Technical Evaluation Report

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Opening remarks were provided by the Co-Chairs, Capt Brent Conner (USA) and Dr. J.J. Sanchez (ESP). The welcome speech was given by General A. Cieza (ESP). The Session Chairs for this meeting included:

- Mr. Richard Delagrave, Deputy Director General, Defence R&D Canada – Valcartier (CAN)
- Dr. Fenner Milton, Director, Night Vision and Electronic Sensors Directorate (USA)
- Mr. Guillermo Gonzalez Munoz de Morales, Ingeniero de Sistemas, ISDEFE (ESP)
- Mr. Karlheinz Bers, Deputy Director, Research Institute for Optronics and Pattern Recognition (DEU)
- Dr. Yolanda Jones King, Chief, Space Based Advanced Sensing & Protection, Air Force Research Laboratory (USA)

Session 1 was classified up to NATO Secret and consisted of three keynote addresses.

The first was a presentation by Capt C. Vicario (ESP) on countering IEDs, the experience and requirements. The paper was subsequently withdrawn. Lt. Col Allen (USA) then discussed the military utility analysis of IED defeat technologies. Lt. Col Allen is based within the US Air Force IED Defeat Program Office at Hanscom AFB. The third address was given by Lt. Col Escalada (ESP) who outlined the management plan for NRBQ threats.

Session 2 consisted of three papers. This session was held up to NATO SECRET level.

The first paper was given by M. Sanchez Martin (ESP) entitled 'IONER NEDS - New Explosive Detection System'. The focus of this paper demonstrated the benefits of ion mobility spectroscopy when detecting explosive devices. The hardware shown recognizes molecular compounds specific to explosive material. Results were shown from the IONER system that was performed under the NATO NIAG SG-84 study. In both checkpoints – the explosive material was detected. This system has immediate effect in airport security and other common checkpoint areas.

The second paper of the session was given by C. A Barrios (ESP), entitled 'Nanomechanical Photonic Microsensor for Ultrasensitive Explosive Detection. The device discussed is composed of SiN slot waveguide disk resonator grown next to an optical waveguide. The structure is designed such that there is a sharp decrease in transmission at a resonant wavelength for which the light is coupled into the slot resonator. The top of the resonator is coated with a polymer that selectively absorbs vapors that are the object of detection. These vapors will accumulate on top of the resonator, induce bending, and shift the resonant wavelength, ultimately leading to a highly sensitive detector for specific vapors. The presentation was primarily theoretical in scope.

The third and final paper of this session was given by A. Anderson (USA) entitled 'Counter IED Detection Technologies: Thinking Outside the Box". This paper discussed the ability to detect buried objects in a dual-color LWIR imagery by exploiting disturbances in the soil. While the technology for this presentation

is still in the basic research phase, much of the idea generating research was presented as a basis of exploration.

Session 3 consisted of six papers being presented. This session was held up to the NATO SECRET level.

The first paper was given by T.K. ten Kate (NLD) entitled "IED Detection, Time for a Change". The technology presented is a keypoint detector used to perform image registration. This detector uses an image registration metric that is keypoint-based as opposed to the more typical image correlation-based methods. It appears that the image alignment and change detection is actually being completely performed in keypoint space, making it rotation, scale, and illumination invariant.

The second paper in the session was presented by G. Fusina entitled "Synthetic Environment Experimentation for the Detection of IEDs Using Mini Uninhabited Aerial Systems High-Resolution Imaging". This crux of this paper showed the probability of correctly classifying 90% of targets using a neural network algorithm.

The third paper presented by F. Milton (USA) on behalf of R. Weaver entitled "Application of Ground Penetrating Radar to IED Detection. The presentation focused on the capabilities of the Wichmann/Niitek GPR for detection of buried objects in a vehicle-mounted, down-looking geometry. The Wichmann technique specifically deals with the multi-path effects that plague conventional GPR designs, and achieves an FAR on the order of one per km of road with a maximum detection depth of 1 m. Better contrast is achieved in wet soil, but the attenuation is worse. For deeper objects, lower frequency radars are needed. A fairly sophisticated system was described that can perform route clearance at about 15 km/hr for shallow plastic and metal mines using size and shape filtering.

The fifth paper was presented by A. Schoolderman (NLD) entitled 'Programme of Work for SCI-193: Detection and Neutralization of Route Threat'. This paper presented the work being done in the SCI-193 Task Group. The work of this Task Group will focus on the assessment of capabilities of equipment (both under development and operationally available) for the detection and neutralization of threats as encountered on and along the route by NATO forces in mission areas in realistic scenarios from the systems aspect. The work for this group is expected to start by the end of CY2007.

The sixth paper was presented by J. Goebel (DEU) entitled 'Laser Ion Mobility Spectrometry (IMS) as a Highly Sensitive and Selective Trace Detection Method for IED Detection'. IMS detectors are widely used in airports for baggage control. Typically, these detectors have high false alarm rates but the technique presented in this paper outlines a two photon ionization process which gives more freedom in discrimination and less cross-contamination (processes which limit false alarm rates).

Session 4 consisted of six papers. This session was held at NATO/PfP unclassified level.

The first paper of the session was given by A.V. Kuznetsov (RUS) entitled 'Overview of Detection of Improvised Explosives (IE) and Explosive Devices (IED)'. The presentation was a great overview of technologies that exist, which can detect IEDs. Most of the topics were not covered in-depth but rather offered a good 'desk reference' evaluation and application of various technologies. Among those covered were x-ray systems, vapor detectors, biological sensors and radars.

