

Decision Applications Division

# **Division Overview**

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# Decision Applications Division—An Overview

## FROM THE D DIVISION LEADER

*Los Alamos National Laboratory is one of the largest multiprogram laboratories in the world. The Laboratory develops and implements science and technology solutions for problems of global importance. The Decision Applications Division (D Division) is the decision analysis arm of the Laboratory. Our division tackles those problems which, because of their complexity, size, and national security implications, fall beyond the purview of other organizations. We have an exciting portfolio of projects and the state-of-the-art capabilities and facilities to execute these projects.*

*This year alone, we have made significant contributions in protecting our homeland from asymmetric threats, including weapons of mass destruction, and we are recognized for our key role in designing the nuclear reactors for space exploration. We have also worked very closely with internal and external organizations to enhance safety and reliability of our nuclear stockpile and to plan for the Laboratory's future growth.*

*I believe our success as a division is a direct result of our adherence to our core values—the excellence of our science and technology base; good stewardship of our programs; the academic and cultural diversity of our workforce; and our local and national community outreach. I am proud to lead such a dynamic organization. We have met past and current challenges and we are prepared to take on new endeavors in ensuring the safety and reliability of our nuclear stockpile, enhancing the security of homeland against terrorist threats, transforming our national defense forces, improving and protecting our nation's infrastructure, and expanding the nuclear technology base for space exploration. I consider it a privilege to work with the outstanding people in D Division.*

*Michelle Derans*

The Decision Applications (D) Division is the science-based decision analysis arm of the Los Alamos National Laboratory (LANL). In fact, decision analysis capabilities are the unique thread of continuity that binds together this otherwise diverse division of 270 employees. The science and technology (S&T) base of D Division has been instrumental in enabling important institutional and national decisions with a direct impact on our national security.

D Division's Department of Defense (DoD) program office also plays a leading role in developing, coordinating, and executing DoD-sponsored research and development across the Laboratory.

Decision analysis, in the context of D Division, creates enhanced decision processes through integration of S&T and applies them to support critical Laboratory and national decisions. The broad-based S&T capabilities of D Division are vital to carrying out multidisciplinary assessments—an essential component of decision analysis of complex systems—and make us a unique division at Los Alamos.

We maintain and continually upgrade our capabilities by recruiting well-published staff, engaging in cooperative research with visiting faculty and students, and through active participation in Laboratory Directed Research and Development (LDRD) programs.

## OUR VISION

Be the national leader in scientific decision support for national security.

## OUR MISSION

Through science-based, multidisciplinary assessments, enable important national security decisions pertaining to the safety and reliability of the U.S. nuclear deterrent, homeland security, national defense transformation, and nuclear energy and environment.

## OUR CAPABILITIES

D Division has seven core capabilities.

### Computational Science

Computational science contributes to fundamental scientific understandings by applying computer-based representations to scientific and engineering problems. This work complements the traditional mechanisms of theory and experimentation in the scientific method. One of the unique capabilities of the Division is bringing together theoreticians and practitioners to translate ideas from theory into reality.

### Engineering

Engineering is a strong component of D Division with fields of engineering varying from nuclear weapons engineering and manufacturing processes engineering to infrastructure reliability and

safety engineering. Our engineers' abilities to work closely with modeling and simulation experts give us unique insights that we apply to designing advanced nuclear reactors for space exploration and to advancing homeland security technologies.

*“The Laboratory Director claims that the Division’s capabilities are extremely valuable...for which it is viewed as a ‘crown jewel.’ This committee endorses these assessments and asserts that D Division capabilities are, de facto, a capability of the nation. There are few, if any, external groups wherein the physical (and engineering) science and the decision science come under a common umbrella.”*

*External Division Review Committee (2003 Annual Report)*

### Modeling and Simulation

The modeling and simulation (M&S) capability develops algorithms, models, and other software components to represent and study actual or theoretical systems of interest. The division delivers these as products in their own right or uses them in support of our analyses. Visualization is an important aspect of the M&S capability.

### Nuclear Science and Engineering

Within D Division, nuclear science and engineering involves both developing nuclear analysis tools (e.g., MCNPX and TRAC) and utilizing such tools to design advanced or special purpose fission systems and to examine the safety and security of nuclear systems.

We also perform fundamental research into radiation transport, thermal and fluid dynamics and nuclear explosives materials response.

