamic noise reduction database will include Spectral Fingerprints of dust/background particles (Background SFPs that are recorded in the database will not appear in the detection phase).
vi) GVS developed a method (to fit GVS' Hyper Spectral Imaging system) to reduce signals of background dust using specific liquid [marker] drops

g. a vacuum cleaner unit of the Metal plate
h. optional RN sensor (from ROTEM Industries)

In addition to the most commonly encountered HAZMAT, various types of Bio-Chemical aerosols/particles can be detected by the system (see table). HyperEye™ allows the system operator to set specific spectral range/s (optional feature) and specific markers (basic feature) for specific CB particulate matter targets.

In principle the HyperEye™ can detect any CB particles/ agents that generating a fluorescence spectral fingerprint light in the VISNIR range.

Our system will enable simultaneous screening for multi (active, fluorescence) agents at the same time. For Spores, the system [the version with the metal plant , outcomes of phase-II] will use a dedicated marker that binds to the Dipicolinic acid (**DPA**) found within the outer spore coating.

	Disease/Agent - PART LIST Spectral imaging [SFP range, 395-1000nm]	Agent type (Bacteria, fungi, Toxin P.M)	Immunoassay applicability (Biological)	DPA applicability (Chemical) Bio Marker	Notes
1	Chemical P.M	Aerosols, PM	No	No	Teflon ver
2	*airborne bacteria, gram-negative bacteria (GNB), and fungi*	Bacteria	No	No	Teflon ver
3	black and organic carbon ; smoke particles				NTeflon ver
4	*Bacillus anthracis*	Spore	Yes	Yes	~~No~~Metal Plat ver
5	*Clostridium botulinum*	Spore	Yes	Yes	Metal Plat ver
6	Tularemia others [out of project scope]	Bacteria	Yes	Yes	Metal Plat ver
7	Others [out of project scope]	Bacteria	Yes	Yes	Metal Plat ver

Examples: Spray of semi volatile in the air and tell them if there exists a vapor particulate hazards and indicate to the First Responder team appropriate levels of personal protection.   The following table lists the most common TICs listed by their hazard index: https://www.osha.gov/SLTC/emergencypreparedness/guides/chemical.html. The PM results from accidents [e.g. fire due to those materials,] generating smoke that GVS system can sense & detect & classify those P.M

2) **The GVS and Tauri data exchange, database, and maintenance processes**
   a. Database:
      i) The HyperEye™ system consists of a dynamic database that includes all the spectral fingerprints of the known HAZMAT and biological and/or chemical detection targets.
      ii) This database is the source for comparison and classification of targets detected by the system.
      iii) The database also includes spectral fingerprints of background particles to reduce false alarm to a minimum.
      iv) When the system encounters a target that cannot be identified by the existing database, an alert can be triggered notifying relevant personnel of the existence of an unidentified target.

   b. Cleaning:
      i) The HyperEye module is a closed system to avoid contamination.
      ii) The air handling module includes a self-cleaning mechanism and allows liquid cleaning when contamination warning occurs.

   c. Maintenance: Hyper-Eye Mechanical Maintenance Frequency
      i) For the base-roller anti-vibration platform: once a year
      ii) Consumables replacement (3 small drums): 3-4 months
      iii) Waste drum cleaner replacement frequency: 3-4 months
      iv) Recalibration: once a month (remotely as an option)

   d. Mechanical Interface Requirements:
      i) Interface to Air-Collector – No Vibration pipe connection to conveyor.
      ii) The Hyper-Eye will be installed on stabilized floor with an anti-vibration mechanism platform.
      iii) HyperEye conforms with IP 65
      iv) System will interface with any existing air handling systems at the installation site. Optional exhaust filter can be attached to system.

   e. System Outputs
      i) Analog and digital signals for Alert system
      ii) Communication links to Site IT platform via TCP/IP
      iii) Operation indicator light
      iv) Maintenance requirement indicators:(i) Hyper-Eye (ii) Air Collector (iii) Cleaner unit (iv) Cyclic unit
      v) Error Indicators: (i) Hyper-Eye (ii) Air Collector (iii) Type roller system ; air pump unit; Light sources unit ; cleaner and marker units, for metal version

   f. System Inputs
      i) Power Supply Requirements 110/220VAC (15A/7A max) - stabilized power source
      ii) Air Sampling via dedicated pipes, with multi pipe unit and filters to avoid entry of big PM into the air inlet system
      iii) Marker drums (liquids) to be supplied by GVS and its affiliate
      iv) Data and system parameters, via the data links (among several Hyper-Eye units at a single site and between units at multiple sites); scenario setup; detection parameters; classification parameters; operation parameters.

Competition and alternative methods

Analytical instruments employ various technologies to perform separation, identification and/or examination of a sample. Increasingly, combinations of technologies are being used for more sophisticated analysis. Following is a comparison table of the existing methods:

Method	Basic Microscopy Classic	Basic Microscopy SEM	GC/LC/MS	FTIR	Current PCR	GVS New System
Extraction						
Expert Required	Yes	Yes	Yes	No	No	No
Time Consumption	High	High	Medium	Low	Medium	Semi-Real-Time
Sample Intervention	Yes	NA	NA	NA	No	No
Exposure to Hazards	Yes	No	Yes	No	Yes	No
Sensitivity	Medium	NA	Low	NA	Low	High
Phase Transition	No	NA	NA	NA	NA	Yes
Analysis						
Self Learning capabilities	NA	NA	NA	NA	NA	Yes
Maintenance	High	Medium	High	Low	High	Minimal
Repeatability	Low	Medium	Low	Medium	High	High
Interpretation / Cost						
Imaging Morphologic	No	Yes	No	No	No	Yes+ Crystallization
Time Consumption	High	Medium	Medium	High	Medium	Low
Cost	Medium	Medium	High	NA	Very High	Low

IPR present situation

Includes status of new IPR, especially with regard to patents that are going to be granted.

GVS and Tauri fully understand the importance of protecting its intellectual property in general and fully realize that such protection is mandatory for marketing product in the US markets.

GVS continuously invests in safeguarding its IP through international patent registrations, and GVS currently has 18 registered patents and 3 trademarks.

GVS currently has 15 registered patents and an additional 3 patents pending in various areas, all based on Spectral Imaging technology and/or Automatic Target Recognition. Following is a listing of the GVS Intellectual Property Portfolio (IPP), current through Dec. 22, 2014. GVS IPP encompasses ten (10) main technological fields (areas, categories) of patented or patent pending inventions, and one (1) category of Trademarks:1) Life quality characterization and applications thereof via hyper-spectral imaging and analysis (HSI) technology
2) Hyper-spectral imaging and analysis (HSI) technology
3) Water resources (water pollution) (HSI) monitoring and   regulating technology
3) Air particulate matter (air pollution) (HSI) monitoring and   regulating technology
4) Biological and chemical agents (HSI) detection and analysis technology
5) Microelectromechanical (mem) hyper-spectral imaging and analysis technology
6) Plant matter grading (HSI) technology
7) Article (document) authentication (HSI) technology

8) Electro-optical inspection and analysis technology
9) 3D microwave scanning and mapping technology
10) Trademarks

The following GVS Ltd. IPP listing of the ten main technological fields (areas, categories) of patented or patent pending inventions is 'representative' of the overall GVS (non-trademark) intellectual property, and includes: (a) issued US patents, each of which has a corresponding patent issued in at least one other (i.e., non-US) country (e.g., Europe, Australia, Israel, Japan, etc.), or a corresponding National Phase (NP) patent application pending in at least one other (i.e., non-US) country; (b) National Phase (NP) patent applications pending in the US, and in at least one other (i.e., non-US) country; (c) active (non-expired) filed US provisional patent application(s), to be converted into PCT international patent application(s).

GVS Ltd. Trademark type IP is separately provided at the end.
a) HYPER-SPECTRAL IMAGING AND ANALYSIS (HSIA) TECHNOLOGY
    i) Allowed US and pending IL (National Phase) Patent Applications, priority date of March 01, 2006, entitled: "PROCESSING AND ANALYZING HYPER-SPECTRAL IMAGE DATA AND INFORMATION VIA DYNAMIC DATABASE UPDATING".
    ii) US Patent No. 7,411,682, and, other countries issued patents, entitled: "REAL TIME HIGH SPEED HIGH RESOLUTION HYPER-SPECTRAL IMAGING".
    iii) US Patent No. 6,697,510, and, other countries issued patents, entitled: "METHOD FOR GENERATING INTRA-PARTICLE CRYSTALLOGRAPHIC PARAMETER MAPS AND HISTOGRAMS OF A CHEMICALLY PURE CRYSTALLINE PARTICULATE SUBSTANCE".
    iv) US Patent No. 6,694,048, and, other countries issued patents, entitled: "METHOD FOR

b) GENERATING INTRA-PARTICLE MORPHOLOGICAL CONCENTRATION / DENSITY MAPS AND HISTOGRAMS OF A CHEMICALLY PURE PARTICULATE SUBSTANCE".
    i) US Patent No. 6,438,261, and, other countries issued patents, entitled: "METHOD FOR IN-SITU FOCUS-FUSION MULTI-LAYER SPECTRAL IMAGING AND ANALYSIS OF PARTICULATE SAMPLES".
    ii) US Patent No. 6,091,843, and, other countries issued patents, entitled: "Method Of Calibration And Real-Time Analysis Of Particulates".
    iii)   US Patent No. 5,880,830, and, other countries issued patents, entitled: "METHOD FOR ON-LINE ANALYSIS OF POLYCYCLIC AROMATIC HYDROCARBONS IN AEROSOLS".

c)   WATER RESOURCES (WATER POLLUTION) (HSIA) MONITORING AND REGULATING TECHNOLOGY
        i) Pending US and other separate country International (National Phase) Patent Applications, priority date of March, 2013, entitled: "REAL-TIME MONITORING, PARAMETRIC PROFILING, AND REGULATING WATER RESOURCES THROUGHOUT A REGION, VIA HYPER-SPECTRAL IMAGING AND ANALYSIS".

d)   AIR PARTICULATE MATTER (AIR POLLUTION) (HSIA) MONITORING AND   REGULATING TECHNOLOGY
        i) Allowed US and other separate country International (National Phase) Patent Applications, priority date of June, 2010, entitled: "REAL-TIME MONITORING, PARAMETRIC PROFILING, AND REGULATING OUTDOOR AIR PARTICULATE MATTER THROUGHOUT A REGION, VIA HYPER-SPECTRAL IMAGING AND ANALYSIS".

e)   BIOLOGICAL AND CHEMICAL AGENTS (HSIA) DETECTION AND   ANALYSIS TECHNOLOGY
        i) Allowed US, and additional separate country (Singapore, South Korea) International (Paris Convention) Patent Applications, entitled: "HYPER-SPECTRAL IMAGING AND ANALYSIS OF A SAMPLE OF MATTER, FOR IDENTIFYING AND CHARACTERIZING AN OBJECT OF INTEREST THEREIN". US CIP of U.S. Patent No. 8,159,661.

ii) U.S. Patent Nos. 8,817,253, and 8,159,661, entitled: "HYPER-SPECTRAL IMAGING AND ANALYSIS OF A SAMPLE OF MATTER, AND PREPARING A TEST SOLUTION OR SUSPENSION THEREFROM".

iv) GB Patent No. 2,459,600, entitled: "HYPER-SPECTRAL IMAGING AND ANALYSIS OF A SAMPLE OF MATTER, AND PREPARING A TEST SOLUTION OR SUSPENSION THEREFROM".

f) MICROELECTROMECHANICAL (MEM) HYPER-SPECTRAL IMAGING AND   ANALYSIS TECHNOLOGY

i) Allowed US and other separate country International (National Phase) Patent Applications, priority date of May, 2011, entitled: "MICROELECTROMECHANICAL SYSTEM (MEMS) AND (MEM) OPTICAL INTERFEROMETER FOR HYPER-SPECTRAL IMAGING AND ANALYSIS".

g)   PLANT MATTER GRADING (HSIA) TECHNOLOGY

i) Allowed and soon to be issued US (National Phase) Patent Application, priority date of Sept., 2009, entitled: "METHOD FOR GRADING PLANT MATTER USING HYPER-SPECTRAL IMAGING AND ANALYSIS".

Any patentable or non-patentable invention(s) made by GVS employees during the term of this Agreement/project and relating to hyper spectral imaging technology shall be and remain the sole and exclusive property of GVS.

Any patentable or non-patentable invention(s) made by Tauri employees during the term of this Agreement /project and relating to sample collection technology shall be and remain the sole and exclusive property of Tauri.

All parties agree not to reverse engineer, disassemble, or reverse compile any portion of the other party's IP and shall not use any method to trace, decompile, or disassemble any portion of the other party's IP. Such obligations shall continue in force for perpetuity so long as such IP constitutes a trade secret or until the last to expire patent if such IP is patent protected.

Industry standards

The proposed product will meet the industry standards, including but not limited to the UL and CE safety standards. GVS also have ISO-9002.

Obligations to government agencies

During the development program both Tauri and GVS will cooperate to establish relationships with specific government agencies that have supported any part of the innovation development.

Tauri will work closely with US first responders to assist in fully testing, evaluating and installing the HyperEye-ID systems in selected US locations.

C. Proposed R&D Program

C.1. Analysis of the Problem

Many of the available detection systems can function properly only under 'laboratory' conditions, i.e., a sterile environment free of most background particles. In contrast, the HyperEye was designed to function under extreme environmental conditions. That is, the HyperEye is capable of detecting various biological agents even if the environment is saturated with particles of various sizes, shapes, and constituents.

