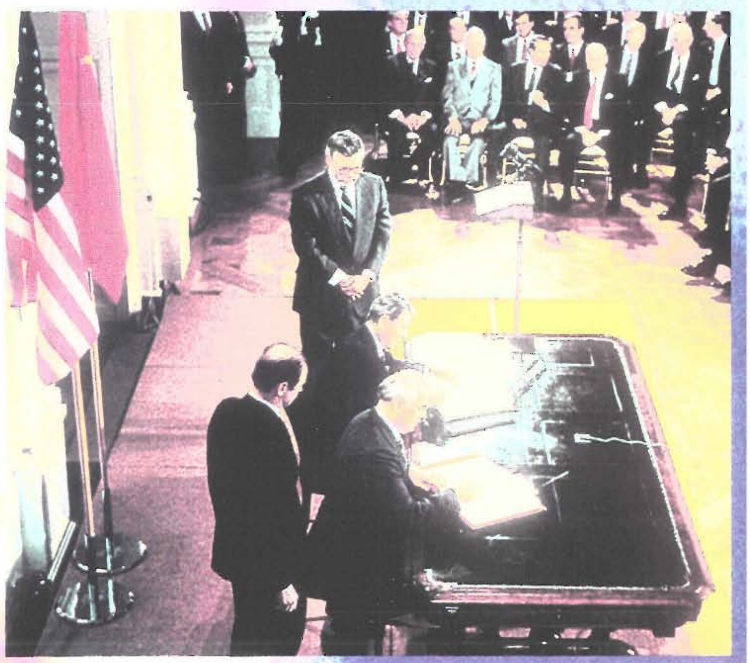
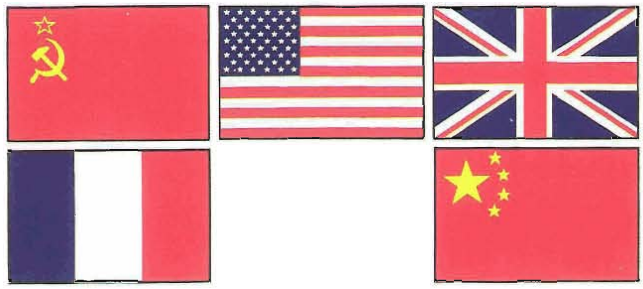
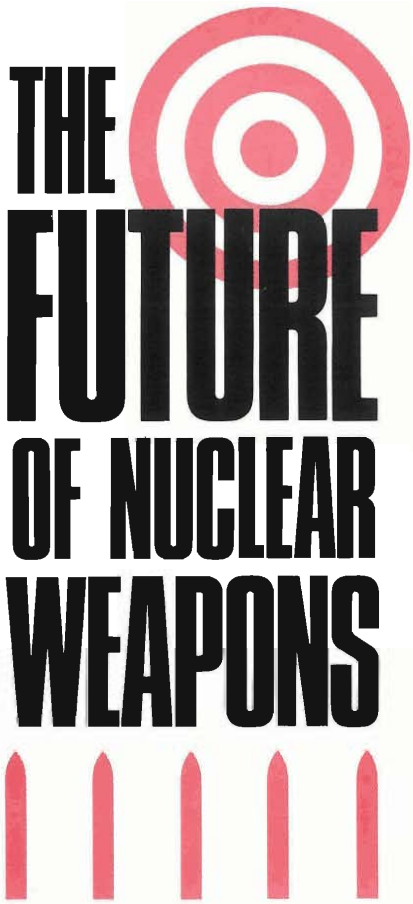




THE FUTURE OF NUCLEAR WEAPONS

THE NEXT THREE DECADES



An Introduction

by Paul C. White

Some forty-six years ago many of the best scientists in the world assembled on a mesa top on the eastern slopes of the Jemez Mountains of northern New Mexico. They arrived in a steady stream, carrying secret military orders, often traveling under code names to conceal their identities. Many of them did not know the real nature of the project they came to work on until after they had arrived. But, coming as they did from a United States and a Europe gripped in the throes of the Second World War, all of them firmly believed that they were there to undertake a scientific challenge characterized by great technical difficulty and tremendous political urgency. They had been assembled to develop a nuclear explosive, an "atomic bomb," and they absolutely had to be the first in the world to do it. If they failed and Germany developed a nuclear weapon first, then Hitler would win the war. If the New Mexico scientists won the race, then the United States and the Allies would save the world from Nazi domination.

