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The 21st Century First Responder
The Vision

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Summary

The threat of an event involving weapons of mass destruction (WMD) is greater today than ever before. Despite the promise of new technologies and upgraded security measures, indications are that we are not prepared to meet this threat. In an emergency, medical and emergency service communities will play a critical role and will require the best training and response equipment available. Unfortunately, the latest military response equipment is not currently available for all domestic responders. In addition, there is a lack of information concerning what response equipment is needed to satisfy multiple emergency response demands. This paper identifies some of the basic needs of the ultimate 21st century domestic first responder and suggests technology uses and response equipment that will aid the responders in carrying out their duties during a time of crisis. This paper also presents a concept for the short-term, identifying some of the available technologies that can be configured into a response system. This research also exposes gaps in technology, suggesting potential areas for further research and development, and provides a vision for the future first responder. This vision must be anticipated, planned for, designed, integrated and developed so that we will be ready before the event happens.

1.0 Introduction

"We face a new threat at the dawn of the 21st century, and it is one that we must think about and for which we must prepare." Jeffrey D. Simon, Biological Terrorism – Preparing to Meet the Threat.

Those local and state authorities who have crisis and consequence management responsibilities in the event of a Nuclear, Biological, or Chemical (NBC) terrorism incident are referred to as First Responders. They are so named because they are typically the first to arrive on the scene. Responders generally include , firefighters, police and emergency medical personnel. The Stafford Act (Public Law 93-238), under Executive Order 12656 and the Federal Response Plan (FRP), established the authority for this response. In June 1995 the White House issued a Presidential Directive defining the policies of the federal response to threats or acts of terrorism involving NBC or Weapons of Mass Destruction (WMD). Additionally, the National Defense Authorization Act for Fiscal Year 1997 was signed into law on September 23, 1996. This law, now known as Public Law 104-201 initiated a report to congress by the Department of Defense (DoD) identifying training and equipment needs as well as other requirements of domestic first responders (Department of Defense 1997). This report also identified additional support needed to enhance the federal government's ability to respond to these events. Over the past several years a number of federal agencies have conducted studies and focus group discussions involving local, state and regional representatives in attempts to determine the needs of first responders in the event of a WMD incident. These studies focused on plans, capabilities, procedures, training, equipment, and response integration at different levels. Subsequently the U.S. Government has taken measures to begin addressing these needs and to bolster domestic preparedness capabilities.

2.0 Objective

Many government agencies and laboratories as well as private companies have responded to the need for support by developing response equipment, sensors and detectors, tools, and decontamination equipment for the military first responder. Not all of these developments have or will be put to use. This paper seeks to provide additional insight into the personal protective needs and future capabilities for the first responder. This paper does not endorse nor recommend the specific technologies identified - but seeks to provide examples of technologies that are currently available. It seeks to provoke interest and discussion concerning the need for further technologies. This paper attempts to provide insight into needed design concepts featuring the latest technologies and tools in order to foster new research and funding ideas for the 21st century.

In addition, this paper intends to provide a futuristic design concept and vision of a resource prototype for the 21st Century First Responder. This concept is predicated on the assembly of existing, new, and future technologies that can be combined to produce an "ultimate first responder" prepared to enter any unknown environment. A similar concept has been employed in the development of protective suits for astronauts. The concept can be tailored for the domestic first responder who will likely face a range of "urban" unknowns that must be identified and communicated to command post units. This concept seeks to provide ideas for responder survivability, remote sensing devices, and other tools or equipment capable of assessing a wide range of events. This paper includes an investigation of the tools that will be required to protect the responder against various types of nonmilitary, extremely hazardous conditions as well as providing examples of current technology capabilities that can be used in conjunction with the protective suit for data-collection, warning systems, sensors and detectors, and communication devices. This paper also provides a concept for the short-term and identifies some available technologies that can be integrated into a system. As a result of this research, some gaps and areas of potential research and development have been identified.

3.0 Requirements

The number of diverse first responder teams identified to support an incident involving WMD is increasing as the combination of new military, National Guard, and domestic response teams become integrated and active. Although this paper does not specifically discuss military preparedness, the needs discussed for the domestic responder may apply in kind. Currently, the primary issue involves the nonavailability of equipment for all potential responders and the limited equipment available for today's domestic responders. Equipment shortages are foreseen for responders who will control security, engineering and public works, communications, general transportation, decontamination, casualty transportation, medical, and mortuary services.

