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| *Title:* | CHEMICAL DECONTAMINATION TECHNICAL RESOURCES AT LOS ALAMOS NATIONAL LABORATORY (2008) |
| *Author(s):* | MURRAY E. MOORE |
| *Intended for:* | DAVID R. JANECKY, LANL ENV-EAQ |

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Form 836 (7/06)

# Chemical Decontamination Technical Resources at Los Alamos National Laboratory (2008)

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September 30, 2008

Submitted to:
David R. Janecky
ENV-EAQ: Ecology & Air Quality

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## EXECUTIVE SUMMARY

This document supplies information resources for a person seeking to create planning or pre-planning documents for chemical decontamination operations.

A building decontamination plan can be separated into four different sections: Pre-planning, Characterization, Decontamination (Initial response and also complete cleanup), and Clearance.

Of the identified Los Alamos resources, they can be matched with these four sections:

**Pre-planning:**
* Dave Seidel: EO-EPP, Emergency Planning and Preparedness
* David DeCroix and Bruce Letellier, D-3, (Computational fluids modeling of structures)
* Murray E. Moore, RP-2, (Aerosol sampling and ventilation engineering)

**Characterization (this can include development projects):**
* Beth Perry, IAT-3, Nuclear Counterterrorism Response (SNIPER database)
* Fernando Garzon, MPA-11, Sensors and Electrochemical Devices (development)
* George Havrilla, C-CDE, Chemical Diagnostics and Engineering
* Kirsten McCabe, B-7, Biosecurity and Public Health

**Decontamination**
* Adam Stively, EO-ER , Emergency Response
* Dina Matz, IHS-IP, Industrial hygiene
* Don Hickmott, EES-6, Chemical cleanup

**Clearance (validation)**
* Larry Ticknor, CCS-6, Statistical Sciences

[redacted]

**(1) Name:** David J. Seidel

**(2) LANL affiliation:**
ADSS, Emergency Operations Division
Emergency Planning and Preparedness Group
http://int.lanl.gov/orgs/eo/epp/index.shtml

**(3) Technical background, history and abilities:**

The Emergency Planning and Preparedness Group (EPP) implements or recommends implementation of protective actions, as needed, to minimize or to mitigate the consequences of an emergency incident and to protect the health and safety of workers, the public and the environment and ensure national security. Identifies and analyzes facility and institutional hazards and threats. It assists in the development of up-to-date Building Emergency Plans and Hazards Surveys to describe the potential conditions that may be experienced in an incident. EPP establishes an Emergency Planning Hazard Assessment for on-site activities that have hazardous materials in such quantities that they may "reach out and touch a neighbor" during an emergency incident. EPP develops and prepares emergency plans and procedures, and identifies personnel, capabilities, and other resources needed for a timely and effective response. Additionally, EPP acquires and maintains emergency response resources and conducts drills and exercises at the facility and institutional level. Estimates of onsite and offsite consequences of actual or potential releases of hazardous material prior to and during emergency incidents are made and consequence assessments are integrated with event classification and protective action decision-making. Finally, EPP documents the level of emergency readiness for the Laboratory.

**Technical capabilities include:**
CIH - Industrial Hygiene, CSP - Safety, CHMM - Hazardous Materials Management, CHO(NRCC) - Chemical Hygiene, CQM - Quality Management,
CHS IV - Homeland Security, CBSP - Biological Safety, SM(NRM) - Microbiology, ChE - Chemical Engineering, HP - Health Physics PMP - Project Management.

**(4) Equipment and facilities resources:**
Emergency Operations Center (TA-69-33)
HAZMAT/Hazardous Devices Team Operations (TA-49)

**(1) Name:** Fernando Garzon

**(2) LANL affiliation:** Materials Physics and Applications - MPA-11: Sensors & Electrochemical Devices

**(3) Technical background, history and abilities:**

The Materials Chemistry Team consists of three Ph.D researchers, a technician and varying numbers of Postdoctoral Fellows and Graduate Research Assistants. Research interests include materials for solid state energy conversion applications and solid state chemical sensors for a variety of applications. They are also engaged in research in the fields of oxide thin film science, ion transport in solids, gas separation membranes, fuel cell and hydrogen storage materials research and oxide materials chemistry.

The MC Team specializes in complex impedance analysis of ion transport in solids, thin deposition and characterization of ion conducting materials, modern X-ray analysis methods including whole pattern X-ray diffraction analysis, the chemical imaging of surfaces and the measurement of thermodynamic properties of materials for energy conversion.

