

F.A.S. PUBLIC INTEREST REPORT

JOURNAL OF THE FEDERATION OF AMERICAN SCIENTISTS (F.A.S.)

Volume 54, Number 1

January/February 2001

Low-Yield Earth-Penetrating Nuclear Weapons

By Robert W. Nelson

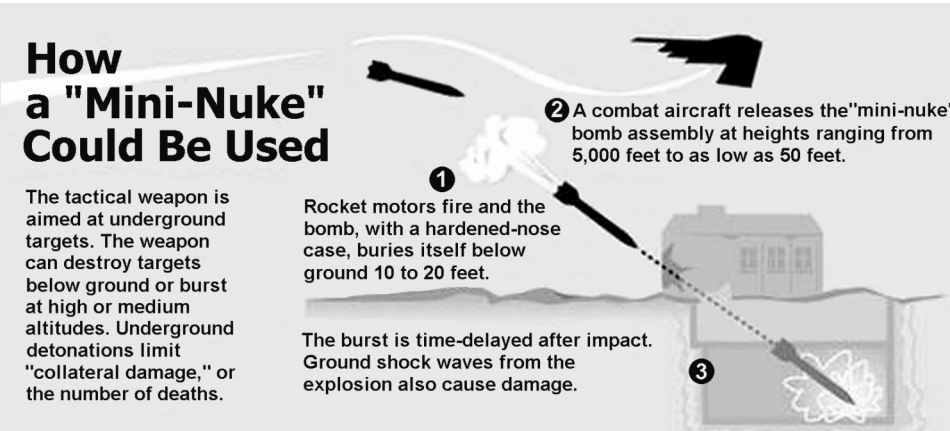


Figure 1. Diagrams like this one give the false impression that a low-yield earth penetrating nuclear weapon would "limit collateral damage" and therefore be relatively safe to use. In fact, because of the large amount of radioactive dirt thrown out in the explosion, the hypothetical 5-kiloton weapon discussed in the accompanying article would produce a large area of lethal fallout. (PHILADELPHIA INQUIRER/ Cynthia Greer, 16 October 2000.)

Despite the global sense of relief and hope that the nuclear arms race ended with the Cold War, an increasingly vocal group of politicians, military officials and leaders of America's nuclear weapon laboratories are urging the US to develop a new generation of precision low-yield nuclear weapons. Rather than deterring warfare with another nuclear power, however, they suggest these weapons could be used in conventional conflicts with third-world nations.

Critics argue that adding low-yield warheads to the world's nuclear inventory simply makes their eventual use more likely. In fact, a 1994 law currently prohibits the nuclear laboratories from undertaking research and development that could lead to a precision nuclear weapon of less than 5 kilotons (KT), because "low-yield nuclear weapons blur the distinction

between nuclear and conventional war."

Last year, Senate Republicans John Warner (R-VA) and Wayne Allard (R-CO) buried a small provision in the 2001 Defense Authorization Bill that would have overturned these earlier restrictions. Although the language in the final Act was watered down, the Energy and Defense Departments are still required to undertake a study of low-yield nuclear weapons that could penetrate deep into the earth before detonating so as to "threaten hard and deeply buried targets." Legislation for long-term research and actual development of low-yield nuclear weapons will almost certainly be proposed again in the current session of Congress.

Senators Warner and Allard imagine these nuclear weapons could

A Faith-Based Science Policy?

By Henry Kelly

Americans have a right to expect that the President will have the best possible advice both about facts defining his choices and the values that should be brought to the decision. And they have a right to expect that he can tell the difference. It's a bad sign that the new President is pushing forward on many complex issues – including preparing his first budget – without any apparent source of advice from the science community. No Science Advisor to the President has been named (let alone confirmed) and few, if any, of the Cabinet members managing major federal research portfolios come with any experience or instincts in managing science and technology.

While Clinton named his Science Advisor along with his cabinet, the elder Bush waited a full five months before having a science advisor in place – well after the internal alliances that defined the network of Presidential decision-making had been solidified. This created enormous problems; scientists in the White House find their work difficult even in the best of circumstances. Science advisors easily become the odd person out in political circles – someone who can be counted on to tell amusing stories about Mars rocks before everyone

continued on p. 6

continued on p. 2

be used in small-scale conventional conflicts against rogue dictators, while leaving most of the civilian population untouched. As one anonymous former Pentagon official put it to the *Washington Post* last spring,

“What’s needed now is something that can threaten a bunker

tunneled under 300 meters of granite without killing the surrounding civilian population.”

