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ITT Industries
Attn: Mr. Bryan E. Campbell
5009 Centennial Boulevard (80919)
P.O. Box 39550
Colorado Springs, CO 80949-9550

Dear Mr. Campbell:

This is in response to your enclosed January 26, 2006 request for public release approval of the enclosed abstract titled:

- "Autonomous Eye-Safe LIDAR for Continuous Monitoring of Atmospheric Aerosols"

The abstract is **APPROVED** for public release. However, this approval does not include any photograph, picture, exhibit, caption, or other supplemental material not specifically approved by this office. Our concurrence for release does not imply DoD endorsement or factual accuracy of the material.

This office has moved out of the Pentagon. However, our mailing address remains Office of Security Review, 1155 Defense Pentagon, Washington, DC 20301-1155. Please send future requests to this address.

Please direct any questions regarding this case to Mr. Brian Rohrbach at 703-696-4709, email: Brian.Rohrbach.ctr@whs.mil.

Sincerely,

M. M. Langerman
Chief

Enclosures:
As stated

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January 26, 2006

Pentagon Force Protection Agency
CBRN Defense

Attn: Mr. Paul Benda, Director

Subject: Request for Public Release Approval

Dear Paul,

ITT requests authorization for unlimited public release under ITAR section 120.11(7) for the enclosed abstract. This material is intended for presentation at the International Symposium on Spectral Sensing Research (ISSSR) 2006. A Disclosure Authorization Form for the Symposium is also enclosed.

If you have any questions, please contact me at 719/599-1711; fax 1799; or email bryan.campbell@itt.com.

Sincerely,

Bryan E. Campbell
Sr. Contracts Manager

Encl: As stated

Cc: Scott Higdon
Patrick Ponsardin
Janna Mitchke
Shane Mayor
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Autonomous Eye-Safe LIDAR for Continuous Monitoring of Atmospheric Aerosols

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ABSTRACT

Effective monitoring of the atmosphere for potentially hazardous aerosol plumes in urban areas requires a lidar that produces high signal-to-noise backscatter returns, fine spatial resolution, rapid updates, eye-safety at all ranges, and long-range operation. A scanning elastic backscatter lidar with high pulse energy that meets these requirements was recently developed at the National Center for Atmospheric Research (NCAR). This system, called Raman-shifted Eye-safe Aerosol Lidar (REAL) has been described in several papers (Ref 1-3). ITT Industries, under contract with NCAR, has developed a second generation REAL (REAL v2) that is designed for continuous and unattended operation. Figure 1 is a picture of the unit after completion. In addition to continuous and unattended operation, design goals of REAL v2 included operation at 20 Hz to allow faster scanning rates and full electronic gain control. This development is an important first step toward networks of surveillance lidars for urban areas.

The system is housed in an 8 x 8 x 8 ft weatherproof shelter and uses an Ethernet link to broadcast atmospheric data and to allow remote controlled operation. The transmitter consists of a Continuum Powerlite Nd:YAG laser (800 mJ / pulse at 20 Hz) along with a 1.54-µm DFB laser (60 mW, CW): both beams are introduced into a high-pressure cell containing methane and argon. The 1064-nm pump laser is Raman-shifted to 1543 nm in methane and the DFB laser seeds the process providing higher pulse energy and better beam quality. The transmitter is capable of producing up to 250 mJ but is typically operated at about 200 mJ with an M^2 of about 9 and 4-5 ns pulse duration. The 1064- and 1543-nm beams are separated after the Raman cell using a series of dichroic mirrors, reducing the amount of transmitted 1064-nm light to well within the eye-safety limits for all ranges. The Raman-shifted laser beam is expanded to 5 cm prior to transmission reducing the divergence to within the acceptance cone of the coaxial receive path. The receiver includes a 40-cm, F/3 Newtonian telescope. The light is collimated after the field stop to provide a suitable space to introduce a narrow-bandpass filter centered at 1543 nm. A custom set of optics is used to focus the collected light onto a 200-µm InGaAs detector.

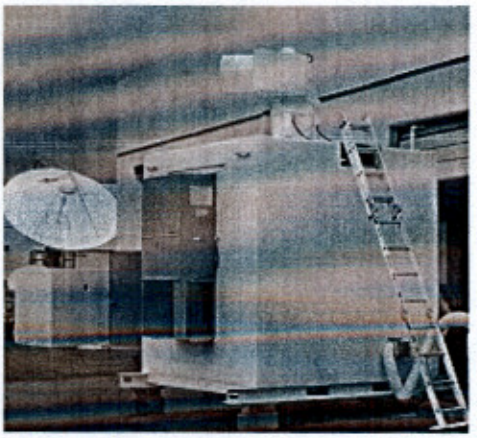

Figure 0: REAL v2 system integrated inside a shelter

The control system hardware uses the PXI platform to provide a flexible and robust configuration. The software was developed in LabVIEW and is structured around an event-driven state machine. The operator can remotely turn on or off the system and specify the scan pattern as well as enable/disable some specialized functions that were developed to ensure autonomous operation. These include hard-target pre-scan (low gain scan of selected scan pattern to ensure that no close obstacle is present in the field of view), automatic gain adjustment (computer adjusted detector gain to ensure optimum use of data acquisition dynamic range), e-mail notification of critical failures, weather park (alarm from precipitation sensor parks the scanner to protect it from inclement weather), graceful shutdown (loss of power triggers

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scanner parking and control system reverts to a listen mode, waiting for a remote operator to order system restart).

The REAL v2 system was tested in conjunction with REAL to directly compare performance. Both systems provided identical radiometric characteristics. The REAL v2 system is currently transitioning to a 24/7 operational mode.

REFERENCES

[1] Mayor, S. D. and S. M. Spuler, "Raman-shifted Eye-safe Aerosol Lidar", *Appl. Optics*, 43, 3915-3924 (2004).

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[3] Mayor, S. D., S. M. Spuler, and B. M. Morley, "Scanning eye-safe depolarization lidar at 1.54 microns and potential usefulness in bioaerosol plume detection". SPIE Lidar Remote Sensing for Environmental Monitoring IV, Paper 5887-23, San Diego, CA (2005).

MANUSCRIPT DISCLOSURE AUTHORIZATION FORM – FORM ISSSR06

PART I: To be completed by author of manuscript.

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OR WORK BASED ON IR&D*? ☐ YES X ☐ NO

PART II: To be completed by a certifying official.* **

I hereby authorize disclosure of the information referenced to above for presentation at the 2006 International Symposium on Spectral Science Research (2006-ISSSR) and/or for publication in the Proceedings to the 2006-ISSSR.

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