They have experience with polymer electrolyte membranes to place them in a unique position to apply this expertise to the development of hand-held chemical warfare agent detectors. These sensors would be valuable in remote detection systems for buildings, tunnels, laboratories, and public spaces, as well as in portable detection systems like those needed by first-responders to emergency situations. Their chemical detection system uses the MEA to foster an electron transfer reaction triggered by the presence of certain chemical agents.

**(4) Equipment and facilities resources:**

Their research facilities include a high temperature chemistry laboratory, scanning electron microscopy coupled to energy dispersive X-ray analysis, gas chromatography, mass spectroscopy, electron beam evaporators, R.F. magnetron sputtering systems, ion mill, high resolution X-ray diffraction equipment, X-ray fluorescence spectroscopy, differential scanning calorimetry, thermal gravimetric analysis, solution calorimetry, AC impedance spectroscopy, DC voltammetry, and a BET surface area measurement apparatus.

http://www.lanl.gov/orgs/mpa/mpa11/matchem.htm

**(1) Name:** Bruce Letellier and David DeCroix

**(2) LANL affiliation:** International Nuclear Systems Engineering (D-5)

**(3) Technical background, history and abilities**

Ventilation and aerosol transport modeling can be a valuable asset for chemical contamination recovery. Numerous applications include: (a) understanding the magnitude of the physical clean-up effort in terms of deposited concentrations throughout the facility, (b) informing and directing surface sampling efforts to protect worker health, (c) prioritizing recovery zones to maximize the rate of facility usability, and (d) analyzing and optimizing HVAC-assisted decontamination techniques that involve distributed sprays and/or duct washing. LANL staff members Bruce Letellier and David DeCroix have for the past 10 years constructed large-facility HVAC ventilation networks and conducted CFD aerosol transport analyses for operational spaces and aerosol collector performance. Specific applications include detector placement analyses of sports arenas and convention centers and aerosol transport assessments of metallurgy foundries and radiological laboratories. Concurrent expertise with both commercial and government network models and commercial CFD suites has provided unique opportunities to couple HVAC system performance with detailed resolution of air flow patterns in critical zones such as mixing chambers and ventilation ducts. Advanced methods development includes potential flow solutions of network ventilation models for improved estimates of aerosol residence time and CFD user functions to better predict the physical interaction of aerosols with surfaces. Both of these strategies would improve existing capabilities for chemical contamination recovery.

**(4) Equipment and facilities resources:**
Government and commercial ventilation modeling codes including CONTAM, MELCOR, AFT Fathom.
Developmental potential flow solutions (PFIAT) of building ventilation networks for improved residence time and concentration estimation.
High-fidelity CFD (FLUENT) simulation of specific spaces, mixing chambers, and high-velocity HVAC components.
UNIX cluster computing environment.

DeCroix, DS, Visualizing chemical dispersion in populated regions, Los Alamos 2003 Tech Report LA-UR-03-3839
http://lib-www.lanl.gov/cgi-bin/getfile?01045543.pdf
1.9MB {Access restricted to selected government agencies}

**1) Name:** George J. Havrilla

**(2) LANL affiliation:** C-CDE

**(3) Technical background, history and abilities**

Scientist 4 working at Los Alamos National Laboratory in the Chemistry Division, Chemical Diagnostics and Engineering group, since 1993, working primarily on elemental analyses using X-ray fluorescence for both bulk and mesoscale samples. Prior to LANL he was at the BP Research R&D facility in Cleveland, Ohio and spent a couple of years at the National Bureau of Standards as an NAS/NRC postdoc. He has a PhD from West Virginia University, MS from SUNY at Stony Brook, and BS from the University of Scranton. His current research interests include applications of XRF to materials characterization and problem solving. This includes optics for spatially forming X-rays, trace element analysis by XRF, and materials characterization using elemental and molecular spectroscopic imaging along with chemometric processing of the data. His research goal is to develop a more comprehensive material characterization approach by the integration of molecular (micro-Raman and micro-IR) and elemental images for chemical phase identification. Also, involved with developing molecular recognition systems for small molecule targets.