The second paper of the session was given by J.M Theriault (CAN), entitled 'Passive Standoff Detection of Vapour, Liquid and Solid Threats.' This presentation focused on both the emanation of vapors from production facilities as well as battlefield deployment of chemical threats such as TATP, VX, mustard gas and various explosive powders. The use of a dual-input FTIR that compares the vapor cloud of interest to a reference is investigated. The FTIR effectively performs an optical subtraction providing the differential

spectrum at 8 wave number resolution. A ruggedized version of the FTIR, called CATSI-RDM, was built by Telops.

The third paper in the session was given b y I.Y. Gorshokov (RUS) entitled 'SENNA – Portable Sensor for Explosives Detection Based on Nanosecond Neutron Analysis'. A suitcase-sized commercially-available product was described that performs 3-D imaging of the chemical composition of an object by generating alpha and neutron particles and detecting emitted gamma rays. The device can penetrate concrete and metal, and extracts the signature of the object by virtue of the distribution of chemical elements. Upon generation of alpha and neutron particle pairs, the alpha particles are captured on a 2-D array while the neutrons travel in the opposite direction, impinge on the object, and produce gamma radiation that is captured by a gamma ray spectrometer. The time delay provides the range information, while the spectrometer captures the chemical signature, apparently via proportion of C, O, and N. The device can also serve as a nuclear material detector.

The fourth paper in the session was given by J. Laserna (ESP) entitled 'Standoff LIBS Sensor Technology'. Dr. Laserna discussed the development of an instrument that identifies explosives on a solid surface; the stand-off Laser-induced Breakdown Spectroscopy technique (LIBS). The benefits of this autonomous instrument were discussed as well as ideas to make the instrument less susceptible to false alarms. Data was presented that showed positive identification up to 50 meters.

The fifth paper was given by J. Dubois (CAN) entitled 'Zone Active Protection Laser Ionization for Guidance of High Energy Transients'. This paper describes exploratory work done under two technology investigation projects aimed at remotely detecting explosives using terahertz (THz) waves and neutralizing/triggering them using laser assisted transmission of energy. The combined system uses short-pulse laser technology to achieve standoff THz time domain spectroscopy (TDS) for the detection through clothes or common containers and to guide various forms of energy and defeat the weapon. The project is known as Zone Active Protection Laser Ionization for Guidance of High-energy Transients (ZAPLIGHT).

The final paper in the session was given by A. Mueller (GER) entitled 'Hydrogenated Diamond – A Low Cost Semiconductor Technology for IED Detection'. HD sensors can detect low concentrations of Nitrogen gas while the sensor is operating at room temperature. Gaseous profiles of an IED typically have a small concentration of nitrogen. Ultimately, Mueller showed that on-site IED search can be executed in confined spaces with an HD sensor. One drawback is that this sensor can not be used in open air, limiting its use to more civil applications.

Session 5 consisted of three papers. This session was held at NATO/PfP unclassified level.

The first paper of the session was given by W. de Jong (NLD) entitled 'Polarized Light Camera: a Tool in the Counter IED Toolbox'. Dr. de Jong presented information and data regarding landmine and IED detection with a polarized light camera. The camera can discriminate man-made objects in real-time fashion. One question is about the ruggedness of the camera – in hot sandy theater conditions – how long will the camera last before the need to replace. Another question is the cost of such a device – does the cost necessitate replacing the camera or refurbishment?

The second paper in the session was given by T. Nielsen (DEN) entitled 'Real-Time Distribution of Fused Sensor Data in a Bandwidth Starved Network'. Nielsen concentrated data fusion for real-time actionable information. The sensor suite proposed receives sensor information, interprets actionable information and sends out a jamming signal – within seconds. Questions of size and weight for this sensor suite arise but the idea of a wireless real-time situational awareness system has definite application in civil and theater environments.

The final paper of the session was given by J. Cechak (CZE) entitled 'Detection and Identification of Persons in the Conditions of Operations Performed in an Urbanized Environment'. This presentation

showcased different kinds of technologies that can be used to detect and identify persons in theater; of those discussed were electro-seismic, electro-magnetic sensors and radio frequency jammers.

At the completion of the technical presentation sessions, a summary was provided by Capt Brett Conner (USA) and J.J. Sanchez (ESP). An inclusive panel discussion was chaired by Dr. Yolanda King.

It was concluded that there is a need for cooperation and sharing information between the panel member nations. There is a wide swath of historical experience from each NATO country and their partners based on the different types of IEDs employed by various threat organizations and groups. Technology can only be one part of a holistic approach to defeating IEDs; tactics must extend to information gathering and doctrine.

It was noted that there were too few papers on prediction of IED activities. This is a critical area that could prevent IEDs from being placed. The user community such as Explosive Ordinance Disposal Technicians, soldiers and airport security guards should be incorporated into the technology development process. Many technological tools are not used by users because of inaccurate detection, false alarms and the difficulty of use. Technologists need to be aware of what is required to take their tools out of the laboratory and incorporate the technology into an operational concept.

IT was noted that other NATO panels should be made aware of SET's IED detection technologies and that the SET panel should look at technologies presented and determine which are mature enough for incorporation into the NATO Counter-Terrorism Technology Demonstration held in 2008.