In addition to equipment needs, the first responder will also need:

- knowledge of indicators, signs and symptoms for exposure to NBC agents
- the ability to identify the agents based on signs and symptoms
- to recognize and communicate the need for additional resources during the incident
- knowledge of individual and self-protection measures during the incident
- knowledge of how to initiate actions to protect others during an incident
- to understand the measures for evacuation of personnel
- an understanding of decontamination procedures for self, victims, site and equipment
- an understanding of crime scenes procedures and evidence preservation
- understanding of procedures and safety precautions while collecting evidence
- an understanding of federal and other support infrastructures
- to understand the risks of operating the response clothing and other instruments that may be needed
- to understand emergency and first aid procedures
- to understand procedures for the safe transport of contaminated items
- to understand the methods for collecting samples for detection
- to understand the testing and diagnostic methods for identifying agents

Technology solutions responsive to these needs may include databases, procedures, and voice-activated data that could be downloaded to a helmet-mounted display (HMD) located inside the responder's visor. In addition to the knowledge requirements, the equipment list is extensive. The following table includes examples of some of the equipment required. This list may appear overwhelming, however, it is likely that responders, regardless of their training, could well face situations that will test the limits of their equipment and individual abilities. The vision for the ultimate responder is to have a maximum amount of the testing, detection and communication or decontamination needs attended to remotely, indirectly and automatically.

Example of Current First Responder Equipment [a]

Clothing	Support Systems	Collection Devices	Communications	Sensors/ Detectors
Level A chemical/biological resistant suit	Batteries and chargers	Draegar Kits	Cellular phone and chargers	Water test kit
Coveralls	Air inflatable tents	Sampling pumps	Encrypted phone (STU III)	Chemical detector kit
Underwear	Collapsible pool	Sample containers	Pagers with message screen	GM detector and probes
Cool vest	High test hypochlorite	Flashlight	Secure radios	Detection paper
Positive pressure capabilities	M-295 individual decontamination kit	Plastic sheeting	Digital camera	Immunoassay tickets
Helmet with visor	Portable shower kit	Spill containment pillows	Lap top computer	MiniCAD detector
Hoods	Sodium carbonate (decon solution)	Collection drums	Video recorder	Phosgene detector
Nitrile gloves	Sodium hydroxide (decon solution)	Chemical agent monitors	VHS player	Global positioning system
Explosive resistant boots	Water canteen	HazMat gear bag	Television with CNN	Spray stimulant bio and chem agents
Hazmat knee-boots	Convulsant antidote	Soil samplers	Video hookup	Filters for some detectors
SCBA	Nerve agent antidote kit	Sample collection kits (Trelborg or equal)	Multi-line system for fax and copiers	Detection procedures and pocket guidebooks

[a] Adapted from the Department of Defense Plan for Integrating National Guard and Reserve Component Support for Response to Attacks Using Weapons of Mass Destruction. January 1998. Or DOD 1998.

4.0 Issues

The 1998 Interim Report on Current Capabilities for Improving Civilian Medical Response to Chemical or Biological Terrorist Incidents (The National Research Council, Institute of Medicine, 1998) examines the current capabilities and requirements for personal protective equipment (PPE) for nonmilitary responders. This report addresses NIOSH/OSHA/EPA requirements and classifications of protection needed for chemical, biological and physical hazards. The basic rule in PPE selection is that the equipment be matched to the hazard. The report also states that NIOSH and the Mine Safety and Health Administration designates performance characteristics of respirators and provides approval for all commercially available respirators.

This report points out that although chemical response clothing is not yet subject to government established performance standards, the American Society for Testing and Materials (ASTM) has developed methods for testing the permeability of protective clothing materials subjected to a battery of liquids and gases. The National Fire Protection Association (NFPA) has incorporated the ASTM test battery into widely accepted standards for response suits to be used in hazardous chemical emergencies. None of the ASTM permeability tests, however, employ military nerve agents or vesicants. Military PPE has been tested for protection against those agents but generally does not have the certification by NIOSH or NFPA that would allow its purchase and use by civilian workers for any purpose. Some progress addressing this issue has been made in conjunction with the Army's Chemical Stockpile Emergency Preparedness Program (CSEPP). CSEPP has made recommendations on PPE for civilian response personnel in those communities adjacent to military bases stockpiling chemical weapons (Argonne National Laboratory 1994; DoD 1998). CSEPP has also sponsored tests of commercial respirator filters (Battelle Laboratories, Inc.1993), and fabrics used by commercial chemical suit manufacturers (Daugherty, et al., 1992). The Army has tested specific Level A, B and C suits and has approved two Level-A commercial suits for use in chemical agent emergencies at Army facilities. The Army also has approved an "informed" purchase of a commercial Level-A and Level-C PPE by the Metropolitan Medical Strike Team (MMST) (DoD 1997).

To date, most response gear, although providing protection against a majority of threats, is uncomfortable and can cause serious problems for the user. These difficulties (noted by soldiers and civilians alike) include sweating, skin irritation, thermal stress, a sense of confinement, lack of mobility, and breathing difficulty. In addition, wearers have experienced decreased vision, impaired communication and diminished job performance. Any combination of these problems will usually limit the wearer's effectiveness and, in some cases, cause illness. Added mechanisms intended to compensate for problems such as heat stress, increase the weight of the suit and can necessitate short-term operation or additional power source requirements (Steffen et al. 1997).

