

New Technologies in Support of Nonproliferation

For many years Los Alamos National Laboratory has had an active arms-control program with two main goals: to provide technology for verifying compliance with arms-control treaties, generally bilateral, and to support international activities in nuclear-materials control. But the world of the 1990s demands a considerable broadening of this charter. Technologies are needed for the deterrence and detection of worldwide tendencies toward the proliferation of weapons of mass destruction.

Initially viewed as a component of the Laboratory's Arms Control and Intelligence programs, nonproliferation support has recently emerged as a major new Laboratory initiative under the auspices of the Department of Energy's Office of Arms Control and Nonproliferation. A vastly increased role is anticipated for Los Alamos in activities relating both to monitoring and preventing proliferation, primarily of nuclear weapons but also of other weapons of mass destruction and their means of delivery. This role will utilize the Laboratory's expertise in space-based monitoring of weapons programs and in materials control and accounting as well as its premier capability in the nuclear-weapons program.

The historical bases for such Laboratory activities are the existing programs to analyze weapons programs overseas and to provide assessments of their motivations and their technical capabilities. Los Alamos has also contributed to national and international efforts to safeguard special nuclear materials such as plutonium and enriched uranium. All International Atomic Energy Agency inspectors have been trained at Los Alamos, and the equipment used by IAEA inspectors to monitor activities of nuclear facilities has largely been developed here and at Sandia National Laboratory. To assist in limiting the spread of technologies used to produce nuclear weapons, Los Alamos and other laboratories have provided technical expertise for national and international export controls, including technical advice on revising or updating international lists of controlled items for the Zangger Committee, the Nuclear Suppliers' Group, and other multilateral bodies.

The first major arms-control activity at Los Alamos was the design and preparation of the Vela satellite in 1960, which was used to detect atmospheric nuclear-weapons tests. To verify compli-

ance with the Limited Test Ban Treaty (1963), Los Alamos collaborated with Sandia to provide spaceborne instrumentation for detecting nuclear tests either in the atmosphere or in outer space. These activities illustrate the Laboratory's characteristic role of utilizing the most advanced technologies on short notice in the space environment and adapting them to a variety of launch vehicles. Today such capabilities transfer directly into nonproliferation-related functions such as the detection of x-ray, gamma-ray, radio-frequency, neutron, and charged-particle radiations from nuclear detonations. In support of programs such as the detection of directed-energy weapons tests, they also supply data on natural and artificial space radiation. In 1993 the ALEXIS satellite is scheduled for launch into orbit to provide improved determination of the low-energy x-ray environment in space.

The Department of Energy's Accident Response Group (ARG) and Nuclear Emergency Search Team (NEST) are kept in readiness to respond in the event of a nuclear threat or nuclear weapon accident. Los Alamos provides both technical experts and equipment to these groups. This operational-readiness

capability proved important in preparing DOE inspectors (from Los Alamos and other laboratories) who supported the IAEA and UN Special Commission inspections in Iraq. Maintenance of these emergency-response assets and capabilities will become increasingly important.

To meet emerging threats of proliferation, the laboratories are responding with vigorous R&D programs across the board. Ongoing safeguards R&D programs are devoted to developing various radiation detection and measurement devices, engineering new hardware and software to do the necessary measurements, and designing complete safeguards systems integrated with physical protection and process operations. Current and future safeguards technologies and techniques will enable us to begin to properly address the new problems of nuclear weapons and special nuclear materials raised by the collapse of the Soviet Union and the ongoing radical reductions in nuclear arms. Topics of concern include commodity export, technical-data transfer, consulting, and guidance on foreign visits.

Recent R&D activity in export control at the Laboratory has focused on developing a Proliferation Information Network, an on-line interactive database system to centralize proliferation data and provide analysis tools. Although the network is currently providing export-license information for government agencies and the national laboratories, there is a real possibility to expand the scope of the data in the system. Integration of these data into actionable intelligence poses challenging problems

in data transfer, display, and administration. R&D programs in this area are focusing not only on technical solutions such as improved data links, pattern recognition, and anomaly detection but also on the administrative challenges of the compartmentalization of information for security reasons.

Monitoring activities include satellite systems for wide-area detection of suspicious activities. For some years the Laboratory has been involved in projects to analyze observables resulting from hydrodynamic shock propagation and from surface ground motion near an underground nuclear test. These programs have recently become parts of an Integrated Geophysics Program to investigate the entire range of phenomena by means of which an underground explosion couples its energy into detectable signals such as seismic or acoustic waves. Historically, the major goal has been to verify nuclear-test-ban treaties. However, applications of most interest in the future may be the detection and identification of covert nuclear-weapons tests by new nuclear-weapon states who may or may not be signatories to the Nuclear Nonproliferation Treaty. Longer-range goals could include the use of combined seismic and acoustic data to estimate yields of any detected tests.

Additional monitoring activities involve high-resolution instruments that remotely detect effluents in chemical plumes, local sensors to monitor activities in production facilities, and portable systems that detect the presence of weapons or special materials. Because of its extensive experience in developing and fielding nuclear

sensors, the Laboratory can make significant contributions to this important area of arms control. Non-destructive testing expertise and facilities at the Laboratory continue to play an important role in the development of on-site inspection tools that may include, among others, radiation detection, radiography, or acoustic resonance. One of the promising technologies in this arena is LIDAR (light detection and ranging). The DOE weapons laboratories can assist the military with analyses of military vulnerabilities and response options and help define and develop future technologies based on current NEST capabilities.

Emerging proliferation threats require active programs to develop the knowledge, technologies, and capabilities to prevent the spread and use of nuclear weapons and other weapons of mass destruction. Nonproliferation and arms control are expected to be among the most rapidly growing Los Alamos programs through the 1990s and into the next century. The Laboratory has demonstrated for more than thirty years an ability to use its expertise in nuclear weapons and related technologies to address and solve challenging problems in these important fields. As requirements become more clear in the world that emerges from the incredible changes of the last several years, we anticipate that the Laboratory's special capabilities for fast response to critical technical problems will continue to play a major role in ensuring U.S. national security. □