The Hyper-Eye-ID Compact version to be developed during this BIRDF Project will be based on current GVS detection technology and systems, and on Tauri's history of planning for event avoidance, detection, consequence management and restoration of catastrophic events of concern to First Responders.

The large variety of HAZMAT spilled during accidents [fire; personnel/ terrorist acts] has a large number of associated First Responder operational scenarios. The need to sense and detect the HAZMAT onsite is a critical requirement of first responder and HLS authorities. The available CB agents detection systems take advantage of the characteristic spectral emission peak/s, but with the unpredictable backgrounds in dirty operational scenarios, the capabilities of current systems to provide a high end rapid solution is seriously diminished. Accommodating this variable background is one of the GVS and Tauri BIRDF program objectives. Moreover, we intend to develop a rapid, adaptive, highly sensitive multipurpose solution for First Responder and Homeland Security threats & hazards detection, identification and fate/transport for current and future missions.

As a comparison, the HyperEye of GVS integrates both chemical and biological detection approaches, capitalizing on the speed of the chemical detection approach along with the high sensitivity and specificity of the biochem agents fluorescence detection approach.

Moreover, while other detection systems can only detect limited chemicals and bio agents (PM)-forming bacteria / aerosols, the HyperEye with its bio-chemical active (fluorescence P.M.) detection approach is capable of detecting specific bacteria and fungi for which specific markers are available. These include Toxic Fungus, aerosols & particulate matter, and many more.

The use of a Real-Time PCR in the detection of the *Bacillus anthracis* bacteria may yield false negative results and thus, pose a great danger. According to Heninger et al. (2006), *Bacillus anthracis* bacteria were found to be lethal even when missing the three genes (PA, LF, and EF) long considered as responsible for the high lethality of *B. anthracis.* This new evidence renders detection systems utilizing the real-time PCR technique in its current setup (that detects the discussed genes) inefficient and dangerous.

References: **Heninger, S.**, **Drysdale, M.**, **Lovchik, J.**, **Hutt, J.**, **Lipscomb, M.F.**, **Koehler, T.M.**, **Lyons, C.R**. (2006) Toxin-deficient mutants of *Bacillus anthracis* are lethal in a murine model for pulmonary anthrax, *Infect. Immun.,* 74: 6067-6074.

The HyperEye-ID [M] [CB] system, on the other hand, utilizes an absolutely different approach and takes advantage of immunoassay techniques. That is, detecting the Spectral Finger Print of fluorescent probes conjugated to Bio Marker specific to a protein commonly found on the *B. anthracis* spores. Hence, the unique detection approach of the HyperEye is not affected by the new findings and conforms to the highest standards of rapidity, accuracy, and above all safety.

The HSIS (core technology of the Hyper-Eye-ID detection system) employs microscopic chemical imaging coupled with adaptive learning algorithms to identify biochemical material that may be present on aerosol particles. HSIS' **basic** mode of operation illuminates the sample (collector surface) with active UV and/or Laser Beam(s) to generate a hyperspectral image, thus scanning the collected PM, and recording each sample's **spectral and spatial** finger prints. The HyperEye reconstructs **multiple** sample views to provide comprehensive data on the sample. The current HyperEye analysis results provide information on each detected particle: particle type, size, shape, morphology, density and chemical composition with sensitivity greater than 10^{-12} g/cm^2. The software developed for the HyperEye compares the spectral and morphological data collected for the sample with the data in the source library and reports the presence of identified sources and their percent contribution to the mass of sample collected.

The current two systems (i) HyperEye-ID Lab prototype and the FIPA-20/40 offline system, as per the following two drawings hereunder, are the baseline of the current BIRDF project development activities:

HyperEye-ID [CB] optional [RN] for early warning & tracking PM pollution across the inspected region
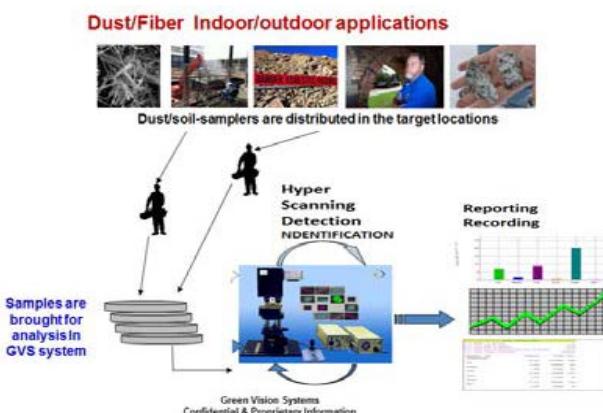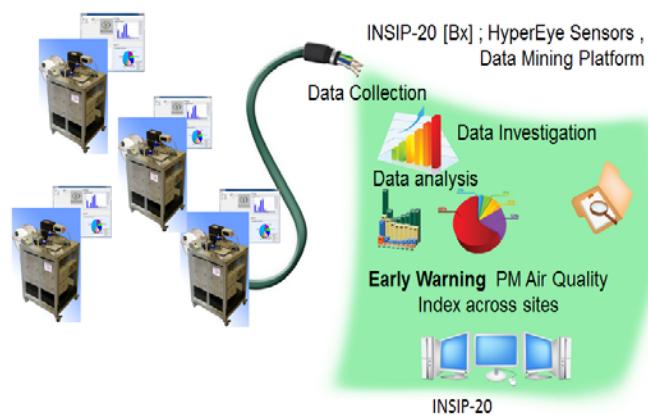
The core technology of HSIS is based on four-dimensional (4D) imaging VISNIR spectroscopy used to generate chemical imaging. Spectroscopy studies the location and spacing of emission and absorption (spectral) lines in specific wavelengths to detect any atoms or molecules that may be present in a target material. The Company's unique imaging approach is based on the fact that every element/molecular/cell can only (with active markers to detect specific bio-agents!) emit or absorb certain energies or wavelengths.

HyperEye/FIPA-20 Gathering and Interpreting

A Combined Results
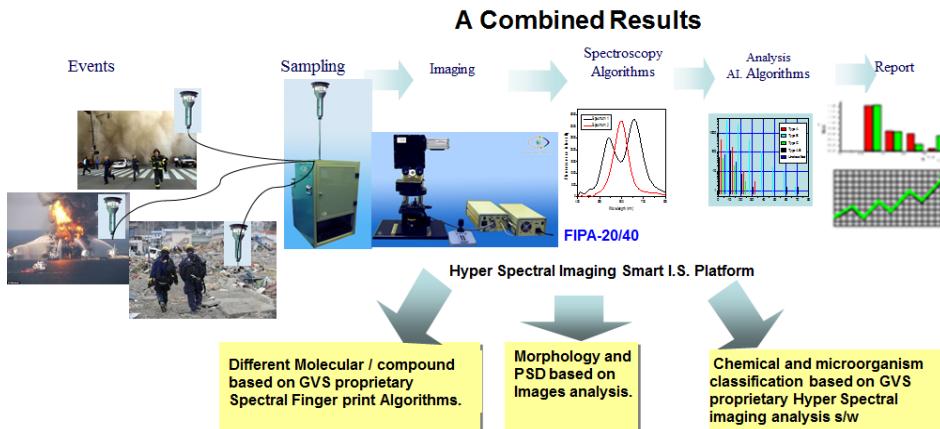
Figure 1 shows the cycle of HAZMAT detection and classification using GVS HyperEye systems and technologies.

GVS' HyperEye Solution, based on HSIS on Line Active Hyper Spectral (dual Range optional) Imaging techniques, enables the detection, classification, and tracking of HAZMAT, where high sensitivity and very-low false alarm rate are needed, regardless of how the threat has or will unfold.

The performance of a sensor is best characterized by a number of interrelated parameters such as sensitivity, probability of correct detection, false positive rate, and response time. The optimization of sensors should enable the variance of one or more of these parameters in order to optimize sensor.

The core-analysis-part (the GVS' HSIS) equipped with specific hardware and mechanics modules to enable upgrade of the system capabilities for future needs (such as adding/ changing the: spectral range/ Light sources/ Filter active markers / etc.) for detecting additional targets (agents /bacteria/particles/ other needs).

BIRDF representative personnel can get more GVS proprietary technical information as needed to enable better understanding of the base vs. extended HyperEye (HSIS) system.

The GVS PM and Aerosols Collector - GVS has been an active participant in the PM hazard Detection System program for the United States Postal Service from its early development through prototype production and validation tests. The HyperEye-ID is an autonomous detection platform that collects an environmental [indoor / outdoor] sample, prepares the sample for testing, and performs the analysis and identification.

Tauri's contribution has been the design and oversight of the test and evaluation of the current and proposed BioWatch systems.

Recognizing the complex ambient indoor/outdoor environment that exists and poses a challenge to detection and identification of HAZMAT, GVS with Tauri propose development and evaluation of two types of sampling system solutions for First Responder and HLS applications:
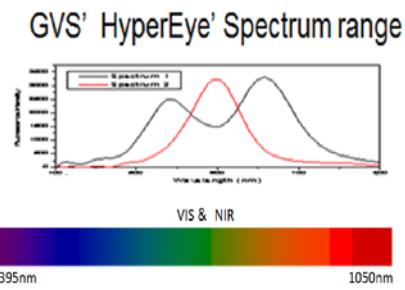
1) Main objective of the Project, Phase-I: **HyperEye-ID [F] [CB] / Compact** version uses our current HyperEye-AP system to re-engineer & develop a compact, lower cost, near-real time system based on air sensing of the PM and Aerosols ;
    a. Work in cycles of 30 min - 12 hours
    b. Collecting the particles and bio aerosols on a Teflon 50 m filter type, spot of 7 mm
    c. Detect and classifying and quantifying per cycle the collected microscopic sizes of Particles/dust with aerosols/ Spores/ Bio agent / HAZMAT that have SFP signatures using UV light execution
    d. Additional optional RN sensor will be added to the system.
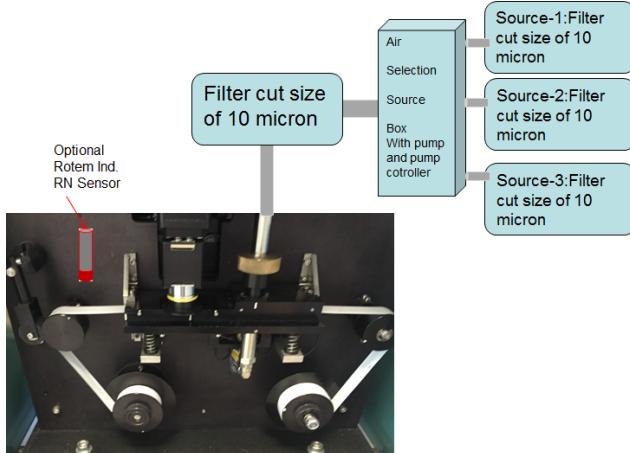
Figure 2 shows the air sampling unit with continuous Teflon filter PM collection. The Teflon type collected on spot of 7mm the PM using low/mid volume of air pump (5-30 litter/min) the filter spot will be scanned and analyzed, then the surface automatically cleaned or replaced for the next analysis.
    e. The process allows for creating a sample archive by simply storing the roller for use in follow up analysis by a laboratory.

2) Phase-II and Phase-III of the project: HyperEye-ID [M] [CB] / Compact version: continuance cycle metal-plate method [that developed during the 1st BIRDF project in 2005-2008], will collect and concentrate suspected biological and particulate matters to provide an ideal surface substrate for the Hyper-Eye-ID. In addition, the method will be automated to provide a renewable surface to eliminate the need for manual filter changes further reducing the logistics burden associated with the operation of the system. Note that the core collection technologies, including the proprietary corona charging method and collection surfaces, have been demonstrated in the laboratory and have been shown to provide superior operational characteristics. The precipitator, shown in Figure 3, operates by drawing air into the system through a smooth inlet transition passing the charging array.

Biological and chemical HAZMAT particulates become charged as they pass through the sampler corona needles. The charged particles are then attracted to a collection zone and collected onto this surface. The sample air, less collected particulates, finally exits through the low power system fan. The charging mechanism is a current-controlled corona charging system. The current control provides a uniform charging zone, which allows the system to be very stable and efficient, while maintaining very low power usage.

Air Collection
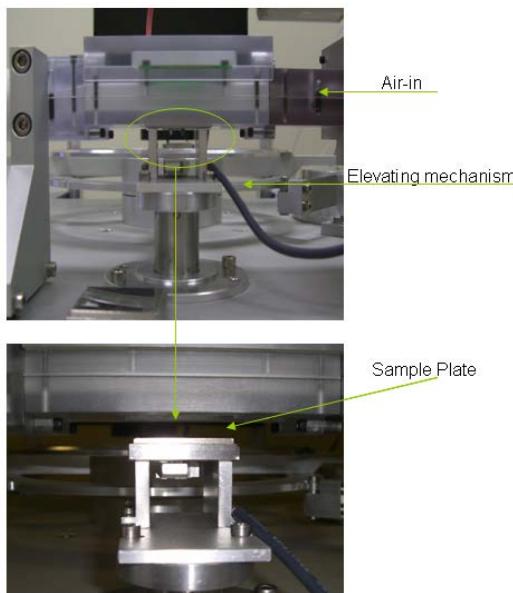
Figure 3 shows a typical result of collection efficiency with a collecting rod and similar results will be realized with the disk. Note that the highlighted portions of the view show the particle collection areas. The collection zone/ground electrode shown in the illustration will be modified and will be a small flat disk, which will provide an ideal target for laser interrogation. The material collected on the disk will be analyzed, then the surface automatically cleaned or replaced for the next analysis. Flow rate for this approach go can go up to 200 liter / min.