**(4) Equipment and facilities resources:**

2 – commercial micro X-ray fluorescence instruments, for nondestructive elemental detection/imaging at the 10-50 micrometer level, for elements from Na through Pu

1 – research grade prototype confocal micro X-ray fluorescence instrument provides nondestructive 3D elemental imaging for elements from Ca through Pu

1- commercial imaging micro FTIR instrument, for nondestructive molecular imaging at the 20 micrometer level

1- commercial and 1- prototype controlled deposition system to deposit known masses of elements or molecules on surfaces for calibration of instruments or facilitating sampling of precious samples, volumes from 1 pL to 100 nL

Miller, TC, Baker, RT, Havrilla, GJ, Mann, G, Warner, BP, Wells, CA Combinatorial development of highly specific receptors for CBW agents
Los Alamos Tech Report LA-UR-02-0700
http://lib-www.lanl.gov/cgi-bin/getfile?00854793.pdf
2.5MB {Access restricted to selected government agencies}

(1) Name: Beth Perry

**(2) LANL affiliation:** IAT-3, LANL
bperry@lanl.gov
505-665-6237

**(3) Technical background, history and abilities**

**(4) Equipment and facilities resources:**

SNIPER Chemical Weapons Database

The SNIPER Chemical Weapons Database is part of a suite of information tools that were developed for the DOD to provide up-to-date information on potential threat agents. The Chemical Weapons database includes physical property, safety, lethality, first aid, decontamination, and persistence data on Chemical Weapons, Narcotics, Toxic Industrial Chemicals and Materials (TICs and TIMs), and over 300 Precursors. In addition, there are a variety of search capabilities which enable the user to search the database by key word, chemical formula, or chemical structure and to search for chemical weapons or narcotics based on the precursors found on-site.

**(1) Name:** Donald Hicknott

**(2) LANL affiliation:** EES-6

**(3) Technical background, history and abilities**

B.S. geology, Ph.D. in geochemistry. Currently acting group leader of EES-6, the geology, hydrology and geochemistry group at LANL. Seven years line management experience, Over 10 years experience in environmental cleanup projects at LANL's TA-16. These projects have focused on HE, metals, and organics in soils and waters. Other recent research projects have focused on gas-hydrate clathrates, molecular organic framework (MOF) compounds. Expereience with a wide-range of analytical techniques including SIMS, accelertaor based analytical methods, and standard geoanalytical methods.

**(4) Equipment and facilities resources:**

EES-6 has a wide range of analytical equipment including: radioanalytical equipment, stable isotope ration mass spectrometers, nanoparticulate characterization equipment, SEM, XRD, and a well-equipped wet chemistry laboratory

Reference:
RRES Remediation Program, Quarterly Technical Report, July-September 2002, Los Alamos Tech Report LA-UR-02-6976
http://lib-www.lanl.gov/cgi-bin/getfile?01054712.pdf
49.3MB {Access restricted to selected government agencies}

**(1) Name:** Kirsten McCabe

**(2) LANL affiliation:** B-7

**(3) Technical background, history and abilities**

Biochemist, Molecular Biologist

PI of a currently funded Molecular Recognition project

PI of Honey Bee Olfaction studies

**(4) Equipment and facilities resources:** Q/SCI cleared,
Select Agent worker, Classified office space, BSL1 and 2 fitted labs, common QSTAR MS, Victor III, access to MXRF and Procise, LC, common Flow Cytometry Resource

**Trained honeybees to detect explosives**
www.lanl.gov/news/newsletter/112006.pdf

**(1) Name:** Dina Matz

**(2) LANL affiliation:** Group Leader, Industrial Hygiene and Safety Institutional Programs Group (IHS-IP)

**(3) Technical background, history and abilities**

The Industrial Hygiene and Safety Institutional Programs Group (IHS-IP) functions as the corporate Industrial Hygiene and Safety organization. IHS-IP is responsible for institutional industrial hygiene and safety policy/program development; industrial hygiene and safety institutional services; regulatory reporting and coordination; and industrial hygiene and safety research.

**(4) Equipment and facilities resources:**

LANL IHS-IP Group webpage
**Institutional Programs**

Laboratory Industrial Hygiene & Safety Manual (LIHSM)

LIHSM Tool Box

**(1) Name:** Murray E. Moore

**(2) LANL affiliation:** Radiation Protection, RP-2. Coordinator of the Aerosol Engineering Facility.

**(3) Technical background, history and abilities**

Murray E. Moore is the coordinator of the Los Alamos Aerosol Engineering Facility, which specializes in the design and testing of aerosol particulate sampling systems. He has a bachelor's and master's degree in nuclear engineering, and a Ph.D. in mechanical engineering, all from Texas A&M University. The AEF Aerosol Engineering Facility has been the co-developer of the Canberra™ Industries Environmental Continuous Air Monitor. The facility has been serving as an experimental test-bed resource for CAM (continuous air monitor) evaluation at Los Alamos, including studies with the Thermo-Fisher™ Alpha-6 CAM and the Bladewerx™ SabreECAM.