### Operations Research/Systems Analysis

Practitioners of operations research/systems analysis (OR/SA) develop and apply tools and methods in order to understand the behavior of complex

systems. The goals are to provide a rational basis for decision-making and to predict system behavior and improve system performance.

### Qualitative Analysis

Qualitative analysis refers to an interdisciplinary set of computational and descriptive techniques and tools used to understand problems and develop solutions in domains that are inherently difficult to quantify. Included are methods for eliciting, representing, and integrating information from diverse sources.

### Statistical Science

Distinguished by its multidisciplinary nature, statistics is the science of extracting scientifically meaningful qualitative and quantitative information sets and learning from data of all types. The ultimate goal is to support decision making under uncertainty, from decisions about basic scientific phenomena to public policy.

### DIVISION THRUST AREAS Nuclear Weapons

About a decade ago, the United States stopped producing new nuclear weapons, resulting in an aging stockpile. Nuclear weapons testing also ended, making it more difficult to assess the safety and reliability of that stockpile. Today we need improved analytical methods and tools to manage this overly committed and constrained weapons program. To support the nuclear weapons programs, the Division provides a broad array of technical capabilities such as

systems engineering, project risk analysis, uncertainty quantification, reliability and surety assessment, manufacturing process planning and analysis, nuclear safety analysis, stockpile planning, and facility planning. Our work is critical to both the short- and long-term success of the Laboratory’s nuclear weapons program.

We lead several Laboratory activities related to

- ▼ systems engineering and risk analysis, and
- ▼ modern pit facility and technology planning.

We have a vital role in

- ▼ weapons reliability and quantification of margins and uncertainties (QMU),
- ▼ advanced concepts planning,
- ▼ military analysis and stockpile planning,
- ▼ nuclear facility planning, and
- ▼ nuclear stockpile surety modeling and analysis.

D Division currently supports a multitude of projects in the nuclear weapons arena. The nuclear weapons programmatic funding base is approximately \$25M. We provide decision support to all aspects of the program. The major long-term objective is to better integrate the division into the decision-making structure of the Laboratory’s nuclear weapons program. Keys to our success have been teaming with other divisions and encouraging career development for our staff.

## Homeland Security

The 9/11 World Trade Center attacks raised concerns about our nation's ability to prevent and respond to terrorist threats and underscored the need for integrating our nation's disparate pieces of information (e.g., knowledge discovery and dissemination).

D Division is developing technologies to protect our critical infrastructures for asymmetric threats, including threats for WMD (weapons of mass destruction). We coordinate our efforts through CHS, and collaborate closely with B and N Divisions. One of our long-term objectives is to maintain D Division as the national center of excellence for modeling and simulation of critical infrastructure interdependencies.

The National Infrastructure Simulation and Analysis Center (NISAC) provides fundamentally new modeling and simulation capabilities for analyzing critical infrastructures, their interdependencies, vulnerabilities, and complexities. We apply our modeling, simulation, and systems analysis capabilities to designing optimum strategies to assess, mitigate, and respond to threats from weapons of mass destruction (WMDs).

D Division is also a national center of excellence in biosurveillance. This role is evidenced by the fact that several cities use our technologies (e.g., BASIS) to monitor and respond to radiation, nuclear, biological, and chemical threats. We are actively working to advance our technologies through collaborative research sponsored jointly by the Department of Homeland Security (DHS)

and the Defense Threat Reduction Agency (DTRA).

## DOD/Conventional Defense

As the DoD applies technologies to transforming defense, the Laboratory is playing a growing role in providing innovative science and technology solutions for conventional defense strategies. The Defense Transformation (DT) and Horizontal Integration (HI) initiatives require complex decisions regarding technology selection and qualitative modeling. This presents unique opportunities for D Division to re-establish itself as the integrator of defense systems and technologies developed across the Laboratory and across the country. Our DoD Program Office works diligently to develop programs in these areas, leveraging our existing capabilities. We also work closely with the Associate Directorate for Threat Reduction - Deputy Associate Director (ADTR-DAD) Office.

## Energy and Environment

D Division has a strong background in the safety, security, and environmental aspects of nuclear energy. We support critical regulatory, policy, and planning decisions for our customers, and our programs support the NRC's Offices of Research, Reactor Regulation, and Nuclear Materials Safeguards and Security. We also support the Advanced Fuel Cycle Initiative for the DOE Office of Nuclear Energy. We are a national center of excellence for design and analysis of compact nuclear reactors.