The GVS Technological Edges

GVS' detection technology covers indoor, outdoor and remote air monitoring for detecting biological and chemical threat materials. The system operates continuously and without the use of expensive consumables, providing real-time early warning monitoring to prevent massive catastrophes both in casualties and in economic losses. GVS' systems will comply with the most stringent governmental regulations, as the system is highly sensitive and works in real-time.

GVS' Hyper Eye Solution is based on active/passive Hyper Spectral VIS &NIR spectroscopy. Imaging techniques enables the detection, classification, and tracking of Chem/Bio agents in various scenarios where high detestability and very-low FAR are needed. The wavelength accuracy of the interferometer is 2 nm. (In a sense, this is similar to scanning digital optical microscopy). The image is then digitized and pixel-by-pixel spectral information is collected. Target material size and morphology information is also recorded to enhance detection performance. The software compares the spectral and morphological data collected for the sample with the data in the source library (the source library to be developed will contain spectral and morphological information on target bio-chemical HAZMAT compounds that are considered dangerous) and reports the presence of identified sources and their percent contribution to the mass of sample collected.

Key to detection of biological and chemical agent threats is the ability to collect and concentrate solid particulates and liquid aerosols. GVS has developed and demonstrated a unique and novel collector based on Teflon base and electrostatic base to collect and concentrate biological and chemical aerosols. The particular advantages of this approach are the high collection efficiencies at the desired flow rates, rapid collection of the sample, and concentration of the target material directly onto a small solid surface, the collection disk. It is important to note that

the electrostatic collector is an active collector, which means it samples a much higher quantity of air and therefore, produces a high probability of collection and detection of the threat materials.

The capabilities to scan the filters in multi ROI[Region of Interest (sensing multi locations of the filter spot)] with a UV Fluorescence microscopic and FT-VISNIR Imaging technologies enables a rapid, high performance capability.

GVS' detection technology covers indoor, outdoor and remote air monitoring for biological and chemical HAZMAT material presence. There are no savings for these systems, as continuous early warning monitoring is essential in order to prevent massive catastrophes both in casualties and in economic losses. GVS' systems will comply with the most stringent governmental regulations, as the system is highly sensitive and works in real-time.

GVS systems can work on a network and can "talk" to each other, as well as to a central unit that will receive inputs from all system and distribute new data to them. For example, when a new/unknown bio-chemical compound is detected by one of the systems – the data is immediately transferred to the central unit, where a bio-chemical expert examines and identifies the new material. The identification of the new material is then distributed to all the systems with a "threat/no-threat" tag. From then on, the new compound is an integral part of all the systems' database. The central unit can also improve detection accuracy through integrated smart statistical analyses.

GVS' systems employ hyper spectral imaging coupled with adaptive learning algorithms to identify bio-chemical species that may be present in the air. Briefly, the instrument scans the collected particles and records the particle-by-particle spectra using an interferometer based imaging Fourier spectrometer coupled to a microscope with advanced optics.

The uniqueness of the GVS' Hyper-Eye is the ability to detect and classify both biological agents and chemical agents simultaneously, with great efficiency, using very little power and onto a solid surface for precise imaging and identification.

GVS' Hyper Eye Solution, based on Real Time Hyper Spectral Imaging techniques, enables the detection, classification, and tracking of C/B HAZMAT in various scenarios, especially where high sensitivity and very-low false positive rates are needed.

The proposed joint system

GVS and Tauri propose to develop an autonomous continuous monitoring system for CB HAZMAT particulates, dust and aerosols.

The performance of a C/B agent sensor is most properly characterized by a number of interrelated parameters such as sensitivity, probability of correct detection, false positive rate, and response time. The operation of sensors should enable the variation of one or more of these parameters in order to optimize sensor performance for specific application/s. For instance, in some circumstances one might be willing to accept a higher false positive rate in order to obtain a better sensitivity. The C/B sensor's Threshold Operating Parameters (TOP) set the performance balance between sensitivity, probability of correct detection and false positive rate.

There are several variants that affect a sensor's performance, but for continuously operating C/B detection sensors, it is useful to consider TOP curves that relate sensor sensitivity rates to false positive at a given detection confidence. The ability to be dynamically alert by global tracking

system (connected to a network of sensors) and feed sensors a tunable TOP enables peck performance all-time.

Cycle of the Proposed Solution

GVS' system employs hyper spectral imaging coupled with adaptive learning algorithms to identify specific (e.g. fungi, anthrax spores using a dedicated marker on the HyperEye-ID [M] version) bio-chemical species that may be present in the indoor or outdoor facilities – a schematic representation of the principle of operation described in **Figure 4**. Briefly, the system scans filter (with or without active marker/s) that includes the collected bio-agent / particles and records the particle-by-particle spectra by using the unique HSIS device (GVS own proprietary technology) VISNIR spectral scale based on ultra-sensitive-Adaptive-Imaging Fourier spectrometer coupled to a microscope with advanced optics (with optional -- for future upgrading to dual excitation laser lights [270 nm and 365nm] using data mining approach, for additional possible biochemical agents to detected.

GVS devices continuously monitoring air samples on PM sample holder [Teflon Filter with/without coating; cycle can be user defined from 30 min up to 12 hours). The PM (Particulate Matter) are carried by specific hydro-mechanical-unit , that will be design based on First Responder and DHS requirements into GVS' Hyper-Eye-ID system for detection, classification and alert tasks.
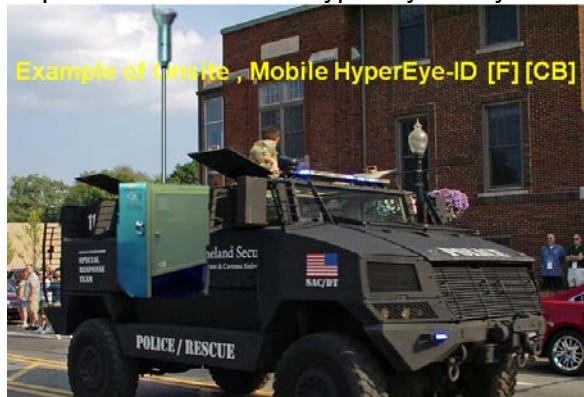
Each cycle (20 min. to few hours) of air sampling collected by GVS' air collector, transferred to a filter unit. The filter will be placed on XY stage unit in order to scan multi FOV (Field Of Views). The raster (or spiral) scanning of the tested filter [155 mm^2] technique (covers 5few% of from total filer area) enhances the detection performance. In order to enable high detection sensitivity with very low FAR – the filter might include specific "markers" that will generate fluorescence (or dual laser excitation hyper data mining, for future C/B threats) spectral signatures.

A spectral image of the sample's 'spectral' signature or fingerprint characterized by two dimensions of pixel intensity and frequency allows for matching to fingerprints contained within the database as well as identification of materials that are outside the current database. The GVS system performs fast (near real-time) automated, non-contact, non-destructive physicochemical imaging, classification, and analysis, of bio-aerosols without requiring consumable materials for sample processing.

The system operates with sophisticated algorithms and software packages, customized by GVS' technical personnel, according to specific application requirements. **Figure 4**, represents the reliability of the Hyper-Eye dual (high*/low) resolution // phases cycle methodology. Those two modes are setup by First Responder and DHS users based on specific security requirements.
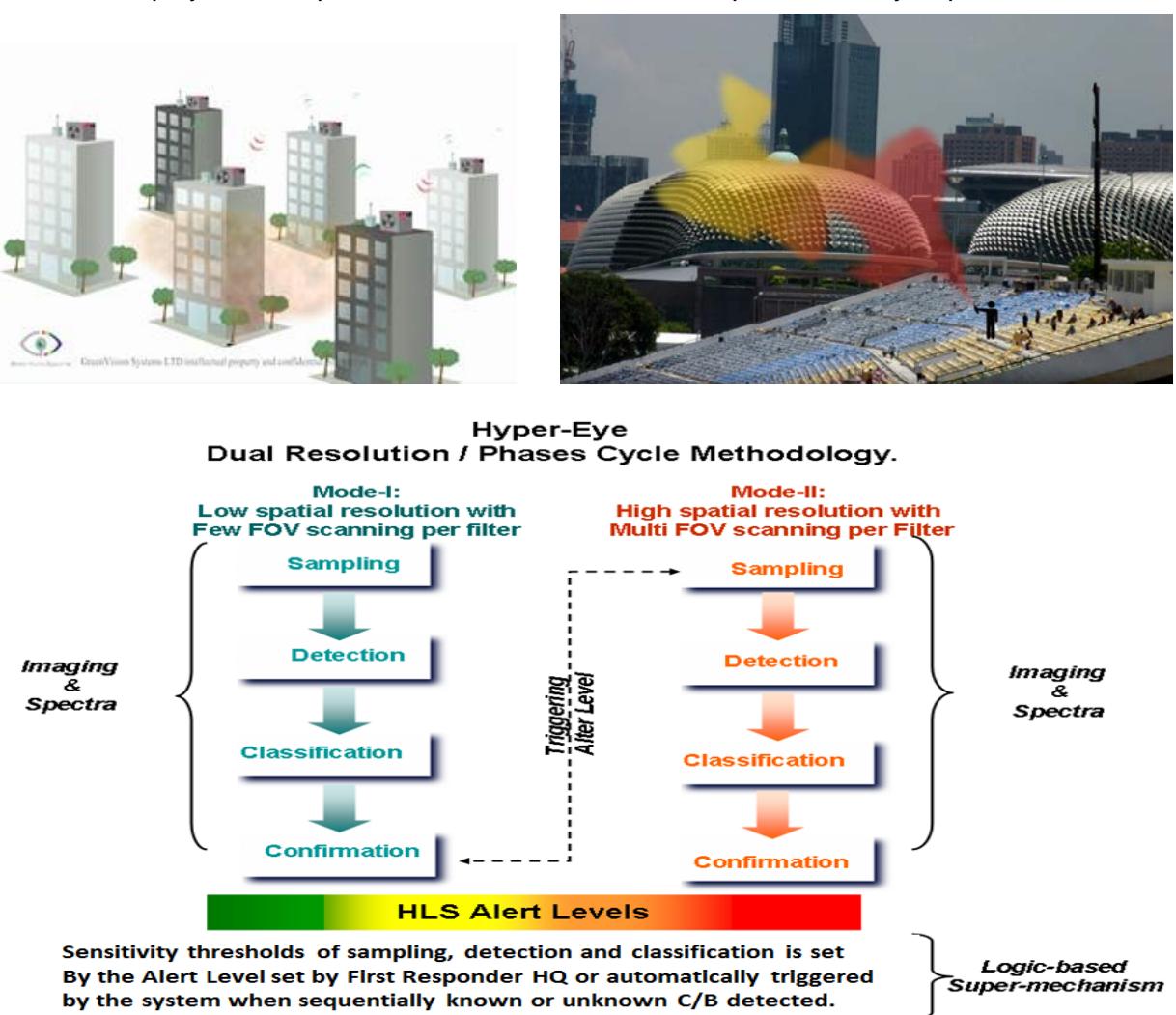
Figure 4: Two modes of operation, using System Low/High sensitivity mode of operation, cycle time can be set as per the 1st responder alerts scenarios

The GVS' HSIS , Hyper-Eye, processes the analysis of each filter based on all spectral images (Field Of View, "FOV") that are collected throughout the routine, simple, scanning process of the said filter. The scanning should be as per the setup of the HSIS scenario. Therefore, the scanning can include as many FOV's as necessary and in a random manner. This enables the accumulation of the optimal statistical data of the filter.

A Dual – Resolution approach is presented to meet HLS Alert levels and /or irregularity of unknown C/B agents ("targets") detection (warning→ Alert) and confirmation phase. Upon sequential "target" detection, an optical focusing is applied at the HSIS scanning phase, resulting in a higher resolution and a higher Signal to Noise Ratio (more pixels per target at the expense of smaller Region of Interest (ROI) size is achieved with more FOV collection for higher detection sensitivity.

The multi HSI spectral-images are processed using GVS proprietary and patented Detection, Classification 4D ATR algorithms – based on dynamic full secured and controlled Targets database (includes the specific C/B Spectral Finger Prints and morphological information).

The software compares the spectral and morphological data collected for the sample with the data in the source library (the source library that will be developed will contain spectral and morphological information on target CB compounds that are considered dangerous refer to first responder entities needs) and reports the presence of identified sources and their percent contribution to the mass of sample collected. Also the system will alert on a "new" unknown "agent" that detected (which is/are different from the existing library data base). The Library database is constantly updated under rule base mechanism) with the (non-harm) backgrounds agents/particles.