The Aerosol Engineering Facility has served as an engineering consultant with David Fuehne for exhaust stack sampling issues pertinent to the ANSI N13.1-1999 implementation in the new LANL RLUOB facility.

For two years, the Aerosol Engineering Facility has performed experimental tracer gas studies to evaluate ventilation system performance at the Los Alamos LANSCE Lujan Center complex.

**(4) Equipment and facilities resources:**

* Low velocity wind tunnel (0.5, 2.2 and 6.6 m/sec test velocities compliant to 40 CFR 53.42 regulations for air sampler testing).
* Analytical aerosol capabilities: Generation, collection and quantification of fluorescent tagged liquid droplet aerosol particles.
* Tracer gas studies: analytical sulfur hexafluoride Lagus Autotrac™ gas chromatograph analyzer. Automated nine port system allows for time-based automated sampling of spatially distributed tracer gas concentrations.
* Exposure chamber sub-facility. A 384 $ft^3$ isolation chamber in the 2,000 sq. foot AEF building has been used to provide a separate test environment for air sampler studies.
* Malvern droplet sizer is capable of real time measurement of droplet diameters from spray distribution systems.

Moore, ME, Coughlin, DR, Tracer gas ventilation measurements in the Los Alamos National Laboratory Los Alamos neutron science center facility. Los Alamos LA-UR-07-6178, 2007
http://library.lanl.gov/cgi-bin/getfile?LA-UR-07-6178.pdf
405 KB {Access restricted to selected government agencies}

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**(2) LANL affiliation:** Certified Industrial Hygienist, Emergency Response Group, LANL. http://int.lanl.gov/orgs/eo/emer_resp/index.shtml

**(3) Technical background, history and abilities:** Emergency Response Group

**(4) Equipment and facilities resources:** This is a non-descriptive list of LANL resources for you to determine if further consideration is warranted.

Here at Emergency Response we maintain numerous types of personnel trained and qualified in Hazardous Materials response. We are certified through the California Specialized Training Institute because they maintain the most rigorous and comprehensive qualification program. Within ER we have Industrial Hygiene personnel, Health Physicists and Safety Professionals. These folks could either be listed as a capability or assist in your development of standing procedures for a cleanup. We are also fortunate to have our personnel trained and well-versed in the National Response Plan (NRP) which is going to be used in any Federal response and most local responses.

As I think about a written plan to address a chemical incident, we wouldn't treat it that much differently than we do incidents here at LANL. To do that, we use Haz Mat Responders to stabilize the incident, IHS personnel (if necessary) for our health and safety concerns, enviro people for our acceptable limits on mitigation (and release to environment, if necessary), and waste personnel to figure out how to package and get rid of it. So I would cite each of these groups as a likely asset in development of plans on response to a chemical incident.

Just in case you're putting together actual assets for response, please note that we have MOU's with the County and State, so this wouldn't be a far stretch for us. However, our primary function is to safeguard LANL and maintain capability for on-site response. Any off-site response would be subject to availability and number of personnel. Also, we are in the business of stabilization and not necessarily full clean up of an incident. Once the emergency phase was complete, a contractor team of clean-up personnel would be the next step.

**(1) Name:** David Janecky

**(2) LANL affiliation:** ENV-EAQ

**(3) Technical background, history and abilities**

**(4) Equipment and facilities resources:**

Janecky, DR, The Chemical Restoration OTD Sampling and Analysis, Los Alamos Tech Report LA-UR-05-3519
http://library.lanl.gov/cgi-bin/getfile?LA-UR-05-3519.pdf
496 KB {Access restricted to selected government agencies}

[redacted]

**(1) Name:** Lawrence O. Ticknor

**(2) LANL affiliation:** Statistical Sciences, CCS-6.

**(3) Technical background, history and abilities**

Lawrence Ticknor has designed sampling plans for nuclear materials, environmental pollutants, and bio-weapon agents. Lawrence currently has sampling plans being used to search for the existence of Bacillus that has been sprayed in residential areas. The plans support a project to examine the persistence of the microorganism in Seattle Washington and Fairfax Virginia. These sampling plans attempt to answer the question of whether the agent still exists in the environment within specified error bounds for false positive or negative results. For environmental restoration efforts, sampling plans were designed to look for pollutant hot spots and for characterizing pollutant distribution. Lawrence developed sampling plans for verifying the nuclear inventory at LANL, which have been used for many years and continue to be used.