The scientific foundation of this research is grounded in our technical expertise. Important current Division research activities include assessing vulnerabilities to terrorist threats in the nation's nuclear energy facilities, space nuclear reactor design and technology development, and systems modeling of advanced fuel cycle options.



*The newly built D Division office building at LANL, completed in fall 2003.*

## Workforce Excellence

D Division has a workforce staffing plan that involves division and group managers, furthers the D Division strategic and group business plans, and implements the division's strategic hiring process. We encourage diversity in scientific approach and team membership, and foster a work environment that encourages creativity, academic freedom, fair evaluation of ideas, and celebration

of achievements. We encourage professional development through mentoring, discipline associations, training, peer review, publications, and presentations. The framework for workforce planning includes identifying strategic staffing needs based on our division's thrust areas and group business plans. Core capabilities are reviewed and critical

skills are identified as needed to enhance the division's core capabilities in concert with thrust area goals. D Division strives to hire our next generation of scientists to increase our technical depth across disciplines.

## Facilities

D Division facilities primarily support office and computing requirements. In November 2003, the division dedicated a

\$5M general purpose building that is now housing approximately 100 employees in the statistical sciences and stockpile complex modeling and analysis groups. Strategically located in TA-3 near the Nonproliferation and International Security Center and the Nicholas C. Metropolis Center for Modeling and Simulation, this secure, 22,000-square-foot building provides a much-needed improvement of work environment for our staff and will help us attract new staff with critical skills to support the Laboratory's mission. This new facility is part of the infrastructure revitalization at the Laboratory. The D Division Visualization Laboratory is located in TA-3 and offers high-performance graphics processors; a range of visualization and graphics tools; a large-screen, stereo-enabled projection environment; quadrasonic sound; and some motion tracking for virtual reality applications.

We are developing our long-term, facilities strategic plan to consolidate our workforce into one central science complex to achieve cost savings and new construction to accommodate projected mission need.

### SPECIAL RECOGNITION

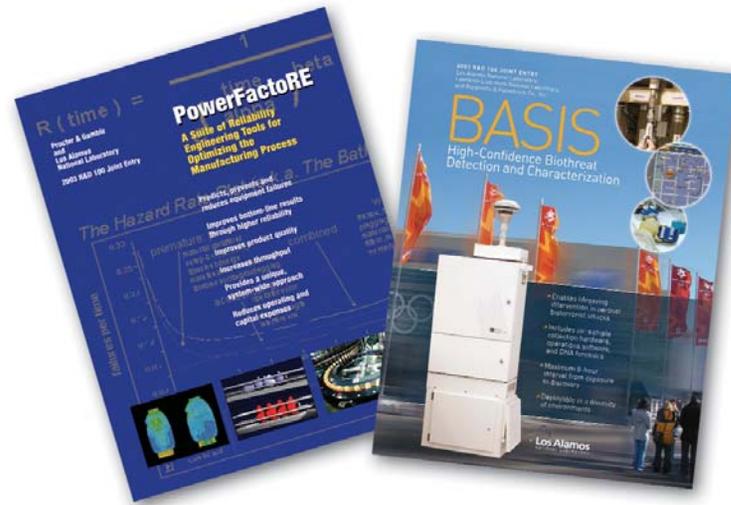
This past year D Division received two R&D 100 Awards for our statistical analysis and bio-detection research.

The R&D 100 awards program is designed to honor significant commercial promise in products, materials, or processes developed by the international research and development community.

Each year, *R&D Magazine* recognizes the world's top 100 scientific and technological advances with awards for innovations showing the most significant commercial potential. D Division received two of the eight projects that were selected within the Laboratory.

**PowerFactorRE** is a suite of reliability engineering tools designed to optimize manufacturing processes. The result of a collaboration between the Laboratory and Procter & Gamble, it comprises a unique set of methods, statistical and analytical tools, simulation software, procedures, and training that enables manufacturing line managers to understand reliability losses and to correct seemingly isolated defects in the manufacturing process. This work was done in D Division's Statistical Sciences Group.

**Biological Aerosol Security and Information System**, commonly known as BASIS, is a biothreat detection and characterization technology for protecting civilian populations against terrorist aerosol releases of micro-organisms capable of inducing lethal infection. BASIS allows the detailed identification, localization, and time-of-release pinpointing of select aerosol-released organisms. This precise detection facilitates the rapid treatment of exposed individuals, often even before symptoms appear. This work was done in D Division's Systems Engineering and Integration Group. ▲



Covers of the division's two R&D 100 award winners for 2003.