The scientists faced an enormous set of technical challenges. To begin with, neither the physical nor the nuclear properties of the fissionable isotopes of uranium and plutonium were known. These materials wouldn't even exist, in other than laboratory samples, until they could be produced in the nuclear reactors and the isotope separation plants of the Manhattan Project. The necessary data had to be verified by experiments often conducted on minute quantities of the rare materials. Neutron transport models had to be devised, fission cross-sections had to be measured, and new diagnostic techniques and instrumentation had to be developed. To produce a nuclear explosion, the fissionable materials had to be acted upon by chemical explosives. In the case of the implosion device, the timing of explosive detonations and the focusing of the detonation waves were new hurdles that had to be overcome. These and other challenges were met by teams of dedicated scientists, working often under makeshift conditions and certainly under extreme time pressures.

One of the most significant aspects of this massive undertaking was that a successful outcome was by no means certain. No one knew for sure that a nuclear explosion could be generated, and success would come only if a whole series of technical problems could be solved. Even if solutions were found, it was not clear until late in the war whether the Germans might find them first. This uncertainty created both

Center for National Security Studies

The Center for National Security Studies exists at Los Alamos to provide the Director and the Senior Management with insight into the connections between national security policy and technology issues. In recent years the relationships between the Laboratory and its programmatic sponsors have become more and more complex. Paperwork and layers of bureaucracy interfere with clear communication and direction about national priorities. Budget actions often seem remote from the technical requirements of the Laboratory's traditional missions. The missions themselves are even being scrutinized and, in some cases, are being broadened to include technological applications in whole new arenas. In this changing world the Center tries to provide a broad perspective on policy issues related to national defense. It is hoped that this perspective will better equip the Laboratory to make decisions about technical priorities and directions.

The Center approaches this objective in a number of ways. The staff is a mixture of professionally trained policy analysts and scientists drawn on rotating assignments from the Laboratory's technical divisions. Consultants and contract personnel experienced in the assessment of national policy issues multiply the effect of the Laboratory staff. The Center uses its collective resources to study and analyze themes similar to that of the Future of Nuclear Weapons project described in the accompanying article. This research does not attempt to make technical assessments; such assessments are the responsibility of the technical programs. Rather the Center seeks to take a broad, long-range view of the ways in which policy trends at the national and international level may affect program choices. The Center uses briefings and reports to communicate the results of its studies to Laboratory personnel, and it circulates the results among the wider policy analysis community in government, military, and academic circles, as well as private industry. The Center also sponsors seminars, workshops and conferences designed to bring Laboratory personnel into contact with outside experts and to improve the Laboratory's understanding of defense policy issues. Finally, the Center acts to enhance communication between Los Alamos and other organizations, such as colleges and universities, that are studying issues of interest to the Laboratory.

In an increasingly complex world, the Center is seeking to provide the broad background that will enable the Laboratory to make the best possible technical decisions. The Center stands as a link between the internal technical community of Los Alamos National Laboratory and the external policy community that can have such a profound effect on the Laboratory's mission and programs. ■