Another issue involves decontamination and reuse of the suits. In suits containing electrical components or items that require power, decontamination may pose serious obstacles. When designing the ultimate response suit, sacrifices often must be made for one use or another. In general, the higher the level of PPE protection, the greater are the risks associated with the use. In addition to comfort and "time-in-the-suit" limitations, present equipment inhibits the amount of testing, identification and detection that can be accomplished. For example, current protective material gloves limit dexterity, may pose problems in sample and evidence collections, and in using communication devices (e.g., cell phones). Administering antidotes will also present problems if the suit integrity must be breached (e.g., administering by mouth or injection).

The current focus of HazMat responder team activity is for short-term operations to control or mitigate a release, rather than sustained efforts in locating and extracting victims. This raises the question of who is to have access to the ultimate PPE and how the cost can be accommodated for those that have the need.

5.0 Available Technologies

For the purposes of this paper, several sources were researched via open catalogs or the internet, seeking *available* technologies that would provide ideas for the Ultimate 21st Century First Responder. None of the products mentioned were investigated or tested in actual use nor were the vendors contacted. This paper does not endorse any of these products but includes them to illustrate the concept vision and design. The items mentioned are not all-inclusive and are, in fact, but a small portion of what may actually be available for use. The items researched were primarily intended for civilian application. However, some international equipment manufacturers indicated military uses.

Contact information regarding many of the products and technologies included within this report can be found in the Appendix.

5.1 Protective Clothing and Suits (PPE)

Currently, most HAZMAT teams have a limited number of Level A suits. Most, if not all, NFPA-certified commercial Level-A suits are likely to provide protection for brief periods or against low concentrations. One approach taken for selected teams in large cities is to establish cache or caches of lightweight Israeli-made "escape hoods" that can be used by first responders to minimize exposure of victims and rescue personnel. Skin and respiratory protection is limited, still it is better than no protection at all.

Several companies manufacture PPE suits for various needs. One such company, ILC Dover, Inc., manufactures aluminized, fiberglass cover suits that are designed to protect in flash fire situations. This company also manufactures portable, self-contained cooling vests and circulating systems that employ frozen gel strips inside the outer protective suits. They also make suit integrity test kits used to pressure check the suit, and polyester splash and anti-fog visors for the outer suits.

Another type of extreme survival suit is diving and immersion suits. These include hot-water circulation, bodily waste collection bags and personal rebreather systems that reduce respiratory heat loss and scrub metabolic produced CO_2. Helly Hansen Spesialprodukter A/S of Oban, Scotland is one manufacturer of these suits.

Protection equipment is produced by a number of companies and are used for international military protection around the world. Kemira Safety of Finland manufactures respiratory response devices for NBC protection. Their equipment features full-face masks and filters, powered respirators, filtering devices with hoods, and compressed airline-breathing systems. Most of their NBC mask systems, which tout protection against all known chemical and biological agents as well as radioactive and toxic particles, are lightweight, comfortable to wear, are field ready and have connections for optical and communication devices.

5.2 Helmet Mounted Protection Devices

The National Aeronautics and Space Administration's (NASA) Jet Propulsion Laboratory in Pasadena, California has a proposed helmet-mounted opto-electronic instrument that provides real-time stereoscopic views of otherwise invisible toxic, explosive, and/or corrosive gases (NASA 1995a). The display is semitransparent and the images give indications of the volume and concentrations of gas clouds as well as their locations relative to other objects in the field of vision. This instrument serves as a safety and forensic device for astronauts, emergency response crews, firefighters, or anyone working near invisible hazardous gases. It comes in a helmet-mounted or an automated-sensor version, a hand-held version could be easily designed (NASA 1995).

5.3 Helmet Mounted Display Units (HMDs)

NASA has developed a helmet-mounted display (HMD) that will present flight, navigation and weapon information in the pilot's line of sight. Additional development in progress will provide a two-primary color display that enhances the viewing of the data in the display (NASA 1995).

5.4 Image Intensification Systems

A lightweight, self-contained, third generation image intensification system capable of being either hand-held or mounted on one's head or helmet, has been developed by 21st Century Hard Armor Protection, Inc. This device is intended for use in starlight and moonlight for reading, vehicle maintenance, and administering medical or other aid. The device incorporates an infrared (IR) light source to provides illumination required for close up viewing. It can be used as an eyepiece or mounted on a camera.