The proposed system's components:

The Air Collection and Sample handling Unit that includes three basic components:
   a. an air inlet, dedicated pipes and controlled pump will transfer the incoming PM[biological and chemical aerosols] to a sample holder ;
   b. a pre-filter air samplling unit and pump controller unit array a flat surface [Teflon filter] on which to collect, concentrate, and the collected the solid particles or semi-liquid aerosols
   c. The agents collected flat Teflon filter surface integrated to GVS' Hyper-Eye system for analysis;

The GVS Hyper-Eye Unit that includes:
   g. Collector tape unit, including automatic feed-in // feed-out elements with controlled steeper motors ;
   h. Automatic scanning stage with XY movements and auto focus mechanism
   i. The HSIS - Hyper Spectral Imaging Microscopic Technology.
   j. Automatic detection and classification with co-sharing SFP database s/w

HyperEye-ID is highly sensitive in comparison with other methods of detection – using semi dry technology thus requiring minimal maintenance and low operation costs. Continuous early warning monitoring is essential in order to prevent massive catastrophes both in casualties and in economic losses..

HyperEye – ID is highly sensitive in comparison with standard methods of detection, capable of detecting even the slightest presence of contaminating P.M. [Particulate Matter] sources in the air. The system uses dry and semi-dry technology thus requiring minimal maintenance and extremely very low operational costs.
   • Integrates wide range of air pollution P.M. sources -- adaptable to application needs.
   • 24/7 online operation with full control by expert.
   • Allows real-time tracking on background contributions!
   • High connectivity to provide Export-Import of data to INSIP-20™, network tracking platform.
   • Selective and scalable detection capabilities—can be set according to onsite needs.
   • Low maintenance & operational costs—no consumables, no sample preparation.
   • Enable to track "hot-spots" with versatile spatial resolution (based on number units / building), using INSIP-20™, automatically sends the data to the central operation network system (command-room). The database can be updated continuously to add new PM source for detection and classification.

HyperEye-ID Main Features / Building block

The HyperEye system based on continuous realtime, semi-dry, versatile Cyclic approach. The system is built with an "open architecture" allowing (i) upper-level-operator to export any part of the data into main-computer files (ii) remote maintenance and./or assistance, help-deck (iii) data collection and distribution;
The main components are:
- Add on sampling interface unit
- Air Collector will take an air sample from a batch of envelops or close control room (or other sub environments) ;
- Hyper Eye C/B agent Detection and Validation unit
- Backbone platform includes Data base, report generation, system-control, data-links, MMI, recording, self-testing procedure and more …
- Cleaning & Waste unit

System Operation Performance
- Detection sensitivity: Enable to provide source apportionment on collected indoor air from one/two or more air inlet! System can detect down to tens of PPM levels (of air-dust sampling!). Cycle time (adaptive and programmable): 20 min – 12 hours ; at a remote sites 24/7 days operation
- Detection sensitivity: in tens of PPM levels, using multi FOV [field of view] approach.
- Miss-Detection: aims to be 95% performance based on adaptive data base,
- Confirmation PoD (Probability of Detection); aims to be better than 97.5%

Hyper-Eye^{TM} –ID Mechanical Maintenance Frequency
- System cleaning: 3-4 months
- Markers Drums replacement (small drum): once 3 months
- Calibration check procedure frequency: once a month (remotely as an option).
- Light Source replacement: once 6 months

Outputs signals and objects
- Analog and digital required signals for Alert system.
- Communication links to Site IT platform: RS-232/422; TCP/IP.
- Operation indicator light.
- Maintenance requirement indicators:(i) Hyper-Eye (ii) Air Collector (iii) Cleaner unit (iv) Cyclic unit
- Error Indicators: (i) Hyper-Eye (ii) Air Collector (iii) Cleaner unit (iv) Cyclic unit

Inputs signals and objects
- Supply Requirements 110/220VAC (10A/5A max) - stabilizing power source.
- Air Sampling , via Air Inlet (pipe)
- Markers drums (Liquids)
- Data and system parameters, via the data links - Data-base updated information (among several Hyper-Eye units at a single site and between units at multiple sites); Scenarios setup; Detection Parameters; Classification Parameters; Operation Parameters.

Additional Technical Specifications and Requirements: Environmental Conditions (can be changed to meet application needs)
- Operating Temperature: 20-28 °C. Standalone operation in ~25 °C.
- Storage Conditions: 20-60°C.
- Humidity Operation: 20-70 % non-condensing.
- Integrator will handle controlled chamber to enable solid environmental conditions.

Standards
- Comply with UL & CE standards.
- Application / users demands

Examples of possible bio chemical PM contamination:
   i)   Accidents in bio labs generating aerosol concentrations due to process complexity in bio labs such as (i) dropping a fungal plate (ii) dropping a large bottle (iii) centrifuge rotor leaks and a blocked syringe filter. Many of these

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accidents generated low particle size (size of few micros per aerosol), which would be inhaled into the lungs of any exposed laboratory staff. Spray factors (SFs) have been calculated using the results of these experiments as an indicator of the potential for accidents to generate microbial aerosols. Model risk assessments have been described using the SF data. Weekly routine tests using our HyperEye-ID [F] will enable to track long terms bio-accidents in selected laboratories, to generate early warning signals. GVS and Tauri plan to approach those laboratories to provide **quantitative risk assessment support** for those laboratories can provide data that can aid the design of containment laboratories and the response to laboratory accidents.

ii) In Aug 6 2012 a Chevron 4 Crude Unit Fire. An 8" line from the atmospheric distillation column with hot diesel like material leaked and caught fire. 5 Chevron emergency responders were treated for minor burns, and received first aid. More than 15,000 people sought medical attention. Sensing the air with HyperEye-ID [F] in around the accident region

iii) Botulism (agent sizes are: 0.5-2.0 µm in width, 1.6-22.0 µm in **length**) is a muscle-paralyzing disease caused by the botulinum toxin produced by the bacteria clostridium botulinum. The bacteria are harmless, but the toxin they produce is 15,000 times more toxic than VX (the most toxic of the nerve agents) and 100,000 times more toxic than sarin. early detection of those toxin aerosols will avoids health risks. With the HyperEye-ID [M] [CB] version, a dedicated marker will be used to enable detection of the spores' DPA [Fluorescence Detection of Dipicolinic Acid]

Identification and characterization of contamination spots and toxic particulate matter for HLS and public safety and healthcare monitoring, analysis services using HyperEye automatic near real time capabilities.

Figure 5: GVS-Tauri potential solution integrated in the global first responder platform

The ability to speed up the classification cycle, at each site/city with GVS' HyperEye-ID [CB], will be able to down load costs across time and enhance the life security services with semi/ automatic biochem PM [particulate matter] detection and classification systems.

The proposed 1st compact system base performance

Main features will include:

Validation capability	See Table D1
Spectral range (one selection)	VIS: 395nm – 1000nm
Detection cycle time	30 min – 12 hours for PM detection
Average system price , GVS Ex-Work	80K-90K USD [when ordering minimum of 5 units at the same time]

Maintains Costs
        Level-I , Weekly cleaning and base-testing
        Level–II, Quarterly System expert – testing
        and markers replacements
	5 years' service contract for 15% of system price per unit per year.

False alarm rate (low alert level)
        Set to detect Multi agent's detection…
        Set to detect Single agent detection…
	> 1/100 No. of Cycles
	> 1/500 No. of Cycles

Dimensions [W x L x H] of Compact version	[45 x 50 x 60 cm]

Enhancements will be mainly in the Spectral Imaging module, computers, marker module and software. Terms of upgrading 1st generations, with only part of those modules, can be set per project demands and will be define in the future.

Table D1: HyperEye Prime Performance, Scenarios Examples

Example Operation Setup	Alert Level Low ■■	Alert Level High■■
Air intake rate **Dust Concentration [Particles /Liter]** **No. of Particles collected per Min.**	A1= 10 - 20 liter/min. B1= 0.5K – 2.5K P/ L A1*B1 = 100K	A2= 20 - 200 liter/min. B2= 5K – 10K P/L A2*B2 = 3000K
Cycle time (sampling à result) **Buffer-Time**	120min — 12 hours. 5 min.	20min.— 40 min. 5 min
Sensitivity (adjustable): **Chemical (ng/liter)** **Biological (pfu) [unit =liter or Min.]**	0.05 100	0.5 1000

To enhance the system performance – the moment Hyper-Eye detects "unknown" C/B agent (Non-database Agents and/or adaptive background SFP database) – System (Hyper Eye will ALRT and forward data to the H.Q. for tracking processes and further investigation (as needed) – using the optional INSIP-20 platform (to be developed at a later stage of deployment phase).

C.2. Proposed Approach

The HyperEye™ - ID is a unique, patented operational system which is a highly sensitive hyper spectral imaging analyzer with co-sharing database capabilities. The system outperforms the traditional, destructive long-process biochemical analysis techniques. It combines the rapidity of the chemical detection approach along with the selectivity and accuracy of the biological detection approach. This core technology is based on four dimensional (4D) imaging spectroscopy used to

generate chemical imaging. Imaging of submicron particles and the ability to combine digitized high sensitive imaging microscopy with fluorescence / Luminescence / NIR spectroscopy provides unparalleled information.

Based on applying also ATR, Statistical and Spectral algorithms, the HyperEye™ enables the following advantages:

- **Detect and classify** Biological (Spores, bacteria) agents and hazards chemical (fluorescence) particles
- **Versatile system** that unlike the DNA system can detect genetically modified organisms.
- **Fast response time** – analysis report within minutes
- **Low operational costs** and no external databases
- **High sensitivity** and short sampling process while reducing the potential of sample contamination
- Statistical background handling leading to **less false positive alarms**
- **Effective adjustment** of performance characteristics complying with rapidly changing conditions
- **No samples transfer** to or through separate instruments
- **High Adaptability** and learning capabilities (Adaptive detection of agents not in the existing Database)
- Unique capability of **detecting anomalies** (agents / dust that not back ground and not set as target in the data base) **builds** up in specific scenes.
- Optional capability of detecting Radiometric & Nucleus particles (RN).

Additionally, there has been a remarkable increase in the production and availability of chemical (Pesticides residues) and biological (Anthrax, Botulism, Ricin) weapons throughout the world. The combination of these factors has significantly increased the possibility of an attack on the western world involving the use of such weapons. Biological agents are often considered to be psychologically the more threatening of the two and, therefore provide more appeal to the tomorrow-terrorist-war. GVS' HyperEye-ID enables the optimal detection of these agents for emergency first responders via a single platform that detects more common HAZMAT substances normally encountered at an incident scene.

pg. 33

The Project will include three (3) major phases, each of which will be driven by agreed upon and measurable milestones.

Phase-I: Compact, lower cost version of HyperEye System Development and Integration

This phase will last 15 calendar months following PRD kickoff meeting of phase I, the purpose of this phase is to conduct the necessary modifications and software changes and Database creation of the two Industrial Prototype version of the Hyper-Eye systems:
As part of the initiation of this phase, both parties will execute a requirements analysis with potential end users. We will select an operational First Responder partner to meet with and identify and assess the HAZMAT (C/B agents/threats) of greatest concern that we can use for product development, identify constraints associated with access to the agents/threats and the testing environment, and the operational considerations necessary to develop a practical application.

This phase will be about 12/14 months from HLD kickoff meeting:
1. **Project Review Meeting, PRM –** GVS and TAURI Project Leaders and senior Manager/s to review all the tasks vs. time table and evaluate the needed specs of the proposed Hyper-Eye system.

2. **Validation, of the 1st Responder needed screening C/B** – Using simulants in GVS laboratory to be scanned on FIPA-20/40 system – Base Data Base creation.

3. **Hyper Spectral HSI optics and mechanics** – A decision on the optical path range and optimized system stabilization over time according to previous project outcomes. The selected optics and mechanical items for the HSI head will be incorporated in the HyperEye-ID system of the program.

4. **High level Design –** The result of this task is a High Level Design (HLD)**.** The design is mainly in adaptations for the program requirements for Operation Autoimmunization.

5. **Detailed Design and engineering work activities , -** The Result of this task is a detailed design, that will provide the confidence level in the overall system reliability (performance prediction), life cycle costs, and equipment cost

6. **Mechanical Design** of the Compact HyperEye-ID [F] Teflon type version. Reduce size of optical head to Unit Industrial Version. The result of this task is a mechanical conceptual design (preliminary schematics).

7. **Air Collector production & Integration** - to compact design. The Air Sampler will includes devices to enable to collect the PM from the accident's regions The result of this task is a mechanical and electrical integration of the :
   a. Phase-I: HyperEye-ID [F][CB] / Compact Teflon filter roller type version. this Version will also enable to place manually Teflon filter from remote air sample collector [such as small low costs controlled drone [this method of air sample collection enable to be close to the accident place].
   b. Will be done during phase-II: HyperEye-ID [M] [CB] / Compact Disk rotation version, electrostatic collector to the Hyper-Eye-ID System.

8. **Mechanical Robotic unit re-development and integration**- The result of this task is a mechanical and electrical integration of Air Collector, with PM holder, with XY(Z) stage scanner and with Hyper-Eye.

9. **HyperEye samples (Type/metal plats) handling /cleaning.**
   a. Phase-I; mechanical support (re-package) to replace Type rollers, suitable for the requirement of the program
   b. Will be done during Phase-II; mechanical support (re-package) to self-cleaning Metal plat, suitable for the requirement of the program.

10. **Hyper-Eye XY stage** – Interfacing XY(Z , only for the Teflon Roller system) stage to enable multi FOV of scanning.

11. **Concept application (technical & marketing) Validation** - The main task of the Concept Validation is
    a. Performed in specific laboratories-- with supplemental development done in Tel Aviv. The result is a draft report based on the ATP confirmation check list and presenting the detailed results in a Draft Report.
    b. Provides list of applications needs, potential of integration our system in global program for different 1st Responder Scenarios

12. **HyperEye Software modifications and algorithms development   -** Integration with Controllers and Central Processing Unit (based on Win7 platform).