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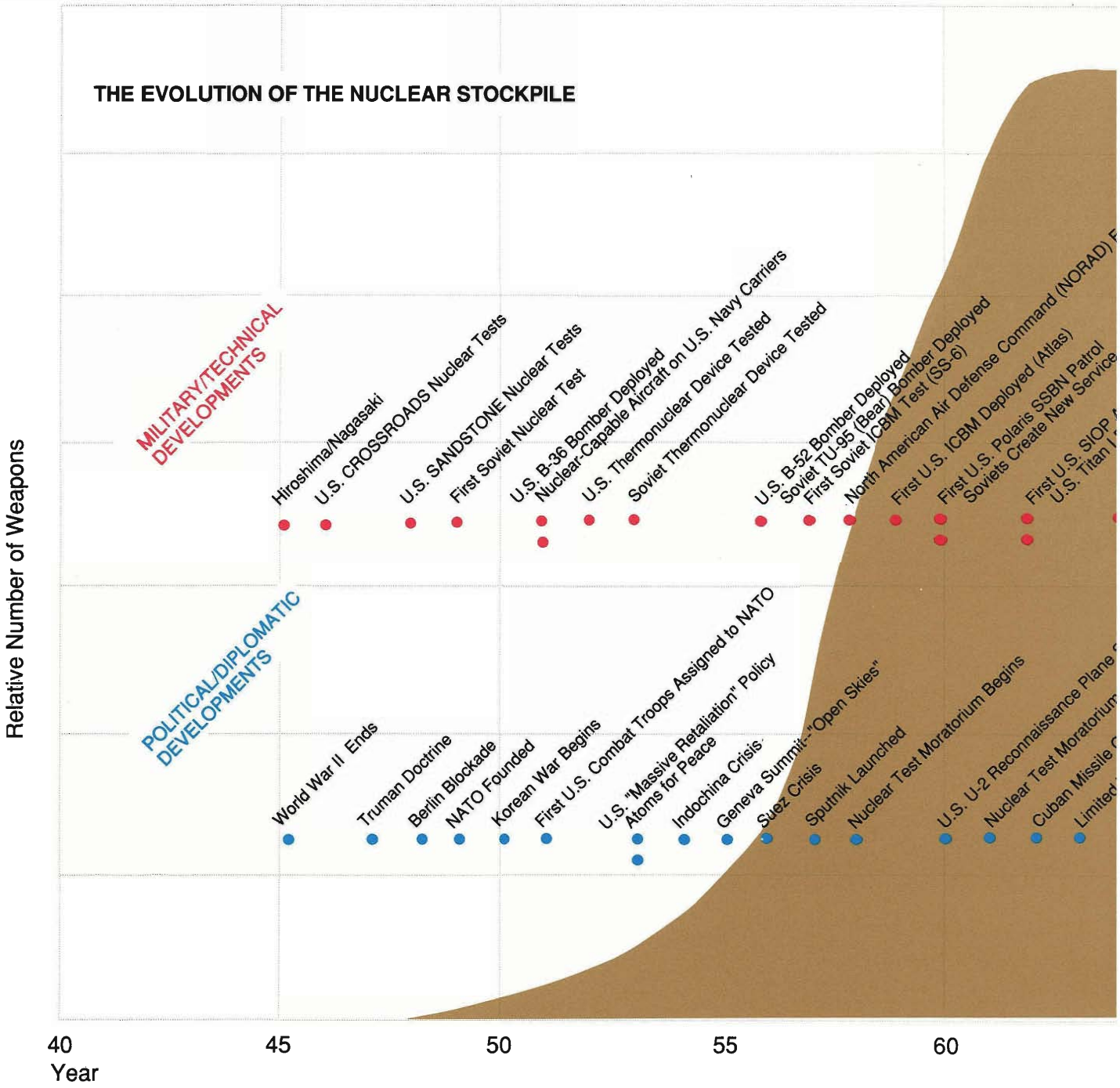
a universally shared sense of political urgency and a heightened feeling of technical challenge. The first Los Alamos scientists were charting new scientific territory, and a special combination of scientific and political motivations drove them to be first.

Their spectacular success was brilliantly apparent one July morning in the New Mexico desert. Later that summer, the first nuclear weapons were used to devastating effect at Hiroshima and Nagasaki, the first and last time nuclear weapons were ever used in war. Many have argued whether this use was ultimately necessary to end the war, but no one could doubt either the magnitude of the technical accomplishment or its significance for the future of conflict between nations.