A radar "flashlight" is being developed to increase job safety for police officers and others by detecting human presence through walls or closed doors. This is possible at distances up to 3 meters. The flashlight-sized device can discern body movements of only a few millimeters. This device, created at the Georgia Institute of Technology, uses a narrow radar beam of less than 20° to detect breathing and other slight body movements. It is part of a family of technologies that can also detect heartbeats.

5.5 Human-Machine Interaction Device

Extenders are a class of robotic exoskeletons worn by humans that enhance human physical strength. Human intellect remains the central control system for manipulating the extender. Commands are transferred to the extender via the contact forces between the human and the equipment. The human body, in physical contact with the extender, sends power and information signals to the extender to maneuver heavy loads with greater dexterity, speed, and precision. Several experimental extenders have been designed and built for various load capacities by the University of California – Berkley, Human Engineering Laboratory's Mechanical Engineering Department (Guo 1998).

NASA has developed an unobtrusive power-assisted EVA glove metacarpalphalangeal (MCP) joint that could provide the user with close to nude body performance. This joint is also being used to demonstrate the technological feasibility of power assisted space suit components (NASA 1994).

Pressure Profile Systems, Inc. has developed a tactile sensor for surgical data acquisition. It is called the “Conformable Tactile Sensor” (CTS) and the device can be unobtrusively mounted on the fingers to measure pressure distributions during surgical procedures. The device is being developed in coordination with Harvard University, where performance experiments and testing is being conducted. The research will be used to improve the sense of touch and realism-through-gloves for surgeons.

5.6 Protective Bio-skin Materials

Information from selected NASA Technical Reports, found under the Man/System Technology and Life Support subject category, introduces so called smart materials that may be used in protective bio-skins, face masks, and venting systems for over-garments to capture and neutralize biological threat agents and chemical toxins before they enter the wearers body. This technical approach involves the development of CAD/CAM and polymer chemistry fabrication technologies for biomimetic material. This material exhibits the mechanical responsiveness and biochemical processing capabilities of living cells and tissues. Porous hydrogels have already been developed and are being used in several commercial applications (NASA 1994; NASA 1995b; NASA 1995c).

5.7 Sensors and Detectors

UE Systems, located in Elmsford, NY, has developed an ultrasonic detector that translates ultrasounds that are produced by operating equipment and by leaks, into the audible range where the sounds are detected by headphones. This detector can be used for detection of leaks from compressed gas systems, vacuum systems, pumps and compressors. The detector is the size of a handgun and includes an LED readout.

A miniaturized, biological sensor has been developed by Texas Instruments that is capable of providing real-time remote testing for E-coli bacteria in beef and which will also monitor water quality. The detector, smaller than a matchbox, uses the integrated surface plasmon resonance sensor technology for chemical, biological and refractive index sensing. The original intended application for this sensor was for food and beverage process control, however, modifications can expand the application to provide for other forensic monitoring.

Physical Optics Corporations has developed a fiber optic immunosensor system for the detection of minute amounts of explosives. This system is based on an olfactory receptor mechanism. It incorporates a fully reversible immunosensor in which an analog, a competing agent for binding to the antibody is fluorescently labeled and bound to the surface. This method eliminates the need for constant replenishment of fluids, and makes the system intrinsically reversible. The fiber optic design is suited for sensing over large areas and the antibody can be replaced to adapt the sensor to a number of different target substances.

NASA (Kennedy Space Center) has developed portable instruments that will detect volatile and nonvolatile organic surface contaminants in real-time (NASA 1995c). The instruments will operate under ordinary ambient atmospheric conditions without the use of messy liquid solvents or cutting contaminated specimens from the surfaces to be inspected. The principle of detection involves sweeping a pure, activated gas across the inspection surface then monitoring light emitted at wavelengths characteristic of excited molecules. These are formed by chemical reactions between the activated gas and the contaminants.

VSE Corporation has developed the Life Assessment Detector System (LADS), a microwave Doppler-movement measuring device that can detect human body surface motion, including heartbeat and respiration, at ranges up to 135 feet. The primary function of the LADS is to provide a reliable method by which medical and emergency personnel can locate people buried in collapsed buildings or those injured on the battlefield. The system has adapted neural network technology that "trains" the system to detect human life signs. It can detect and be used to locate people trapped by an avalanche or mudslide, on a mountain ledge, or under a collapsed tent structure. It can detect battlefield casualties in a chemical/ biological warfare environment or hostages being held in a nonmetallic room.

Graseby Dynamics, part of Smiths Industries in the United Kingdom, has developed several detectors for chemical and biological warfare agents. These detectors make use of a technology called Ionic Mobility Spectroscopy and are marketed under the name of CAM™, GID™2A, and GID-3. The CAM™ is a hand-held monitor designed to detect liquid agents on people, equipment and on the ground. It is battery-powered, lightweight and easy-to-use. It identifies the agent by group and informs the operator what the level of danger is by means of a bar graph. The GID™ was developed as a result of the Gulf War and is designed to mount on larger objects such as ships and fighting vehicles to detect CW agents. Graseby has teamed with Battelle Memorial Institute and Orbital Sciences to miniaturize these detectors.