13. **Hyper-Eye Prototype production –** One (1) Hyper-Eye-ID [F] prototype**.**

14. **Performance Prediction** Analysis of the test results with respect to LOD vs. several parameters, and the life cycle cost. validation tests ; repeatability tests at low, medium , high PM contamination rate

15. **PHASE-I, Summary CPR –** Phase I Critical Project Review presentation.

Phase II Testing; Engineering; Applications scenarios development

This phase will last 6 calendar months following CPR phase I, the purpose of this phase is to conduct the necessary modifications and software changes and Database creation of the two Industrial Prototype version of the Hyper-Eye systems:

16. **Industrial Version Engineering: Re-Engineering** of the Industrial Version and finalize the s/w features and MMI. Enclosure design and Production mechanics for Task-17 prototypes

17. **Production** of two (2) Industrial version of :
    a. Hype-Eye-ID [F] system link with Pipe and Teflon roller PM collector.
    b. Hype-Eye-ID [M] system link with Pipe and Metal Plat to Disk with 4 stage rotation (air sampling; marker for Spores; HSI Scanning filter and analysis; Cleaner). This sub task might take additional 4-6 months as it will be in parallel to this task-17 and all other tasks.

18. **Bio-Aerosol DATA-BASE generation & classification features s/w development** – A DATA-BASE that will serve as a targets vs. background SFPs (Spectral Finger Prints) , list of SFP per target that should be detected and track (fluorescence's agents (e.g. Spores, Fungi). This DATA-BASE (and experiments results). This DATA-BASE will be used and approved during the field tests of phase III. Those runs/tests will be conducted on one of the prototype Hyper-Eye Units.

19. **ATP of Systems and CPR for PHASE II:** Engineering approval, based on the schematics and development approval procedure (check list). **Hyper-Eye final tests**: The result of this task is an Engineering ATP (check list) for the Engineering Development approval**.**
    a.   **Limited utility assessments with our First Responder Partner. This will constitute the first step to achieving authorized equipment status with DHS**.

    b. **Applications Protocols & Operation** Protocols in different 1st Responder Scenarios, provides marketing and sale plan for the first 3 years

20. **Manuals & Documentations –** Providing the following documents: System Description, user manual, Installation manual, commissioning form and troubleshooting.

Major Deliveries of Phase I:
- Development **approval report,** electrical optical and mechanical.
- **Production Files –** Electrical and Mechanical, S/W, Instruction of how to build and assemble, how to tune & calibrate sub units, BOM, tests protocols files.
- **Production of 1 prototype –** Hardware of 1 (qualified) HyperEye-ID [F] system.
- **Data Base** for the detected three agents that are fluorescence [Chemical Aerosols, Spore, Fungi, and Aerosol; Particulate matter]. The Data Base provides number of Spectral Finger Prints (SFPs) of each component**,** will be part of the project technical report [].
- **Performance Prediction** Analysis of the test results with respect to LOD vs. several parameters, and the life cycle cost.
- **List of applications needs**, potential of integration our system into a global program for different 1st Responder Scenarios

Major Deliveries of Phase II:
- Engineering Development **approval report,** industrial version of compact system.

- **Production Files –** Electrical and Mechanical, S/W, Instruction of how to build and assembly, how to tune & calibrate sub units, BOM, tests protocols files
- **Production of 2 industrial prototypes –** Hardware of 2 (qualified) [F] version to units or one F version and [M] version systems.
- **Performance Prediction** Analysis of the test results with respect to LOD vs. several parameters, and the life cycle cost.
- **Applications Protocols & Operation Protocols** in different 1st Responder Scenarios
- **First step to achieving authorized equipment status with DHS**.

Phases vs. Tasks Table

	Task Name	Task Description	Responsibility	Who Does what
	PHASE-I	**Compact, lower cost version of HyperEye System Development and Integration**		
1	**PRM**	**Project Review Meeting**	**Both**	Both conduct requirement analysis with 1st responder partners
2	C-1st-RN	**Confirmation of the 1st Responder needed screening C/B**	**GVS**	Tauri- bio-agent and Chemical PM data; Possible scenarios for potential applications GVS –with External Class C/D Labs sub-contractor
3	HSI-Compact	**Hyper Spectral HSI Compact, optics and mechanics engineering**	**GVS**	GVS - Based on task-1&2
4	HLD	**High level Design and Detailed Design**	**GVS**	GVS - Hyper-Eye system Tauri - Application requirements
5	DLD	**Detailed level Design**	**GVS**	GVS - Hyper-Eye system Tauri - Application requirements and operation protocols examples, when events happen
6	MD [ID] [F]	**Mechanical Design** of the Compact HyperEye-ID [F] Teflon type version	**GVS** **Tauri**	GVS -Hyper-Eye-ID [F] interfaces unit Tauri - data about Interfaces to different platforms to enable effective air PM pollution sensing
7	ACI [F]	**Air Collector integration** to the HyperEye-ID [F] [CB] / Compact Teflon filter roller type version**. The collection devices might includes pipes and other mechanical interface items as per the first responder and DHS demands**	**GVS**	**GVS** - Integrate air sensing unit to the [F] prototype version. **Tauri – provides methods of ways the sampler should be integrated to the first responder teams**

8	MRU	**Mechanical Robotic unit re-development and integration**	GVS	GVS - development and supply with self-cleaning unit Integrate into the prototype Tauri – provides information about ways to handle waste material (e.g. uses contaminate Teflon type)
9	**HyperEye [F] samples handling**	mechanical support (re-package) to replace Type rollers, suitable for the requirement of the program	GVS	**GVS –** GVS development supply prototype sub-units and Integrate into the HyperEye-ID [F] system **Tauri** – provide subject matter expertise to accommodate US market expectations
10	HyperEye-Stage	**Hyper-Eye XY filter scanner**	GVS	**GVS** - re-develop, produce and test the mechanical and electrical parts of the XY(Z) Stage integration in to HyperEye-ID [F] and [M] versions
11	CV	Concept Validation includes a. Performed in specific class C/D laboratories to be done in Tel Aviv. b. list of applications needs , for different 1st Responder Scenarios	GVS Tauri	**GVS** - GVS with Tel-Aviv Bio-Lab's University to process performance validation tests on non-harm C/B agents **Tauri -** list of applications needs for different 1st Responder Scenarios
12	SWD	HyperEye Software modifications and algorithms development	GVS	**GVS** - Development algorithms , s/w modifications , testing and Integrate into the prototype
13	System ver. [F] Prototype Production	One Hyper-Eye Prototype production	GVS	**GVS** - Produce all HyperEye-ID [F] unit and integrate RN sensor into Hyper-Eye units.
14	**Performance Prediction**	Analysis of the test results with respect to LOD vs. several parameters, and the life cycle cost	**Tauri**	**GVS -** will get handle IL. alpha-site. **Tauri** - will get data about needs for US. on sites betta tests to be done after Phase-II will be finished.
15	CPR-I	**PHASE-I, Summary CPR** @ Tel-Aviv (Critical Project Review)	**Tauri**	**GVS** - will prepare IL. tests and project status report **Tauri** - will prepare US. project status report

	PHASE-II	**Testing; Engineering; Applications scenarios development**		
16	**Industrial Version Engineering**	**Industrial Version Engineering: Re-Engineering** of the Industrial Version and finalize the s/w features and MMI.	GVS Tauri	**GVS –** Reengineering items , s/w programming to enable cost reduction of the HyperEye-ID [F] and [M] versions **Tauri** – Provides data about sites conditions and ways to install systems for different applications
17	**Production** of two Industrial	**Production** of one / two Industrial version of Hype-Eye-ID [F] and optional (not in the project	GVS	**GVS** - will produce sub units and assembly the HyperEye-ID system/s. functionality confirmation of the system; repeatability tests

	version	budget!) of Hype-Eye-ID [M]		items and s/w programming, if needed.
18	**Bio-Aerosol DATA-BASE generation**	**Bio-Aerosol** DATA-BASE that will serve as a targets vs. background SFPs	**GVS**	**GVS** - To generate SFP and D.B based on all tests – and extra lab tests as needed **Tauri** – Provides data about potential PM agents
19	**CPR**	**PHASE II,** -Engineering approval, ATP Approval, **-** Applications & Sale Plan Approval **- Limited utility assessments**	**GVS** **Tauri**	**GVS** - arrange final ATP reports and CPR documents **Tauri** - arrange CPR documents and meeting **focus on applications and sale plans**
20	**Manuals & Documentations**	System Description, user manual, Installation manual, commissioning form and troubleshooting.	**GVS** **Tauri**	**GVS – will handle the user Manuals and the Expert and support Manuals** **Tauri- will support edit as needed, and generate final version of those document s**

	PHASE-III	**Commercial Phase: Marketing and Sales and Deployment**		
	After/During BIRDF Project Tasks will be successfully	**-** Field Testing - On site Validation Test -Marketing efforts to get commercial projects, ordering at least 5 units during the first 6 months after fulfilled - Implementation (for Marketing and Sale		

D. 20 months Program Plan, GANNT
Phase-I time table vs. tasks 1-15

GVS Tauri		2016 2017 2018	Duration		
	Phase-I	Phase-I			
Task-1	PRM	Project Review Meeting	4 / 4		
Task-2	C-1st-RN	Confirmation of the 1st Responder needed screening C/B	8 / 4		Validation, of the 1st Responder needed screening C/B
Task-3	HIS-Compact	Hyper Spectral HSI Compact, optics and mechanics engineering	10 / 0		
Task-4	HLD	High level Design and Detailed Design	10 / 10		
Task-5	DLD	Detailed level Design	10 / 10		
Task-6	MD [ID] [F]	Mechanical Design of the Compact HyperEye-ID [F] Teflon type version	12 / 8		
Task-7	ACI [F]	Air Collector integration to the HyperEye-ID [F] [CB] / Compact Teflon filter roller type version	11 / 6		
Task-8	MRU	Mechanical Robotic unit re-development and integration	14 / 6		
Task-9	HyperEye [F] samples handling	mechanical support (re-package) to replace Type rollers, suitable for the requirement of the program	9 / 9		
Task-10	HyperEye- Stage	Hyper-Eye XY filter scanner	12 / 0		
Task-11	CV	Concept Validation includes a. Performed in specific class C/D laboratories to be done in Tel Aviv. b. list of applications needs , for different 1st Responder Scenarios	26 / 26		HyperEye Software modifications and algorithms development
Task-12	SWD	HyperEye Software modifications and algorithms development	56 / 38		
Task-13	System ver. [F] Prototype Production	One Hyper-Eye Prototype production	30 / 0		
Task-14	Performance Prediction	Analysis of the test results with respect to LOD vs. several parameters, and the life cycle cost	12 / 12		
Task-15	CPR-I	PHASE-I, Summary CPR @ Tel-Aviv (Critical Project Review)	8 / 8		PHASE-I, Summary CPR – Phase I Critical Project Review

Phase-II time table vs. tasks 16-20

| GVS Tauri		2016 2017 2018	Duration		
	Phase-II	Phase-II, parallel to Phase-I			
Task-16	Industrial Version Engineering	Industrial Version Engineering: Re-Engineering of the Industrial Version and finalize the s/w features and MMI.	20 / 10		
Task-17	Production of two Industrial version	Production of one / two Industrial version of Hype-Eye-ID [F] and optional (not in the project budget) of Hype-Eye-ID [M]	12 / 2		
Task-18	Bio-Aerosol DATA-BASE generation	Bio-Aerosol DATA-BASE that will serve as a targets vs. background SFPs	32 / 32		
Task-19	CPR	-Engineering approval, ATP Approval, - Applications & Sale Plan Approval	8 / 8		
Task-20	Manuals & Documentations	System Description, user manual, installation manual, commissioning form and troubleshooting.	6 / 6		
	Phase-III	Phase-III			
Task-21	After/During BIRDF	Field Testing ; On site Validation Test ; Marketing efforts to get commercial projects , ordering at least 5 units during the first 6 months after fulfilled ; Implementation (for Marketing and Sale			
	Part-I	Task 1,2,3,4,11	4		
	Part-II	Tasks 5,6,7,8,9,10	7		
	Part-III	Tasks 10,11,12,13,18	6		
	Part-IV	Tasks 14,15,16,17,19,20	2		

E. The Market

Introduction

The transnational nature of environmental security is triggering new forms of defense strategies and cooperation. Multipolar global political, economic, and military power, the increasing demand on natural resources, economic turmoil, population growth, the deepening gap between those who could cope with the effects of climate change and those could not, the accelerated rate of technological advancements, the growing strength of organized crime and terrorism, and the proliferation of weapons of mass destruction all fuel uncertainty about the future of international security and first responded efficiencies.

Reportedly, the al-Qaeda cell that shut down operations in the Tizi Ouzou province in Algeria after an accident might have been developing chemical and biological weapons. It was reported that allegedly up to 100 potential terrorists had attempted to enter postgraduate programs in Britain to gain access to laboratories. Experts and security organizations repeatedly warn that the security measures to stop eventual development and use of such weapons by terrorist groups are insufficient and inadequate.