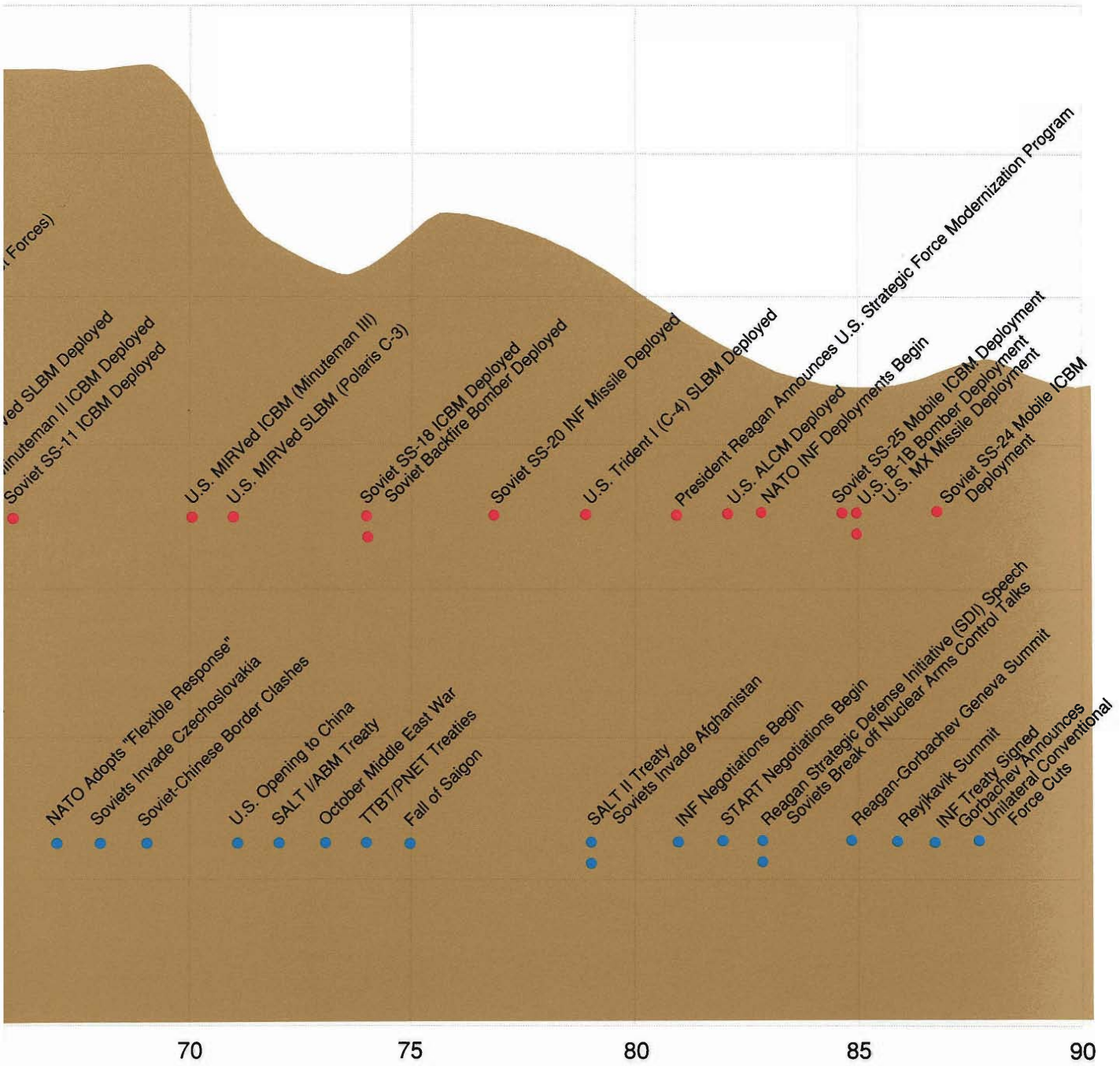
The Present

Los Alamos National Laboratory, along with its sister laboratories of Livermore and Sandia, today stands as a symbol of the continuing role played by nuclear weapons in international relations. Time and again in the years since World War II, the nation has called on its nuclear weapons laboratories to produce new technologies in support of the national security policy of deterrence. Today great nations do not use nuclear weapons to end wars but to prevent them. For example, the United States can threaten the possible use of our nuclear weapons against any adversary contemplating aggression. The threat is intended to be sufficiently credible and to suggest such unacceptable consequences that no potential adversary



would risk a significant attack against the United States or one of its allies. For nearly forty-five years this policy has been highly successful, at least to the extent that no nuclear weapons have been used since their first use, and no major conflict has erupted between the major powers.