NASA (Marshall Space Flight Center) has a device described as a "Thin-Membrane Sensor" with Biochemical Switch (NASA 1994). This device emits an electrical signal indicating the presence of a chemical or biological agent. This device is marketed as a prototype biosensor, useful for industrial or field applications in detecting bacterial toxins in food, to screen for disease-producing microorganisms, or to warn of toxins or pollutants in the air.

The SAW MiniCAD mk II is a personal, lightweight, solid state, chemical agent detector made by Microsensor Systems, Inc. This device detects trace levels of nerve and blister agents and does not provide false alarms caused by other chemical vapors. It uses surface acoustic wave sensor technology and is available for field use. Another device made by Microsensor Systems is the RCAD II Monitor, a rugged, portable trace level chemical agent detector with an integral radio frequency transceiver. This device can provide data to a remote base station and is GPS ready. It can monitor four meteorological sensors: wind speed, direction, temperature, and relative humidity. The device is designed to assist in predicting and tracking an agent vapor cloud.

Pacific Northwest National Laboratory (Pacific Northwest) has developed a portable, compact aerosol collection system that can be used for trapping airborne viruses, bacteria, mold, and spores. The system uses the microelectromechanical (MEMS) and microfluidic technologies. Potential application include the collection of airborne infectious agents in hospital and research labs, monitoring confined spaces such as submarines and subways for dangerous airborne material, identification of “sick buildings” and counter-terrorism monitoring. Pacific Northwest has also developed a portable, real-time, class-specific sensor system that detects the presence and concentration of chlorinated compounds in air and water. The technology is being refined to measure down to the 10-ppb range.

The Corona Catalysis Corporation is developing technologies that will help armed forces and municipal emergency response teams to detect and process airborne bioactive particles and chemicals. The "Corona-Cat" is an innovative microcomponent detection system that provides the portability and low power requirements necessary for adaptation to meet the needs of response teams. This device is used to collect particulates and biological materials for characterization and monitoring.

5.8 Communication and Data Systems

Motorola is developing communication systems for space and has developed systems for the Mars Pathfinder. These systems consist of wireless loop systems and one or two-way radio systems. The StarTAC® cellular phones can combine text messaging and data in a single unit. Many other communications companies have similar technologies that have been developed for space.

Maxus Strategic Systems, Inc. has a “Situation Awareness Visualization System” that graphically depicts vast amounts of real-time information as data terrains: dynamic, visual icons populating a spatially structured three-dimensional space. The resulting visual grammar communicates visual, auditory and interactive cues through an immersive user interface. This will allow the users to identify and select data items, navigate the data terrain for advance cueing of threat and target detection.

5.9 Decontamination Systems

Environmental Elements Corporation has a fast-acting and safe method for decontaminating surfaces exposed to biological or chemical agents under battlefield conditions. This technology minimizes equipment downtime and the number of personnel needed to decontaminate such items. The One Atmosphere Uniform Glow Discharge Plasma (OAUGDP) has been shown to completely destroy microbial agents in seconds and to remove surface films from solid surfaces. Proposed work on this technology is to demonstrate the use and portability under various operating conditions.

5.10 Robotic Units

The NASA Jet Propulsion Laboratory has developed small, light, highly mobile robotic vehicles called "microrovers" that use sensors and artificial intelligence to perform complicated tasks autonomously (NASA 19995b). These rovers can be used in firefighting, clean up of chemical spills, and working in hazardous or toxic environments. A mobile, hazard-response robot called the “Hazbot III” is designed to operate safely in a combustible and/or toxic atmosphere. The device includes camera and chemical sensors that help human technicians determine the location and nature of a hazard thereby enabling an emergency team to determine how to eliminate the hazard without physically approaching it.

The DOD, in conjunction with the military services, has developed the FOX Vehicle. This is a 6-wheeled, light armored, NBC Reconnaissance Vehicle. It has NBC detection capabilities that include the MM-1 Mobile Mass Spectrometer as its primary detection device, the M43A1 Chemical Agent Detector, the M256 Series Chemical Agent Detector Kit, the AN/VDR2 radiation detector, and the ASG1 radiation detector. As of this writing the Fox did not provide any biological detection but does allow the crew to safely take samples for laboratory analyses for biological hazards. The original function of the Fox vehicle was to mark persistent ground contamination areas, however, its use may be expanded on.

