This Appendix provides a toolbox of information for learning more about open path technologies. The overview URL has a basic description of all the open path technologies and a searchable database of over 600 abstracts on various open path subjects. The case studies section provides a wide range of examples where open path technologies have been deployed and each citation is hyperlinked to its complete article or abstract for further information. The Environmental Technology Verification Program section contains links to EPA performance reports on various open path vendor equipment. The guidance section has both EPA and European documents on the use of open path equipment. Finally the vendor section lists the vendors, with contact information, who made presentations or had displays at the workshop.

OVERVIEW

A layman's description of how DIAL works, some examples of its deployment, and references are found at http://www.cluin.org/programs/21m2/openpath/lidar/

CASE STUDIES

An OP-FTIR fence-line monitoring system has been in operation at the TOSCO refinery in Rodeo, California, since 1997. The system consists of two monostatic OP-FTIR configurations deployed along the north and south fence lines of the plant. The one-way optical path of the north fence line is 930 m long and the south path of the south fence line is 955 m. The systems are set to monitor on a frequency of every five minutes and to sound an alarm if concentrations of some 26 target compounds exceed pre-set concentration levels (ppm/m level). Each month a report is developed that evaluates system performance and summarizes the chemicals detected, their concentrations, and the system detection limit for them. The system has a spectral library of over 300 chemicals. Because the collected monitoring spectra are preserved electronically, it is possible to re-examine a given time period to look for the presence of other than target chemicals. See the EPA webpage at http://www.epa.gov/region09/features/tosco/monitoring.html, or Contra Costa County Health Services at http://www.cchealth.org/groups/hazmat/fenceline/

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ENVIRONMENTAL TECHNOLOGY VERIFICATION PROGRAM

The EPA ETV program has tested three OP-FTIR instruments, and the verification reports are available on the ETV website at: http://www.epa.gov/etv

Ail Sytems Inc.--RAM 2000 Fourier Transform Infrared Open-Path Monitor
Verification Statement (PDF, 42.2 K)
http://www.epa.gov/etv/pdfs/vrvs/01_vs_ail.pdf
Verification Report (PDF, 541K) http://www.epa.gov/etv/pdfs/vrvs/01_vr_ail.pdf

Bruker Daltonics, Inc.-- OPAG 22 Open-Path Gas Analyzer
Verification Report. http://www.epa.gov/etv/pdfs/vrvs/01_vr_bruker_opag.pdf

Spectrex, Inc.--SafEye 227 Infrared Open-Path Monitor
Verification Statement: http://www.epa.gov/etv/pdfs/vrvs/01_vs_safeyetwo.pdf
Verification Report: http://www.epa.gov/etv/pdfs/vrvs/01_vr_safeyetwo.pdf

The EPA ETV program has tested four TDL instruments.

Aerodyne Research, Inc.--QC-TILDAS. Open path tunable IR laser with quantum cascade test for Ammonia.
Verification Statement: http://www.epa.gov/etv/pubs/01_vs_aerodyne.pdf
Verification Report: http://www.epa.gov/etv/pubs/01_vr_aerodyne.pdf

Boreal Laser-- GasFinder 2.0 TDL Open-Path Monitor
Verification Statement: http://www.epa.gov/etv/pubs/01_vs_boreal.pdf

Verification Report: http://www.epa.gov/etv/pubs/01_vr_boreal.pdf

OPSIS, AB--, LD500 Continuous Emission Monitor for Ammonia
Verification Statement: http://www.epa.gov/etv/pdfs/vrvs/01_vs_opsis_ld500.pdf
Verification Report: http://www.epa.gov/etv/pdfs/vrvs/01_vr_opsis_ld500.pdf

Siemens Laser Analytics, AB, LDS 3000 Continuous Emission Monitor for Ammonia
Verification Statement: http://www.epa.gov/etv/pdfs/vrvs/01_vs_siemens.pdf
Verification Report: http://www.epa.gov/etv/pdfs/vrvs/01_vr_siemens.pdf

UNISEARCH Associates, Inc.
LasIR Tunable Diode Laser Open-Path Monitor
Verification Statement: http://www.epa.gov/etv/pubs/01_vs_unisearch.pdf
Verification Report: http://www.epa.gov/etv/pubs/01_vr_unisearch.pdf

The EPA ETV program has tested three UV instruments, and the verification reports are available on the ETV website at: http://www.epa.gov/etv

Opsis, Inc.--AR-500 Ultraviolet Open-Path Monitor
Verification Statement: http://www.epa.gov/etv/pubs/01_vs_opsis.pdf
Verification Report: http://www.epa.gov/etv/pubs/01_vr_opsis.pdf

Spectrex, Inc.--SafEye 420 Ultraviolet Open-Path Monitor
Verification Statement: http://www.epa.gov/etv/pubs/01_vs_safeyefour.pdf
Verification Report: http://www.epa.gov/etv/pubs/01_vr_safeyefour.pdf

GUIDANCE AND REPORTS

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Sira Ltd. 2004b. Recommendations for Performance Standards for Open-Path Instrumentation. Remote Optical Sensing Evaluation (ROSE) Consortium, 174 pp.

VENDORS MAKING PRESENTATIONS AT WORKSHOP

ARCADIS--RPM and VRPM technology
ram.hashmonay@arcadis-us.com or http://www.arcadis-us.com/

Boreal Laser, Inc.—Tunable Diode Laser manufacturer
hadam@boreal-laser.com or http:// www.boreal-laser.com

Agenda Enviro AB—Environmental Consulting
lennart.frisch@telia.com or http://www.agendaenviro.se/eng/

Fluxsense, AB is a spin off company from research done at Chalmers University of Technology in Göteborg, Sweden. They have a number of reports and papers on the Solar Occultation Flux Method.
http://www.fluxsense.se/sof_reference_reports.htm

IMACC Instruments—FTIR open path instrument manufacturer
rspellicy@imacc-instruments.com or http://www.ftir.bz/

ITT Corporation-Space Systems Division—Aircraft borne DIAL for gas pipeline leaks
rspellicy@imacc-instruments.com or http://www.ssd.itt.com/angel/overview.shtml

Spectrasyne, Ltd.—DIAL Lidar
For more information on Spectrasyne see:
jan@spectrasyne.ltd.uk or http://www.spectrasyne.ltd.uk/html/about_dial.html

The TGB Partnership—Environmental Consulting--control of air emissions, the development of standards and regulations, structure design
randy.kissell@tgbpartnership.com or http://www.tgbpartnership.com/

VENDORS HAVING DISPLAYS AT THE WORKSHOP BUT NOT MAKING PRESENTATIONS

LaSen, Inc.—Airborne open path pipeline leak detection (ALPIS)
rrjennett@zianet.com or www.laseninc.com

MIDAC Corporation—FTIR instrument manufacturer
mpanek@midac.com or http://www.midac.com/

MSI Air—Environmental Consulting—use of open path monitoring at remedial sites
trminnich@msiair.net or http://www.msiair.net/

Opgal, Inc.—IR camera manufacturer
wahnon@opgal.com or http://www.opgal.com/

Opsis, Inc.—DOAS system manufacturer
paulsf86@prodigy.net or http://www.opsis.se/

Terra Air Services—Environmental consulting—open path fenceline monitoring
mball@terraairservices.com