To support the policy of nuclear deterrence, the national weapons laboratories have worked with the Departments of Defense and Energy to design and develop nuclear weapons with a wide ranging set of characteristics. The stockpile of today (Figure) consists of a large variety of weapons with different designs, sizes, weights, delivery modes, and yields. Such variety is intended, in part, to ensure that the deterrent forces are survivable, deliverable, and effective. Using delivery vehicles that range from submarine-launched ballistic missiles to air-launched cruise missiles, helps ensure that enough forces will survive to make a retaliatory strike credible, regardless of the circumstances of an attack. The spectrum of weapons yield and nuclear effects helps ensure that a nuclear strike can inflict damage that is unacceptable to a potential adversary. Over the last four decades specific requirements to meet these objectives have changed, both as national policy



has evolved and as the characteristics of potential targets have shifted.

Providing the technical resources necessary to respond to such changing requirements is one of the principal reasons for the existence of the national nuclear weapons laboratories. The laboratories support national policy, however it adapts to changing circumstances, by serving as unique sources of scientific capability. In particular, the weapons laboratories offer a broad technology base out of which new requirements can be met. Such requirements continue to include applications directly related to weapons design and effects, such as the ability to defeat newly hardened targets. There is also a continuing and, indeed, growing demand for the application of defense science insight to improved verification of arms control agreements. To respond to all such issues in a timely fashion, the laboratories are finding they must determine technical program priorities well in advance of the stated requirements, and in the context of a complex and changing national and international security environment.

The Future

The Center for National Security Studies was established in 1986 to help

the Laboratory properly interpret the national security policy environment within which it must make technical program decisions (see "The Center for National Security Studies"). The Center undertakes research and analysis projects that explore the long-term relationships between broad national security issues and the Laboratory's most important technical programs. The nuclear weapons program is clearly one of these, and a project known as The Future of Nuclear Weapons was one of the first studies undertaken by the Center. As noted above, many consider that the special combination of deterrence policy and nuclear weapons systems has for several decades provided a stable relationship among the major nuclear powers. However, the world has not remained static, and a number of factors have combined to raise important questions about the future of nuclear weapons and the role they will play in the world.

In the Soviet Union, for example, pressures for economic restructuring appear, at least for the near term, to be reducing the emphasis on strategic competition with the West. The resulting general appearance of reduced tensions, combined with such specific consequences as the Intermediate-range Nuclear Forces (INF) Treaty, are leading to a new debate in Western Europe about future requirements for Alliance security. Some of this discussion also derives from the increasing political and economic multipolarity of the world. Emerging economic powers in East Asia and the growing military potential of other nations are straining old alliance relationships and broadening the focus of concern about international security. Finally, public opinion, particularly in Europe and the United States, is forcing a new look at the roles of nuclear weapons and the resources required to support them.

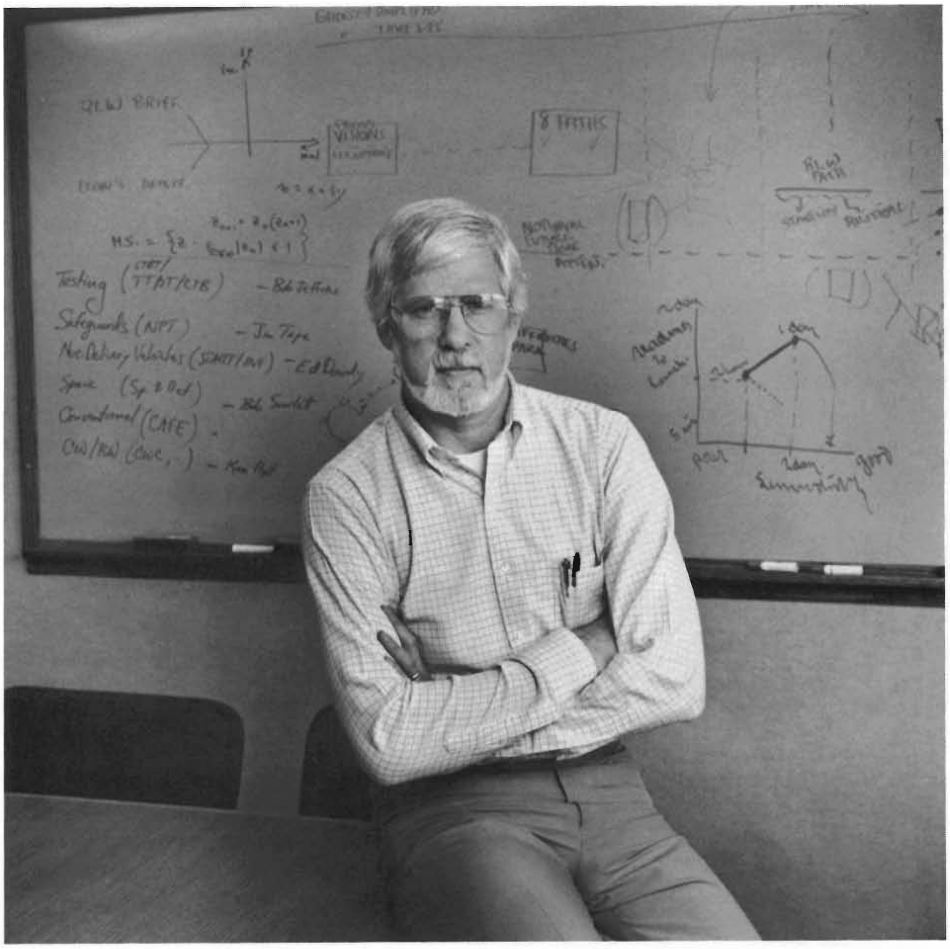
If there are major changes in the way the world and the country think about nuclear weapons, such changes would have a profound effect on the Los Alamos National Laboratory. The Laboratory has a long and distinguished history of providing the technical basis for the design, manufacture and maintenance of nuclear weapons that support the country's national security policy. About two-thirds of the nuclear weapon types in the U.S. stockpile were designed at Los Alamos, and much of the innovation that provides for improved stockpile safety and meets new stockpile requirements continues to originate here. The Laboratory has also been a source of new ideas that have enriched the scope of thinking about future nuclear weapons policy. Nuclear weapons and related programs comprise a significant fraction of the total Los Alamos budget and involve about half of the total Laboratory work force.