Decision Applications Division

**2004 Division Review Committee**

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# 2004 Division Review Committee

## THE COMMITTEE

The 2004 Decision Applications Division Review Committee members includes the following:

### Nozer D. Singpurwalla (Committee Chair)

**The George Washington University,  
Professor of Statistics and  
Distinguished Research Professor**

Dr. Singpurwalla has been a visiting fellow at St. Hugh's College, University of Oxford, U.K., and has held visiting professorships at the Santa Fe Institute; Carnegie-Mellon University; Stanford University; the University of Florida, Tallahassee; and the University of California, Berkeley. In 2002, he was an invited professor at Université de Bretagne-Sud in Vannes, France. In 1991, Dr. Singpurwalla was the first C. C. Garvin Visiting Endowed Professor in the Mathematical Sciences at the Virginia Polytechnic Institute and State University. He is a fellow of the Institute of Mathematical Statistics, the American Statistical Association, the American Association for the Advancement of Science, and an elected member of the International Statistical Institute. Dr. Singpurwalla's areas of expertise are applied probability and Bayesian statistics; reliability theory, warranties, and quality control; time-series analysis; fault-tree analysis; filter-

ing theory; uncertainty in expert systems; and failure data analysis. For his contributions to the theory and applications of reliability, he received the U.S. Army Research Office's S. S. Wilks Memorial Award. Dr. Singpurwalla received his Ph.D. from New York University in 1968.

### Massoud Amin University of Minnesota, Professor of Electrical and Computer Engineering

Dr. Amin holds the H.W. Sweatt Chair in Technology Leadership and is the director of the Center for the Development of Technological Leadership at the University of Minnesota in Twin Cities. His research focuses on global transition dynamics to enhance resilience and security of national critical infrastructures. Dr. Amin is extremely knowledgeable in the critical infrastructures area. For five years before joining the University of Minnesota, Dr. Amin held several positions at the Electric Power Research Institute (EPRI) in Palo Alto, California, including area manager of infrastructure security, grid operations/planning, and energy markets. He directed all security-related research and development at EPRI, including the Infrastructure Security Initiative (ISI) and the Enterprise Information Security (EIS) areas. Before October 2001, he served as manager of mathematics and

information science at EPRI, where he led strategic research in modeling, simulation, optimization, and adaptive control of national infrastructures for energy, telecommunications, transportation, and finance.

### Paul Bracken Yale University, Professor of Management and Political Science

Dr. Bracken teaches courses at Yale University on international strategy and organization, global technology, and management of innovation. In addition, he is responsible for the required MBA course on the strategic environment of management. Before joining the Yale faculty, Professor Bracken was on the senior staff of the Hudson Institute, a think tank, for 10 years. He is currently writing a book called *Technology and Grand Strategy*. Professor Bracken is a member of the Council on Foreign Relations and serves on the Chief of Naval Operations Executive Panel. He holds a Ph.D. in operations research from Yale University.

### Daniel G. Brooks Arizona State University, Associate Professor of Statistics

Dr. Brooks has 20 years' experience applying decision and risk analysis to problems in the development of decision-making processes and risk-based

strategy formulation for both the federal government and private industry. For the past eight years (until December 1999) he served as senior scientist at Applied Decision Analysis, Inc., and for the past two years as a director for PricewaterhouseCoopers' Financial Advisory Services Group. Dr. Brooks is past associate editor, vice-president, and a member of the board of directors for Decision Sciences, as well as a member or past member of the American Statistical Association (ASA), the Decision Sciences Institute (DSI), and the Institute for Operations Research and Management Science (INFORMS). He has a Ph.D. in decision sciences from Indiana University.

### Geoffrey Fox Indiana University, Professor of Computer Science, Informatics and Physics, Director of the Community Grids Laboratory

Dr. Fox is a pioneer in the development and application of parallel computers and now focuses on grid computing. Previously at Florida State University, Syracuse University, and Caltech, he was professor of physics, associate provost for computing, and dean for education computing. Dr. Fox was born in Dunfermline, Scotland, and received his Ph.D. in theoretical physics from Cambridge University in 1967.