Utilizing GVS' HSI sensing technology in the NextGen First Responder Technologies Program will improve First Responder Situational Awareness by providing highly accurate, relevant, real-time, BioChem detection/identification data. During this project the team will adapt and repackage the core HyperEye-ID system to enable a 24/7 routine inspection/monitoring asset that will provide customers [e.g., federal, state, and local first responders, other government organizations, and utilities]:
  (i)   The ability to identify rapidly any hazardous agents and contaminants and
  (ii) The ability to monitor, detect, and analyze passive and active threats and hazards at an incident scene in real-time

Each of these applications will provide a solid foundation and basis for a mature and focused sales and marketing plan and will facilitate the expansion to future customers, including Department of Justice, Customs and Border Protection, and public/private venue owners/operators whose facilities attract large numbers of patrons in high density. These applications and expansion to other end users are also especially important to the US customers, leveraging the mature and established sales and marketing channels of Tauri and other major integrators [e.g., General Dynamic, L3, NGC, others]. Moreover, this expansion will underpin an increased production and larger economy of scale, allowing for lower unit cost of the core technology, thus making the product more affordable to even smaller First Responder organizations than will be the case at the outset.

GVS and Tauri, with support of other US integrators as needed, will offer monitoring, detection, and identification services to a wide range of customers in US markets, including various homeland security first responder biochem protection applications, such as monitoring indoor and outdoor air in strategic buildings / facilities, using (i) GVS HyperEye-ID (ii) Data-base (iii) data-links.

To enable rapid improvement of First Responder situational awareness and force protection capabilities, a widely available asset to provide early warning and continuous monitoring for First Responder use is crucial. Any First Responder has limited time to survey a site after arrival and before deployment of personnel and equipment. The HyperEye-ID system will allow detection of aerosol and surface hazards, but additionally, it will allow rapid analysis of any effluent visible from

windows, doors, and chimneys to warn of the presence of dangerous materials and/or any dangerous reactions under way.   HyperEye-ID can provide this capability enhancement by leveraging its existing competitive advantage and global market presence when penetrating the US market, whose potential is presented in the Section 6, Commercial Potential.

Together, GVS and Tauri aim to investigate and develop an automatic (based on Fast Fourier Hyper Spectral Imaging and database) sensing system for inspection, detection, identification, contaminant fate and transport, and tracking and diagnostics.

First Responder Markets

Tests and validation will be done by both GVS and Tauri team in accordance with the program milestones. GVS will develop a rapid and versatile early warning system for outdoor and/or indoor applications, the HyperEye- ID collects air samples using High Volume full control air collector on sample metal plate. On those metal plates, the particles are collected and then processed in near real time using GVS' HSI (Hyper-Spectral Imaging) platform using massive GVS' proprietary database and bio-chem agents markers to determine real time alert on defined scenarios. System has optional capabilities to detect radionuclides, as well.

GVS and Tauri with Strategic Partners (operational and financial partners) will co-develop and commercialize the use of hyper-spectral imaging (HSI) equipment and services in Target Markets for Bio/Chem (R/N optional) HAZMAT monitoring, early warning and tracking over time of indoor-air in selected buildings (targeting to provide mid/long term services for over 50,000 sites in the US, providing high end clean/secured air quality for the personnel on site;

The U.S. Homeland Security & Public Safety Market: 2013-2020 report is the most comprehensive review of the U.S. Homeland security and public safety market available today. Homeland Security Research Corp. provides the only detailed and reasoned roadmap of this complex market. The analysis combines Homeland Security and Public Safety markets since, in many cases; products have dual-use applications and present the same business opportunities, for example:

- First responders respond to a variety of public safety and homeland security incidents, including human distress (e.g., injury and disease), accidents (e.g., fires), terrorist attacks (e.g., release of anthrax), criminal activity (e.g., hostage situations), technological hazards (e.g., release of hazardous substances), and natural disasters (e.g., floods and earthquakes), and our proposed technology could have applicability across many of these areas.

- Annual investments by the US Federal Government and private sector in Homeland Security and Public Safety products and services increased from $48 Billion in 2011 to $51 billion in 2012, and is forecasted to increase to $81 billion by 2020. 2

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signatures above do not constitute a legal commitment on the part of either party to undertake the project herein described. Such commitment, if made, will be subject to a separate agreement

[2] http://homelandsecurityresearch.com/2012/09/u-s-homeland-security-public-safety-market-2013-2020/;
http://homelandsecurityresearch.com/2015/11/U.S.-Homeland-Security-and-Public-Safety-Market-2016-2022;
http://homelandsecurityresearch.com/2014/03/decontamination-equipment-of-cbrn-hazmat-incidents-industry-technologies-and-global-market-2014-2020/

- The total US Homeland Security, Homeland Defense, Homeland Security related Counterterrorism, and Public Safety Markets grow from $74.5 Billion in 2012 to $107.3 Billion in 2020 at a CAGR of 4.7%.

Other Potential Applications

Current Players in the HLS CBRN markets

The current geostrategic circumstances surrounding the Syrian Civil War, the international campaign against the terrorist organization ISIS, and the continuously spreading Ebola virus epidemic in West Africa have led to an increased interest in Chemical, Biological, Radiological and Nuclear Defense. Strong growth in the developing world, still in the process of creating their own significant CBRN capabilities will offset the strong financial constraints of the Western nations. CBRN defense remains an indispensable part of the strategic security preparedness of all nations. This important characteristic of the market assures a consistent growth over the forecasted period. **The global CBRN defense spending was over $10B in 2015**.

In particular the following companies can be integrators and OEM partners for our HyperEye-ID solution:

- AirBoss of America Corporation
- Allen Vanguard Corporation
- Argon Electronics Ltd
- Biofire Diagnostics Inc
- FLIR Systems Inc
- General Dynamics Corporation
- Nexter Group
- Smiths Group PLC
- Thales Group
- Thermo Fisher Scientific
- Tyco International

F. Commercialization – Plans and Prospects

F.1. Product Manufacturing, Marketing and Sales Activities

1. **Production**

   GVS will be responsible for the production of the Hyper-Eye-ID proposed system, including the integration of GVS' sub-units. GVS will handle the ATP, training and calibration cycles.

   Tauri will be responsible for the applications development and validation tests in the North-American market.

2. **Marketing**

   Tauri will market the product to the United States, Canada -- The Focused Markets. Tauri markets through direct sales and has experienced sales professionals on staff.

   Tauri will conduct the proposed Marketing and Sales program and will allocate the needed sources and Sales team in order to fulfill the presented sales program.

   After the sales are initiated in the US Market, GVS and/or Tauri will work in specific markets in which they have existing relationships with appropriate customers.

   The sales and service network is provided by select domestic affiliate and/or integrators that provide additional geographic and customer specific sales support. Additional sales staff will be hired to support the expected level of sales activity for this important product area.

   GVS maintains a dedicated field service team, which will be expanded to support additional customers as units are deployed.

3. **Sales and Marketing Plan**

   During the first few years both parties will focus on the US market. GVS and Tauri will differentiate between two marketing approaches, Direct and Distribution.

   In this respect, Tauri intends to build a direct sales force targeting key accounts and strategic accounts in the North America focusing on the 1st responder markets.

   The Direct sales force has primary responsibility for developing orders, coordinating distribution, providing demonstrations and providing applications support.

   This sales force will include skilled Tauri applications and GVS service engineers and technically proficient sales people capable of serving the sophisticated needs of prospective customers as part of the customer support process.

   Both Parties (out of the US. market) intend to market the Hyper-Eye-ID internationally through independent distributors managed by the companies and through dedicated agents.

   Tauri plans to exhibit at trade shows to promote existing products and to introduce the joint solution, and participate in technical forums to exchange marketing and product information with its vendors and customers. The Company also intends to advertise in trade journals, technical articles, and direct mail and telephone solicitations to build interest in the proposed solution.

Tauri intends to provide extensive training for its sales force and to support it with marketing tools, including sales brochures, and demonstration test equipment

4. **Service Network**.

   For North America, **GVS Inc.** will become the Approval leader group and will perform the project management and monitoring and will cooperate with GVS technical team that will provide: continues technical support for the qualification phase, its experience and know how in HSI and in operation/installation of the equipment.

5. **Financial Resources**

   GVS: The primary sources of GVS' non-BIRD budget include:
   - Support from the owners of Green Vision Systems Got fund from the Israeli Chief Science Office in the initial phase. Finance Partner with GVS owner -- To be boost this potential project
   - Sales and projects involving GVS and Malcam Ltd., Green Vision Systems' sister company (based on MALCAM's products). GVS sales in to industrial QA applications

   TAURI: Tauri's in-kind cost sharing contribution will come from:
   - Tauri funded Internal Research and Development project
   - Tauri has strong financial backing and can access sufficient line of credit to manage cash requirements in the early stages of production.

G. Cooperation and Benefits

Strategy

GVS – GVS' main objective is to establish market leadership and market share in its defined segment. Since its founding, GVS' major challenge has been to become a leading provider of chemical imaging solutions that enable research and development process engineers and scientists to implement chemical imaging applications both effectively and efficiently. To achieve this objective, the Company has focused on using its core technology to design, develop, manufacture and market innovative, cost-effective, high performance chemical imaging tool and software to increase productivity, shorten time-to-market for new products and reduce the cost of test. The Company intends to continue its focus on the chemical imaging marketplace by enhancing its existing product line and introducing new tools that are cost-effective, highly interactive, easy to use and that pass data effectively.

Tauri - Tauri views this project as a strategic opportunity to expand its current presence within the First Responder markets.

GVS and Tauri bring cutting-edge detector technology to the United States at a time when First Responder / Homeland Security is paramount and organizations are searching for better ways to protect their civilian personnel. The synergistic contributions and organizational commitment are focused solely on the success of this effort. The moral necessity and financial rewards compel our organizations to share fully in both the risks and opportunities.

Tauri's success has been built upon effective advice and counsel to the Government regarding the best available technologies. Working closely with the US First Responder markets, other potential users and Government and private stakeholders, Tauri will provide a system that exceeds the requirements and expectations of a demanding customer.

The key elements of the Companies' strategy are set forth below.

- Create Market Share—The Companies intend to be a leading supplier of products in the chemical imaging market. The Companies intends to leverage that position to increase its penetration of the characterization market.
- Create and Maintain Strategic Relationships—The Companies seek to enhance their market position by establishing strategic relationships. The Companies intend to establish new strategic alliances with other vendors to further strengthen their competitive position.
- Maintain High Level of Customer Service—The Companies believe that a high level of customer service and support is critical to the adoption and successful utilization of their technology. By continuing to work closely with their customers to solve problems, the Companies expect to develop subsequent generations of tools that address the needs of the industry.
- Expand Worldwide Product Distribution—The Companies seek to expand their product distribution through ongoing investments in direct sales and through their relationships with key distributors. The Companies intend to build upon established distributor relationships in foreign markets where partnering add market leverage and in other markets where investment in direct sales has not yet been warranted.

Tauri benefits from the cooperation
- ♦ The ability to enable close cooperation with GVS and link of their samples to the GVS Hyper-Eye-ID C/B agents open new arena of potential business for Tauri in the main

HLS market in mid/long terms and more to become stronger in the 1st responder market.

♦ Tauri will increase the income by getting fees (which will be determined on the final agreement) on each sale of the Hyper-Eye to the main 1st responder market.

GVS benefits from the cooperation

♦ The ability to enable close cooperation with Tauri integrating methods of operation in different scenarios with GVS Hyper-Eye-ID agents open new arena of potential business for GVS in the main First Responder market, where Tauri have strong position that will enable fast entries to this market.

♦ Sales of the Hyper Eye-ID to First Responder market and to additional similar markets in the long term.

♦ GVS will have the opportunity to establish team in GVS Inc. for customer support.

♦ Open new opportunities to joint projects with Tauri in the US. first responder arena

A key benefit to Israel is the opportunity to demonstrate to the world the sophistication of this emerging Israeli technology company. Teamed with a well respected US small business commercialization partner, GVS and Tauri have the opportunity to make a major impact on the safety and security of millions of individuals throughout the world.

H. Organization and Management Plan

The Tauri Group, LLC (Tauri) is a US company that provides analytical, advisory, and engineering support services to its clients. It specializes in the detection, analysis, mitigation, response, and recovery associated with man-made and naturally occurring threats against populations and infrastructure, with particular expertise in biological and chemical threats.

Tauri works with federal, state, and local governments, as well as the private sector, academia, and national laboratories.

Green Vision Systems Ltd. (GVS), founded in 1996, is an Israeli company that provides a comprehensive product suite to enable real-time monitoring, detection and tracking of bio-chemicals based on the Company's patented and field-proven Hyper-Spectral Imaging (HSI) technology and its proprietary database. The company's product suite analyzes and identifies the bio/chemical composition of substances within the scanned images, in near-real-time.

GVS will become the Engineering leader group and will perform the project management and monitoring and will cooperate with GVS Inc. (will be established during the commercial phase) technical team and DRI (External Chemical LAB) in order to implement the future requirements. GVS technical team will perform the main engineering task according to the program requirements and the PDR results.

The Team will cooperate with Tauri technical team during the phases of R&D, engineering, integration testing and installation.

GVS technical team will cooperate with Tel-Aviv University (External Chemical LAB) in order to efficiently meet the requirements of the biochemical finger prints (base Database of Hyper-Eye System.

Coincident with the signing on the Business Cooperation Agreement, the parties shall form a Joint Steering Team ("JST") to coordinate their cooperation and respective obligations for the Project, discuss and solve issues arising throughout development and implementation of the Commercial Solution, and exchange technology, Confidential Information and samples.