6.0 The Vision

An emergency call comes in on 911 in a coast city. The caller can barely speak but manages to relay information to the dispatcher that many people are getting sick and making choking noises. The caller says he was just leaving the airport when a vapor cloud covered a section of the terminal. He says that people are dying and trying to get help - he just managed to get to the phone. The operator hears the phone drop from the caller's hands. There is no further response. Within 30 minutes, a specialized team of first responders is dispatched to the scene. The responders arrive wearing specialized protective suits that are also equipped with miniaturized detection devices. The squad leader speaks into a transceiver inside his helmet to the command center being established outside the established perimeter area. He activates an optical-image sensor device in his visor and immediately sees a dissipated transparent plume, not visible to the naked eye. He presses several buttons on his sleeve. Whooshing sounds are heard as miniature sampling/detector devices on his suit are activated. An LED display inside the visor on his hood indicates a nerve agent has been detected. The miniature video camera on his helmet is taping the scene as he moves deeper into the terminal. He communicates his findings to the command center and takes a rapid body count. He continues observing the scene, all the while touching various keys on his wrist-mounted keypad, automatically sending visual and digital information to the command center. As he continues further into the terminal his immunosensor indicates small amounts of explosive and chemical agent materials. The skin of his protective suit changes color as it begins to decontaminate itself. Other responders soon arrive and begin setting up decontamination, transportation and medical response stations.

This scenario was not taken from a real event. Nor is it from a science fiction movie. It is a vision of the future. A vision that must be shared by technology developers. We know that a mass casualty situation will demand a specialized team armed with the latest technology. The technology must allow optimum comfort for the wearer and also provide surveillance and detection capabilities far beyond what is now available. Figures 1 and 2 are conceptual drawings of a modern First Responder and a First Responder Human/Machine Interface. Some of the needs of the Ultimate 21st Century First Responder are set forth in the subsequent table:

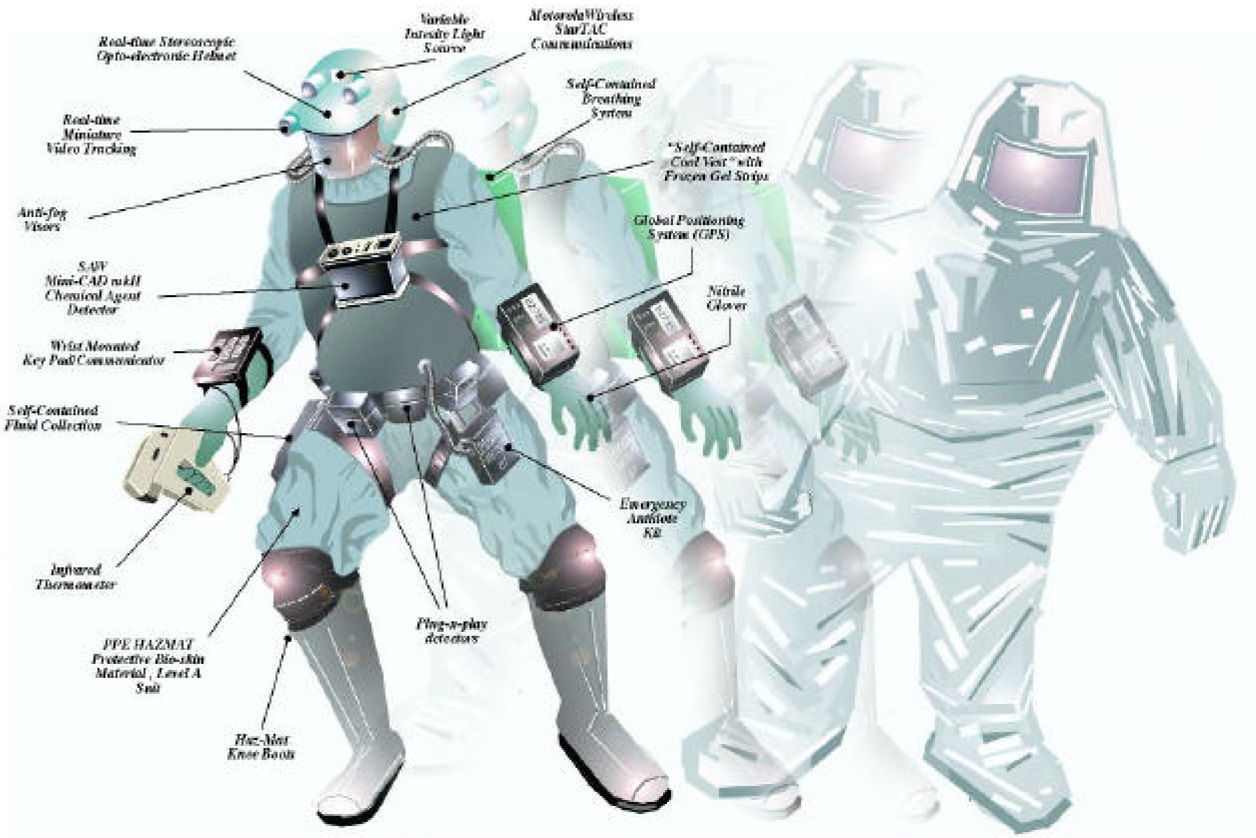

Figure 1. The New 21st Century First Responder Emerges from the Old

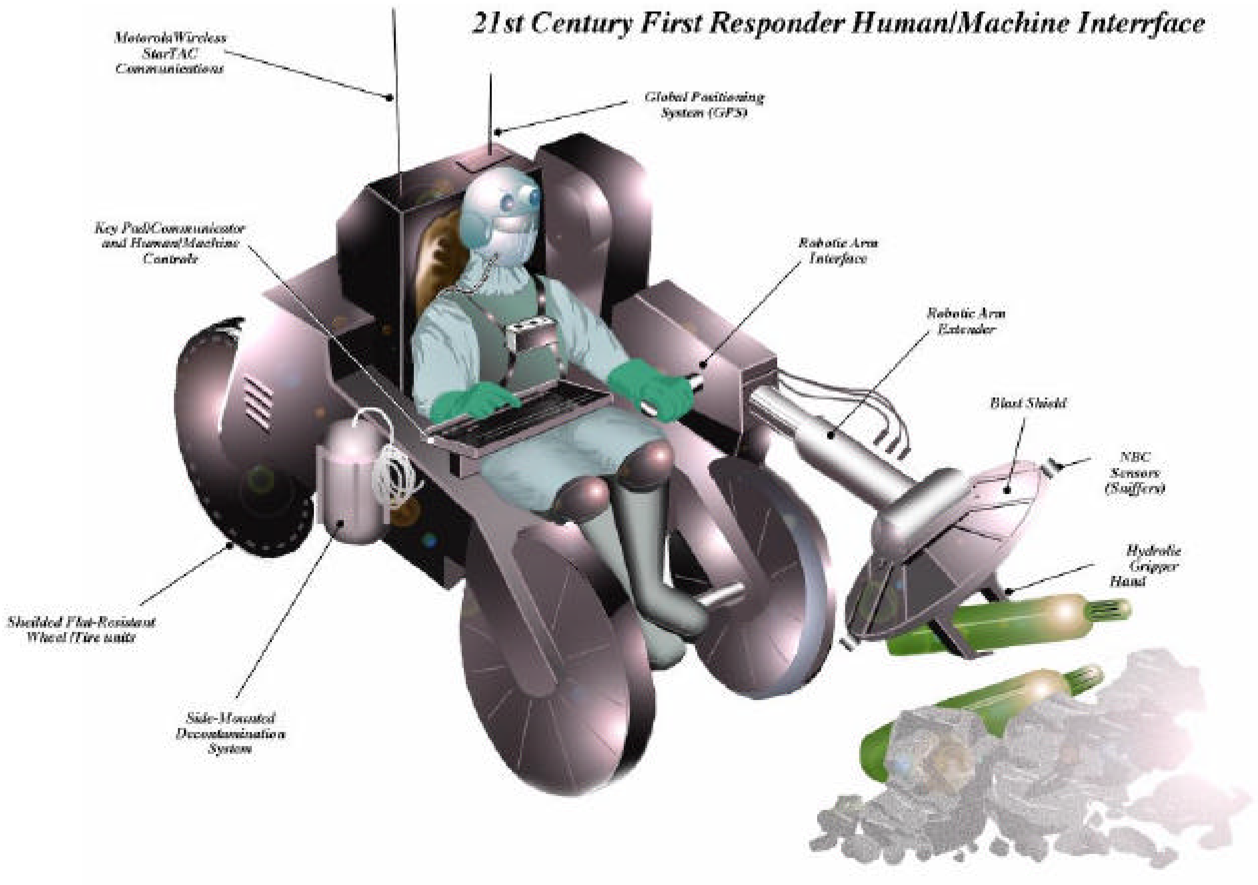

Figure 2. 21st Century First Responder Human/Machine Interface

Example of 21st Century First Responder Needs

Clothing	Support Systems	Alarms/Displays	Communications	Sensors/ Detectors
Total encapsulation chemical/biological resistant suit	Light-weight add-on armor (explosion resistant)	Suit environmental alarm (high CO_2, etc)	Audio-visual recorder and LED readout for data sending	Suit environmental monitoring system
lightweight	Variable intensity, light source	Temperature alarm	Microphone and speaker system for external audibility	IR detector system for various hazards
impermeable	Life support systems	Oxygen alarms	Satellite linked- digitally encrypted communications capability	IR night vision sensor
flexible	Heating/cooling system	Explosive atmosphere (external)	Global information system database hookup and capability	Close-in ground radar imagery sensor
Positive pressure capabilities	Buoyance control	Nuclear (internal)	Digital still-photography capability	Explosive atmosphere sensor (external)
Helmet with electronic visor	Suit static eliminator	Chemical contamination (internal)	Wrist PC capability with key pad	Bio hazard tag sensor
Add on robotic extenders	Vision magnification system	Biological contamination (internal)	Manual signaling device for failed communications	Temperature external sensors
Portable power source capability	Equipment weight support system	Positive pressure failure alarm	Manual external alarm system for failed commun- ication systems	Global positioning system
Decon capability	Exoskeleton mobility enhancement system	Tear in the material alarm	Helmet -internal LED readout display	False alarm validation sensor (backup-type)
Emergency medical capability (atropine, etc)	High noise protection system	Decontamination complete indicator		
Snap-on instrument capabilities (plug-n-play)	Manual on/off controls			

Some of the things that will be needed for the 21st Century First Responder include:

- total encapsulation suits that will have multiple protection and detection capabilities
- PPE that will be comfortable and light weight for the user to allow the maximum "wearing" time
- helmets with electronic displays on the visors that will enable the user to read and translate data
- mobility enhancement capabilities
- high noise protection inside the suit
- suit environmental alarms that will indicate high oxygen and/or temperature changes
- decontamination capabilities that will allow for quick reuse of the suit
- access ports in the protective response suit that will provide for injection and administration of antidote kits
- exoskeleton extenders, and robotic devices that will facilitate human strength and provide instrument carrying capacity