Lawrence has a masters degree in Statistics from the University of California, Davis, and a masters degree in Forestry from Duke University.

**(4) Equipment and facilities resources:**

* Computational and Software resources for sample design and statistical analysis.

**Los Alamos Licensable Technology: Chemical Microsensors**

**Summary:**
Conventional explosives are traditionally the weapon of choice for terrorists, hence, their use remains a serious threat to national security. In addition, small amounts of chemical, biological, or radiological agents can exact a much greater human toll than an equivalent amount of explosives, prompting the need for additional precautions and mitigation methods. Los Alamos National Laboratory has developed new technologies that reliably and rapidly detect trace amounts of chemical, biological, radiological, or explosive materials, hence are of utmost importance in the effort to thwart terrorist . In one development, the microsensor is provided by means of a photopolymerization method that patterns and attaches chemical microsensor films to any oxide surface. This invention is ideal for patterning different elements of a sensor array with chemical sensing films, each with distinct chemical specificities. In another development, the microsensor device consists of a cyclodextrin monolayer on which sensing occurs that is coated onto the piezoelectric substrate of an SAW (Surface Acoustic Wave) device. These technologies can be used for process monitoring of industrial chemicals, monitoring of gas phases for safety, environmental monitoring, or in monitoring of sensitive areas such as airports for restriction of terrorist activities.

Development Stage:
Work is ongoing for most applications. Specific new work has been completed for actuators and hollow fibers. With more application-specific work each of these technologies could provide a substantial base from which to form either a go-to-market product or a complete product line.

**Contact: David Pesiri**, (505) 665-7279 pesiri@lanl.gov tmt-1@lanl.gov

[redacted]

Appendix:

**Requesting Information for Possible Collaboration**

I am putting together a document for Dave Janecky, who is the Deputy Group Leader in ENV-EAQ. Using the two enclosed documents as a starting point, he'd like to develop a resource list of Los Alamos technical and equipment capabilities.

**The issue to be addressed is: After contamination by a chemical agent attack, what is necessary to restore a (large public facility) (e.g. airport terminal complex)?**

The audience for this document would be his current customers in the Department of Homeland Security. He is looking forward to expanding or augmenting the work that he has already performed, and is flexible on future directions and collaborations.

If you are interested in submitting information on your capabilities, please provide the following information:

This document will be cleared with LANL before it is released, and you would have access to it during the compilation process.