The JST shall consist of two representative of each party ("Project Manager" and "Administration Manager") who will meet frequently to discuss issues relating to the Project and:

♦   To be responsible for the development effort covered by the BIRD proposed project and as a Contact Administrator for the receipt of any notices.
♦   The parties shall consider, subject to market demand and other considerations, expending future development.
♦   The parties shall cooperate throughout development and implementation of the Commercial Solution to enable development of optimum platforms and the most cost effective solutions for security applications, including but not limited to C/B indoor detection and tracking.
♦   The parties shall work closely to constantly evaluate, and define the mode of operation and functionality of Commercial Solution, based on customer and market requirements.

♦The parties shall setup the base list of responsibilities and obligations for the Program and Administrative Managers, agree on a mechanism for updating Commercial Solution requirements and performance for Hyper-Eye, and determine the volume production time table, and any other important operation tasks to enable both parties maximize efficiency
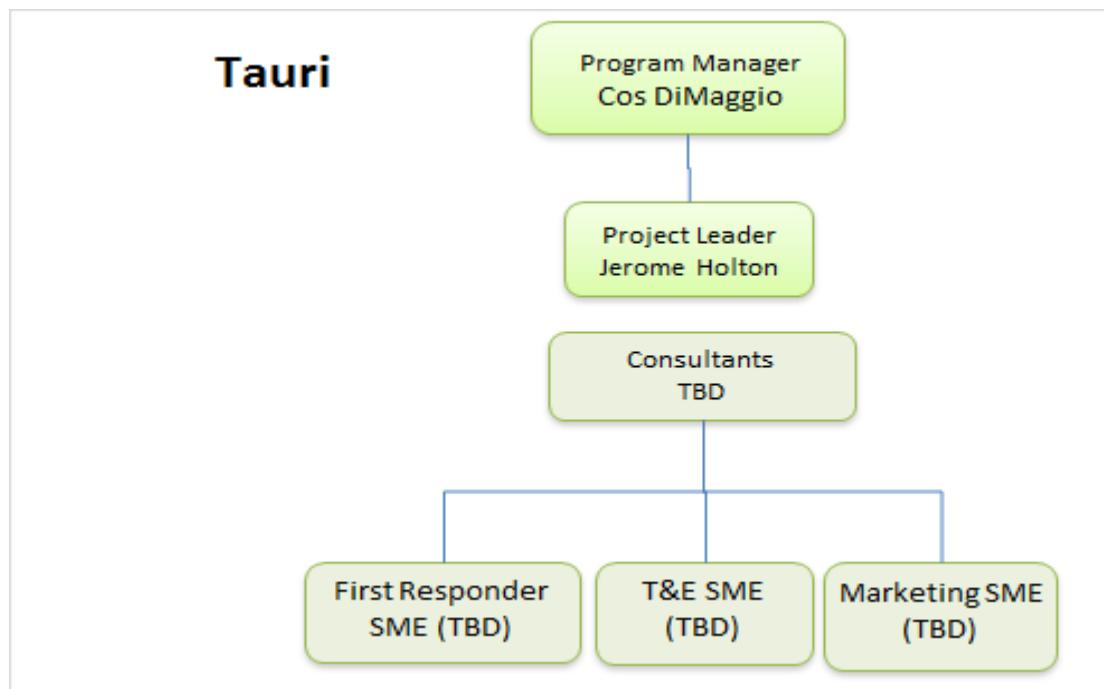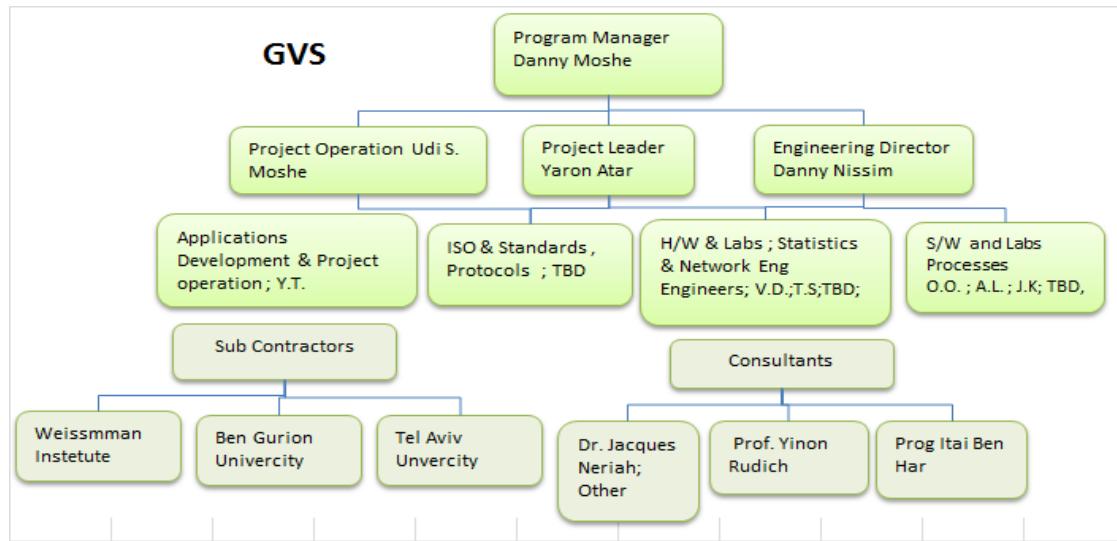
GVS' key personnel

The key roles of the subcontractors used in the project will be:

- DRI expert team- will provide its: LABs, experience and knowledge in bio aerosols, aerosols, chemical analysis, particulate matters, and long lasting experience in utilizing modern efficient methods for chemical analysis. DRI will be operated as an sub contractor serving as an independent external LAB in the US responsible for providing the chemistry theoretic.
- Tel-Aviv University Dept of Chemistry- will serve as a chemical analysis LAB for GVS, and provide theoretical background and support for GVS team.
- Requirements for Government Furnished Resources - The Government shall furnish GVS and its authorized class c/d laboratories sub-contractors with samples of the agents needed to be detected and confirmed in order for testing and database development for the systems.
- Tauri shall provide all relevant information on methods, carrier vehicles, the disperse pattern of the agents to be detected, as well as information on USPS buildings and other studies on channels of air movement within buildings and halls.

Danny S. Moshe, Co-Founder, CEO and President

since founding GVS in 1996, Danny S. Moshe has taken the company from a start-up to become a system and technology house offering services to other companies as well as owning a source technology with an extensive range of applications. In addition to GVS, Mr. Moshe serves as CEO and Chairman of MALCAM, an industry leader in the moisture and density measurement arena with a blue chip customer portfolio, which he has nurtured from its establishment as a start-up company. Prior to establishing GVS and MALCAM, he worked in a number of positions in subsidiary companies of Elisra Electronic Systems Ltd, Israel's leading developer, manufacturer and supplier of advanced electronic warfare systems. As Program Leader and later Chief System Engineer, he had various development, engineering and managerial responsibilities in projects focusing on medical radiology digital imaging systems, automatic machine vision systems for the semiconductor industry and real-time image processing solutions for defense applications. The combination of Mr. Moshe's unique hands-on engineering experience with superior managerial skills have given both GVS and MALCAM their leading edge in the development, manufacture and sale of outstanding solutions designed with the user in mind. Mr. Moshe holds B.Sc.EE and M.Sc.EE degrees from the University of Tel Aviv, and an MBA in Engineering from the Israel Management Institute of Tel Aviv.

Yaron Atar, Project Leader Yaron served as Project Manager, he was responsible for the development of multi-disciplinary optics and solution during this period (2005-2010) Yaron gained experience in mange multi discipline R&D teams cooperating (Joint Development) and development under OEM for huge world known equipment providers. Yaron served Project Engineer at Intel Israel and as a technical officer in the IDF technical LAB. Isaac holds B.Sc. EE.

Danny Nissim , Program Manager

Mr. Nissim has been with GVS for the past 5 years, responsible for software development and R&D particularly in the areas of imaging and data base algorithms. Danny Nissim served Project Manager at Nice and as a software programmer in converse. Danny Nissim holds B.Sc. EE. Danny will handle the s/w modifications and developments tasks

Vladimir Drojnov, Senior h/w Engineer

Vladimir has been with GVS for the past 11 years, responsible for h/w development and R&D particularly in the areas of controllers and analog h/w. Vladimir holds B.Sc. EE.

Udi Moshe, Administrator Program Manager

Udi have Network engineering diploma from Microsoft collage and BA (in his last semester) from Ramat Gan College. Udi has 10 years of experience as project management in process control applications. Udi manage the ISO-9002 and project management activities under the company's protocols and will serve as a program administration, take care the tests and statistical reports across the program and work with s/w programmers to enable multi scenarios detection algorithms

Professor Itai Benhar, PhD [senior advisor]:
A Full Professor and former chairman of the Department of Molecular Microbiology and Biotechnology at Tel Aviv University Israel. Prof. Benhar received in 1992 a PhD in Molecular Biology from the Hebrew University, Hadassah Medical School Jerusalem, Israel, where he studied Microbiology and control of bacterial gene expression. Prof. Benhar did his Post-doctoral fellowship at the National Cancer Institute, NIH, working with Dr. Ira Pastan on recombinant immunotoxins.In 1995, Prof. Benhar joined the Department of Molecular Microbiology and Biotechnology of the George S. Wise Faculty of Life Sciences as a tenure-track assistant professor. Prof. Benhar received tenure at 2002, and became an associate professor in 2005 and a full professor in 2008. In 2007 Dr. Benhar was appointed as Department Chairman until September 2011.Prof. Benhar's is an expert and opinion leader in the field of antibody engineering. Over the 18 years of being active in that field, he prepared several phage display libraries from which antibodies against numerous targets were isolated. Prof. Benhar is also an expert in Microbiology. Prof. Benhar publishes 68 research papers, wrote 10 book chapters and submitted 8 patent applications. .

Prof. Yinon Rudich [senior advisor]
Department of Environmental Sciences and Energy Research, Weizmann Institute of Science.
Prof. Yinon Rudich (Ph.D. in Chemical Physics from the Weizmann Institute in 1994) did his postgraduate work in the Aeronomy lab (Boulder, Colorado), working on atmospheric chemical kinetics and tropospheric heterogeneous chemistry.

Tauri's Key Personnel

Mr. Cosmo DiMaggio III is a founder and managing partner of The Tauri Group. He is an experienced business leader and analyst with over 30 years of service in support of homeland security and defense. In addition to being a corporate executive, he is substantively involved in all Tauri Group efforts related to countering weapons of mass destruction. He provides technical and policy support to military and civilian clients whose mission is to deter, defeat, detect, respond to, or recover from chemical, biological, radiological, and nuclear attacks against the US population, national infrastructure, and military installations. Mr. DiMaggio was the architect of two post 9/11 concepts for early detection of, and response to, biological attacks using disparate military and civilian data sources and response capabilities. He has consulted on the formulation of a national biodefense strategy, the future of bio-detection systems, and the creation of a framework for informing national investments in biodefense. He holds a Master of Science in Public Policy Analysis and a Bachelor of Arts in Planetary Geology, both from the University of Rochester.

Dr. Jerome Holton

is chief engineer with the Tauri Group, where he supports clients in the private sector, the Department of Homeland Security (DHS), and the Department of Defense (DOD). He provides analysis, advice, and counsel to senior government decision makers on policy, technology, and operations issues related to weapons of mass destruction and their effects on civilian infrastructure, first responders, military forces, and tactical operations. Previously he held leadership positions in private sector companies ranging from a scientific research start-up to a large management consulting firm. Past clients include chemical and biological defense entities within DOD, DHS, and the Department of Energy. His work encompasses the field of chemical, biological, radiological, nuclear, and conventional explosives detection and countermeasures, with a focus on counter proliferation of, counterterrorism/domestic preparedness issues for, and the detection, identification, and decontamination of chemical and biological weapons. Recent accomplishments include fielding information operations tools and enhancing intelligence, surveillance, and reconnaissance capabilities to detect and defeat improvised explosive devices, as well as the development of applique armor solutions to counter explosively formed penetrators. He earned his B.S. in physics from Mississippi State University and holds M.S. and Ph.D. degrees in experimental physics from Duke University.

I. The Companies and Their Resources

Tauri Brief Information:

The Tauri Group, LLC (Tauri) is a US company that provides analytical, advisory, and engineering support services to its clients. It specializes in the detection, analysis, mitigation, response, and recovery associated with man-made and naturally occurring threats against populations and infrastructure, with particular expertise in biological and chemical threats. Tauri works with federal, state, and local governments, as well as the private sector, academia, and national laboratories.

GVS Brief Information:

GVS was founded in 1996. For 19 years, GVS has specialized in HSI technology, developed 18 international patents, and operated as an ISO-9001 approved company. GVS's products are approved by UL and EU mark. The company's international strategic partners include Desert Research Institute [DRI, co-arm of EPA] in Nevada, (cooperation arm with EPA) USA; CAI-Asia; AIT Austria, Israel's Weizmann Institute, Tel-Aviv and Hebrew Universities, Mekorot from Israel, IAI from Israel; Gabriel Lippmann Institute and SES from Luxembourg; Kwater, and KMA from South Korea; STE from Singapore; Polytec Univ. from Hong Kong and others. GVS have 18 [9 professors] worldwide experts in pollution monitoring Advisors members [3 from the US; 2 from the EU; 10 from Israel; 2 from Pacific Asia region].