- communication and pager devices that will be attached to the hood and helmets
- audio/visual recorders and LED readout for data receiving and sending
- microphone and speaker system capability
- satellite-linked and digitally encrypted messaging systems
- GIS and GPS system capability
- still photography and wrist-key pad capability
- IR and other detector systems for NBC sensing and monitoring.

In conclusion, the needs of the Ultimate 21st Century First Responder must be anticipated, planned for, designed, integrated, and developed. Technology transfer and adaptation is a key part of the solution to the WMD threat. Many technologies are beginning to show promise and with "application planning", some stretching of the imagination, and some modifications, we will be ready before the event happens.

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Appendix

Manufacturer Listing

Appendix

Manufacturer Listing

21st Century Hard Armor Protection, Inc.
16710 Hedgecroft, Suite 106
Houston, Texas 77060
Telephone: (800) 654-8948 or (281) 405-9220
Fax: (281) 405-9221

Corona Catalysis Corporation
3200 George Washington Way
Richland, Washington 99352
Telephone: (509) 375-3365
Fax: (509) 375-5183

Environmental Elements Corporation
3700 Koppers Street
Baltimore, Maryland 21227
Telephone: (410) 368-7239

Georgia Institute of Technology
Atlanta, Georgia
Telephone: (770) 528-7744

Graseby Dynamics
Park Avenue
Brushey
Watford
Herts WD2 2BW
United Kingdom
Telephone: +44 1923 238 483

Helly Hansen Seisialprodukter A/S
P.O. Box 134
N-5042 Fjosanger
Norway
Telephone: +47 5529 2240
Fax: +47 5529 3468

ILC Dover, Inc.
One Moonwalker Road
Frederica, Delaware 19446-2080
Telephone: (800) 631-9567
Fax: (302) 335-0762

Kemira Safety Oy
Box 501
Fin – 65101 Vaasa
Finland
Telephone: +358 10 861 811
Fax: +358 10 863 6591

Maxus Strategic Systems, Inc.
610 River Street
Hoboken, New Jersey 07030
Telephone: (201) 963-3554

Microsensor Systems, Inc.
62 Corporate Court
Bowling Green, Kentucky 42103
Telephone: (502) 745-0099
Fax: (502) 745-0095

Motorola, Inc.
1303 Algonquin Road
Schaumburg, Illinois 60196
Telephone: (847) 576-5000

Pacific Northwest National Laboratory
P.O. Box 999
Richland, Washington 99352
*MEMS Aerosol Collections Laura Silva
Telephone: (509) 372-4590
*Hal-Snif Alex Fassbender
Telephone: (509) 375-2225

Physical Optics Corporation
20600 Gramercy Place,
Building 100
Torrance, California 90501
Telephone: (301) 320-3088

Pressure Profile Systems, Inc.
605 Sheldon Street
El Segundo, California 90245
Telephone: (301) 322-2464

Proctor Technologies
Pimbo Road
West Pimbo
Skelmersdale
Lancashire WN8 9RQ
United Kingdom
Telephone: +44 1695 50284
Fax: +44 1695 50819

VSE Corporation
41150 Sterling Technology Park, Suite 101
Sterling Heights, Michigan 48314
Telephone: (810) 739-5551
Fax: (810) 739-9648