**(1) Name:**

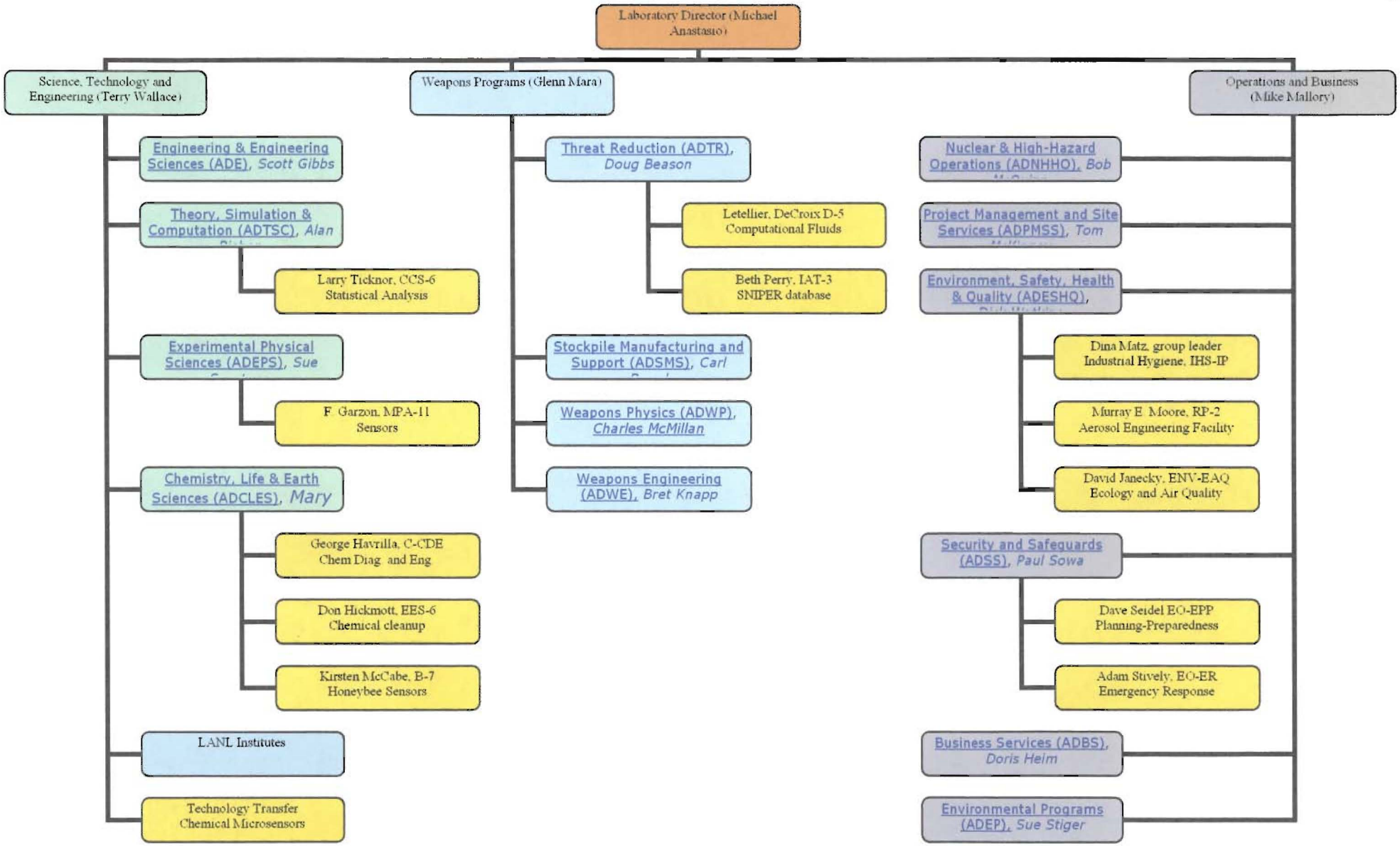
**(2) LANL affiliation:**

**(3) Technical background, history and abilities** (about a paragraph to one half of a page:

**(4) Equipment and facilities resources:**

Thank you very much. I think this will be a valuable contribution. If you can think of anyone who should see this request, please feel free to forward it to them.

Sincerely,
Murray E. Moore


Laboratory Director (Michael Anastasio)
Science, Technology and Engineering (Terry Wallace)
Weapons Programs (Glenn Mara)
Operations and Business (Mike Mallory)
Engineering & Engineering Sciences (ADE), Scott Gibbs
Theory, Simulation & Computation (ADTSC), Alan
Larry Ticknor, CCS-6 Statistical Analysis
Experimental Physical Sciences (ADEPS), Sue
F Garzon, MPA-11 Sensors
Chemistry, Life & Earth Sciences (ADCLES), Mary
George Havrilla, C-CDE Chem Diag and Eng
Don Hickmott, EES-6 Chemical cleanup
Kirsten McCabe, B-7 Honeybee Sensors
LANL Institutes
Technology Transfer Chemical Microsensors
Threat Reduction (ADTR), Doug Beason
Letellier, DeCroix D-5 Computational Fluids
Beth Perry, IAT-3 SNIPER database
Stockpile Manufacturing and Support (ADSMS), Carl
Weapons Physics (ADWP), Charles McMillan
Weapons Engineering (ADWE), Bret Knapp
Nuclear & High-Hazard Operations (ADNHHO), Bob
Project Management and Site Services (ADPMSS), Tom
Environment, Safety, Health & Quality (ADESHQ),
Dina Matz, group leader Industrial Hygiene, IHS-IP
Murray E Moore, RP-2 Aerosol Engineering Facility
David Janecky, ENV-EAQ Ecology and Air Quality
Security and Safeguards (ADSS), Paul Sowa
Dave Seidel EO-EPP Planning-Preparedness
Adam Stively, EO-ER Emergency Response
Business Services (ADBS), Doris Heim
Environmental Programs (ADEP), Sue Stiger