## Stephen J. Guidice Independent Consultant

Mr. Guidice has more than 30 years of nuclear weapons program knowledge and experience. He is formerly the head of the Office of National Defense Programs at the US DOE Albuquerque Operations Office. In that capacity, he managed the nuclear weapons production, mainte-

governments. His other senior executive service positions at ALO included director of weapons production, director of weapons quality, and head of the Office of Energy, Science and Technology. Since 1998, he has been an independent consultant advising the weapons laboratories, weapon production plants, and Congress. He received his B.S. in engi-



The 2003 D Division Review Committee.

nance, dismantlement, quality assurance, nuclear explosive safety, surveillance, and reliability assessment programs with an annual budget of more than \$2B. His responsibilities included managing and integrating the technical activities of three weapons laboratories, seven large commercial contractors operating the weapons production plants, the Department of Defense, and foreign

neering in 1968 and his M.S. in management in 1972, both from the Rensselaer Polytechnic Institute in Troy, NY.

## Charles M. Herzfeld Center for Strategic and International Studies, Senior Associate

Dr. Herzfeld has served as director of the Advanced Research Projects Agency (ARPA) when the ARPAnet was started,

as vice president for research and technology at ITT Corporation, as director of defense research and engineering in the Department of Defense, and as senior consultant to the Science Advisor of the President. He has been a member of the Chief of Naval Operations Executive Panel since its formation in 1970. He has served on the Defense Science Board and the Defense Policy Board. He has testified frequently before Congress and written and lectured in the subjects of defense technology and policy, information technology, and high-performance computing. Dr. Herzfeld has a Ph.D. in physical chemistry from the University of Chicago.

## Jon R. Kettenring Former Executive Director of the Mathematical Sciences Research Center (MSRC) at Telcordia Technologies

Dr. Kettenring joined Telcordia in 1983 after 15 years in the Statistics and Data Analysis Research Department at Bell Laboratories in Murray Hill, where he engaged in and supervised statistics research. He is a fellow of ASA and AAAS and an elected member of the International Statistical Institute. He has represented a "statistics in industry" perspective in a variety of national and international assignments. These include president of the American Statistical Board on Mathematical Sciences of the National Research Council, board of trustees of the National Institute of Statistical Sciences, and board of directors of the Interface Foundation of North

America. Dr. Kettenring has a B.S. and M.S. from Stanford University in statistics and Ph.D. from the University of North Carolina in statistics.

## Per F. Peterson University of California at Berkeley, Professor and Chair, Department of Nuclear Engineering

Professor Peterson manages the UC Berkeley Thermal Hydraulics Research Laboratory. His research focuses on problems in energy and environmental systems, including inertial confinement fusion, advanced reactors, high-level nuclear waste processing, and nuclear materials management. Professor Peterson has served on the UC Berkeley College of Engineering strategic planning committees, as well as chairing the College Committee for Undergraduate Studies. He has contributed to the *Journal of Heat and Mass Transfer* as an associate editor and currently serves as an editor for *Experimental Heat Transfer*. Professor Peterson is a Fellow of the American Nuclear Society, and from 1996 to 1997 he served as chairman of its Thermal Hydraulics Division. He has made contributions as a consultant on the design of the Westinghouse AP-600 and GE ESBWR advanced reactors. He received a Ph.D. from the University of California-Berkeley in 1988.

## James Stanley Tulenko

### University of Florida, Professor, Nuclear and Radiological Engineering

Professor Tulenko is currently the director of the Laboratory for the Development of Advanced Nuclear Fuels and Materials at the University of Florida. He is a fellow of the American Nuclear Society and has received such distinguished awards as the Arthur Holly Compton Award of the American Nuclear Society (ANS) for outstanding contributions to nuclear science and technology Education, the Mishima Award of the ANS for Outstanding Research in the areas of Nuclear Fuels and Materials, the Glen Murphy Award of the American Society for Engineering Education as the outstanding nuclear engineering educator, and the Silver Anniversary Award of the ANS for outstanding contributions to the nuclear fuel cycle in the first 25 years of the ANS. He is currently the vice president/president-elect of the ANS. His areas of interest are nuclear engineering, nuclear fuel management, nuclear waste, nuclear fuel manufacturing, systems engineering, radiation effects on materials, robotic maintenance in hazardous environments, and computer simulations.

### UC Representative

#### Dr. John Ahearne

Dr. Ahearne received his Ph.D. in physics from Princeton University. He has held a lengthy record of government service, including the Air Force Special Weapons Center, the Air Force Academy, the Office of the Secretary of Defense,

the White House, and the Nuclear Regulatory Commission. Currently he is at Sigma Xi and Duke University and serves as the chair of the National Research Council's Board on Radioactive Waste Management and is a member of the University of California President's Council. ▲