The possibility that national thinking about the role of nuclear weapons may change must, therefore, be an important part of the Laboratory's planning. In fact, this possibility prompted the Center for National Security Studies to undertake the Future of Nuclear Weapons project. It is hoped that the project will provide the Laboratory with the crucial background information needed to make decisions about the future character of the nuclear weapons program at Los Alamos. The questions that must be asked include:

- How will the deterrence policy of the U.S. evolve over the next several decades?
- How will any shifts in that policy affect the requirements of our nuclear force structure?
- What technical demands will be placed on the nuclear weapons laboratories to support those future requirements?
- How can the laboratories best proceed now to ensure that they retain the technical capability necessary to support future U.S. nuclear policy?

A recent conference sponsored by the Center addressed some important aspects of these questions. A number of national experts were asked to assess major factors that help shape U.S. nuclear policy. They presented their preliminary analysis to a distinguished audience gathered from government, academic and military circles, and the nuclear weapons laboratories. Extensive discussion then helped to refine the thinking, and some preliminary conclusions are examined in the following article. In a third article, Dr. Siegfried Hecker, the Director of Los Alamos National Laboratory, responds to issues raised by the conference about the future role of Los Alamos. He also discusses changes that may be necessary to position the laboratory to support the national security requirements of the future. Ultimately, the Center will publish the results of the Future of Nuclear Weapons analysis as a volume in its book series *Issues in National Security*.

The early Los Alamos scientists, working under wartime pressures, clearly recognized the significance of their technical work to the nation's security. The leaders of the project, including its director, Robert Oppenheimer, met directly with the highest government officials to determine priorities and the allocation of resources. Interactions with government and with the national security environment have become more complex in the decades since. However, the importance of the Los Alamos nuclear weapons program to national security policy has in no way diminished. The Center for National Security Studies hopes that programs such as the Future of Nuclear Weapons study will help the leaders of Los Alamos to continue providing the best possible technical resources in support of the national interest. ■



Paul C. White is currently the Acting Director of the Center for National Security Studies at Los Alamos. He earned his Ph.D. in physics in 1970 from the University of Texas at Austin, where he pursued research on general relativistic transport theory and cosmology. Prior to coming to Los Alamos, he taught physics and astronomy for six years at St. Edward's University in Austin. Since joining the Laboratory he has, among other things, been the Laboratory Program Manger for Advanced Nuclear Weapons Design Technology and served as a member of the U.S. delegation to the Nuclear Testing Talks in Geneva. He joined the Center as its Deputy Director in the summer of 1986.