J. Project Budget

GVS and Tauri Project budget in two excel files attached to our full proposal that also will be uploading in BIRDF server. Hereby the summary of the Project Budget:

20 months of Project - Support , DRAFT figures to be updated by Tauri			
Description	**GVS ($)**	Tauri ($)	**Total GVS+ Tauri ($)**
Direct Labor	820,000	450,000	1,270,000
Labor Overhead (25%)	200,000	112,500	312,500
Equipment	2,900	0	2,900
Expendable Materials & Supplies	73,500	0	73,500
Travel	18,000	7,000	25,000
Subcontracts	55,000	15,000	70,000
Consultants	27,000	25,000	52,000
Other Expenses	18,000	0	18,000
G&A Expenses (5%)	61,000	30,000	91,000
Total	**1,275,400**	639,500	**1,914,900**

K. CPFA Information

Name and Full Prime Contact Details:

Chief contact at Tauri:
Cosmo DiMaggio III
Managing Partner
703 683 2883
cos.dimaggio@taurigroup.com
703 966 7137

Chief contact at GVS:
Danny Moshe
CEO & President
+972-2-649-5664
danny@greenvs.com
+972-544-511-222

The applicable law governing the CPFA between the companies and the Foundation will be the Israeli Law.

The GreenVision Systems Ltd. Bank details for money transfer:
Leumi Israel Bank (#10)
Habarzel 25 St.
Ramat Hahayal, Tel-Aviv
Account #:75100/71
Branch #: 682
IBAN No. : IL012-610-480790

The Tauri Group, LLC. Bank details for money transfer:
Xenith Bank, should be directed as followed:
Bank Name: Xenith Bank
Bank Address: 901 E. Cary Street, Ste 1700
Richmond, VA 23219
ABA Number 051409184
Account Name: The Tauri Group LLC
Account Number: 5500358101

L. Project Budget
[attached as Excel file by each party]

M. RISK ANALYSIS TABLES

RISK ANALYSIS TABLES
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TABLE 1A

Risk #	Name/Description	Ranking	Impact		
			Duration[1]	Budget[2]	Commercialization Potential[3]
1	Making System Compact and Low costs	Medium	Medium	Low	Medium
2	Bio-Aerosol DATA-BASE that will serve as a targets vs. background SFPs	Low	Medium	Medium	Low
3	Applications & Sale Plan Approval	Medium	Medium	Low	Medium
4	Engineering approval, ATP Approval	Low	Low	Low	Low
5					

TABLE 1B

Risk #	Name/Description	Type*
1	Making System Compact and Low costs	T
2	Bio-Aerosol DATA-BASE that will serve as a targets vs. background SFPs	T
3	Applications & Sale Plan Approval	E
4	Engineering approval, ATP Approval	M
5		

*Type: Technical (T), Project Management/Resources (M), External to the Project (E)

Ranking	Probability of Risk Occurring
High	Above 50%
Medium	30 – 49%
Low	10 – 29%
Very Low	1 – 10%

Impact	Duration[1]
High	Above 6 months
Medium	3 to 6 months
Low	Below 3 months

Impact	Budget[2]
High	Above 20% increase
Medium	10% to 20% increase
Low	Below 10% increase

Impact	Commercialization Potential[3]
High	Above 50%
Medium	30% to 50%
Low	1% to 29%

1. Duration of project extended by the given amount
2. Cost of project increases by the given percentage
3. Forecasted sales in the next 3 or 5 years reduced by the given percentage

N. Sundry Information - Mandatory

1. Venue for the applicable law governing the CPFA between the companies and the Foundation- preferred Israel, as the core technology developing in Israel based on the GVS H.S.I technology ad system

2. Name, direct telephone number, e-mail address and position of the assigned Project Manager from each company.

Typed Name:	Danny Moshe	J. Jerome Holton, Ph.D.
Typed Title:	Project Leader	Project Leader
Tel. no.:	+972-3-649-5664	+1-703 683 2883
Typed Email address:	danny@greenvs.com	jerome.holton@taurigroup.com

3. Name, direct telephone number, e-mail address of the assigned Fiscal Information Official from each company.

Typed Name:	Rina Weisfelner	Mark Herzing
Typed Title:	Accounting Manager	CFO
Tel. no.:	+972-3-649-5664	+1-703 683 2883
Typed Email address:	accounting-gvs@greenvs.com	mark.herzing@taurigroup.com

4. Company's Certificate of Incorporation

Reg. GVS Eng..pdf

5. Details of bank accounts to enable the Foundation to transfer the conditional grant payments to the companies. Specifically, for each company. SEE SECSION K

Annex A - Article regarding CB agent detection system

HyperEye for CB Aerosols For Homeland Security, Inspection Applications

GVS (GreenVision systems), Introducing a high sensitive solution for ambient air security management. The ability to provide a comprehensive product/service suite enables monitoring, detection and tracking of anomalies and contaminations with CB PM in near real time analysis, based on GVS' patented and field-proven HyperEye technology. GVS solutions designed for indoor and outdoor applications. The GVS' HyperEye platform utilizes GVS' massive proprietary database [with as needed bio-markers] to initiate real time alerts in pre-defined scenarios. GVS, with the support of BIRDF, worked with Northrop Grumman Coop to develop and validate NXG of BDS systems for bio agent's detection and validation.

FACTS: On April 24, 2014, the DHS Acquisition Review Board reviewed the Bio-Watch Gen-3 acquisition with OHA and issued an ADM announcing the cancellation of the acquisition of Gen-3. According to the DHS ADM, the AoA "did not confirm an overwhelming benefit to justify the cost of a full technology switch" to Gen-3. The ADM also announced that S&T will explore development and maturation of an effective and affordable automated aerosol bio-detection capability, or other operational enhancements, that meet the operational requirements of the Bio-Watch system.

In April 2014, Bio-Watch Program officials said multiple factors influenced the decision to end the Gen-3 acquisition, including budget considerations, considerations regarding the readiness level of the technology, and the cost to field and maintain the technology. Bio-Watch Program officials said that the Homeland Security Studies and Analysis Institute's and our recommendations to complete a robust AoA, which resulted in not identifying a clear path forward for a single technology type for the Gen-3 acquisition, was also a contributing factor. According to Bio-Watch Program officials, DHS has not ruled out the possibility of pursuing autonomous detection for the Bio-Watch program, but officials said the technology would have to cost less to develop and maintain than was estimated for the Gen-3 system. Bio-Watch program officials said the decision to cancel the Gen-3 acquisition was a cost-effectiveness measure, because the system was going to be too costly to develop and maintain in its current form. It indicated that Gen-3 was expected to cost US' DHS over $ 350 Mil per year.

APPLICATION : Identification and characterization of pathogens, contamination spots and toxic aerosols   for HLS and public safety and healthcare monitoring, analysis services using HyperEye automatic near real time capabilities. The ability to speed up the classification cycle, at each site/city in the US [before validation cycle, that done by PCR current lab methods], with GVS' HyperEye-IC [F] and automatic scanning of the air particulates; PM samples; water samples, the program operator will be able to down load costs across time and enhance the services with semi/ automatic bio aerosols detection and classification systems.

PRODUCTS, SERVICES, RESULTS: GreenVision Systems Ltd. and its partners will focus on developing a smart near real time services based on GVS' Hyper Spectral imaging HyperEye tools for safety initiatives. The HyperEye performs the 'Smart Inspection' functions

by non-contact, non-destructive, off-line and/or near real time on-line, physicochemical imaging and analysis of powdered ingredients or products without needing consumable materials for sample processing.

Designed for indoor/outdoor applications, the HyperEye use air-samples filters or collects air samples using High Volume full control air collector on filters. On those filter's spots, particles are collected and then processed in near real time using GVS' platform using massive GVS' proprietary database and CB agents markers to determine real time alert on defined scenarios.

Tracking Air quality in train stations and metro stations; different types of PM Ambient Air Pollution Sources information base on GVS' HyperEye-IC [F] Systems; The Need For Identifying PM Sources Contributions in Near Real Time

People's exposure to indoor air pollution is determined by the concentrations of pollutants in the indoor environment and, most importantly, by the time individuals spend in polluted environments. Most people spend a large amount of their time indoors, which makes indoor spaces important micro-environments when addressing risks from air pollution. Most of a person's daily exposure to many air pollutants comes through inhalation of indoor air, both because of the amount of time spent indoors and because of the higher pollution levels indoors.

Monitoring Objectives

The air quality inside buildings is affected by many factors. In an effort to conserve energy, modern building and underground facilities design has favored tighter structures with lower rates of fresh air circulation. Factors that can have a negative effect on health and comfort in buildings range from chemical and biological pollutants to occupant perceptions of specific stresses such as temperature, humidity, artificial light, noise and vibration.

Subway systems are commonly being used in **major cities** of the world in order to improve the quality of transport, reduce traffic and air pollution. Millions of passengers spend part of their time in the subway systems and a large number of employees are working in these systems.

Although one of the most important purposes of **subway systems** and train stations are reducing ambient air pollution, the emerging new challenges from cities local government will demand solutions from ambient air pollution problems. Indoor air pollution, building-related illness, and "sick building syndrome" have received increased attention over the last several years.
Pollutants can cause or contribute to short- and long-term health problems, including asthma, respiratory tract infections, allergic reactions, headaches, congestion, eye and skin irritations, coughing, sneezing, fatigue, dizziness and nausea. Due to accidence' smoke generating in large areas poor indoor air quality. high sensative detection systems will avoids contamination to be spread to indoor facilities.   Poor indoor air quality strains relationships among employees, family members, parents, teachers, students and school administrations

GVS Monitoring and Tracking solutions

GVS HSI solutions will enable to support green cities management embodies [e.g. Metro, train systems, public strategic buildings] a very important role as a management index in the planning of **large cities**.

The GVS' unique Hyper Spectral Imaging (HSI) technology is fast becoming the most practical technology for air (indoor, outdoor; underground facilities ;..) contamination tracking, biochemical inspection, mainly for security and health-care applications and recently for Environmental monitoring too.

This very sensitive technology on one hand and its wide range of potential solutions on the other hand makes the HSI technology very attractive. Multi sensing locations with data mining will generate a high strategic value for City' Metro Stations company and to City' Local government.

Power plants, Refineries, Sea Ports Utilities, Biomass burning, and **automobiles** create air pollution that can spread far from the source. To predict where and when a local pollution was produced it is needed to use a network of HyperEye-AP system combined with regional meteorology database. GVS' HyperEye-AP systems enable the sampling of indoor / ambient air in different locations stimulatingly and provide on line and semi-real time information to the central control-rooms.

The following graph illustrate block diagram of the HSI Underground Air Quality Inspection and assessment Platform:
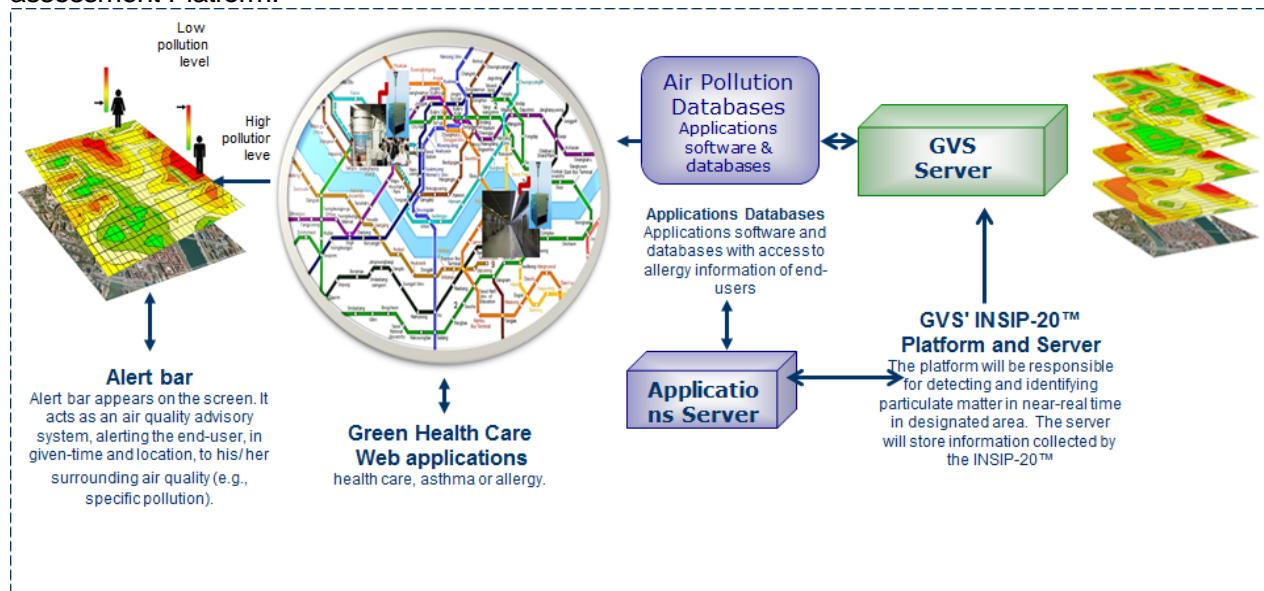
The above example Illustration provides an example of how GVS' HyperEye-AP network systems can provides high values for Metro and public facilities operators. The Hyper Platform will enables to monitor, Track and Map three major layers of pollutances (i) Particulate matter – Mapping and Tracking P.M sources across time; Anomalies detection (ii) Bio Agents species ,e.g. Fungi's (iii) Optional : Radon and R/N detection;

Levels of Warnings