Statements like these promote the illusion that nuclear weapons could be used in ways which minimize their “collateral damage,” making them acceptable tools to be used like conventional weapons.

As described in detail below, however, the use of any nuclear weapon capable of destroying a buried target that is otherwise immune to conventional attack will necessarily produce enormous numbers of civilian casualties. No earth-burrowing missile can penetrate deep enough into the earth to contain an explosion with a nuclear yield even as small as 1 percent of the 15 kiloton Hiroshima weapon. The explosion simply blows out a massive crater of radioactive dirt, which rains down on the local region with an especially intense and deadly fallout.

Moreover, as Congress understood in 1994, by seeking to produce usable



Figure 2. The Pentagon has a growing collection of high precision conventional weapons capable of defeating hardened targets. In this sled-driven test, the GBU-28 laser guided bomb with its improved BLU-113 warhead penetrates several meters of reinforced concrete.

low-yield nuclear weapons, we risk blurring the now sharp line separating nuclear and conventional warfare, and provide legitimacy for other nations to similarly consider using nuclear weapons in regional wars.

In This Issue ...

Low-Yield Earth-Penetrating Nuclear Weapons	1
A Faith-Based Science Policy?	1
FAS Welcomes Sherman to Staff	7
R&D A Priority For FAS Newest Project	7
Defense Export “Reforms” Revisited	7
FAS Obtains First Bush Presidential Directive	8

FAS

The Federation of American Scientists (FAS), founded October 31, 1945 as the Federation of Atomic Scientists by Manhattan Project scientists, engages in research and advocacy on science-and-society public policy issues with an emphasis on global security policy. Current weapons nonproliferation issues range from nuclear disarmament to biological and chemical weapons control to monitoring small arms sales; related issues include drug policy, space policy, and disease surveillance. FAS also works on learning technology and on reductions in government secrecy.

NATIONAL COUNCIL MEMBERS

<i>Chairman:</i> FRANK VON HIPPEL	<i>Secretary:</i> PRISCILLA J. McMILLAN
<i>President:</i> HENRY C. KELLY	<i>Treasurer:</i> MICHAEL MANN
<i>Members:</i> RUTH S. ADAMS	MARVIN MILLER
DAVID ALBRIGHT	DAVID Z. ROBINSON
HAROLD A. FEIVESON	BARBARA HATCH ROSENBERG
JEAN F. HERSKOVITS	ARTHUR H. ROSENFELD
MICHAEL T. KLARE	LYNN R. SYKES
PRISCILLA J. McMILLAN	GREGORY VAN DER VINK

FAS FUND

The Federation of American Scientists Fund, founded in 1971, is the 501(c)(3) tax-deductible research and education arm of FAS.

BOARD OF TRUSTEES

<i>Chairman:</i> STEVEN FETTER	<i>President:</i> HENRY C. KELLY
<i>Members:</i> BRUCE BLAIR	RICHARD MULLER
MARVIN L. GOLDBERGER	PETER REUTER
MARK A. R. KLEIMAN	WILLIAM REVELLE
KENNETH N. LUONGO	HERBERT F. YORK

FAS Public Interest Report

The *FAS Public Interest Report* (USPS 188-100) is published bi-monthly at 307 Massachusetts Avenue NE, Washington, DC 20002. Annual subscription is \$25/year. Copyright©2001 by the Federation of American Scientists. • Archived *FAS Public Interest Reports* are available online at www.fas.org or phone (202) 546-3300, fax (202) 675-1010, or email fas@fas.org.

Editor: Henry Kelly, President
Assisant Editor: Karen Kelley, Organization Manager

BOARD OF SPONSORS

*Sidney Altman <i>Biology</i>	*Willis E. Lamb <i>Physics</i>
Bruce Ames <i>Biochemistry</i>	*Leon Lederman <i>Physics</i>
*Philip W. Anderson <i>Physics</i>	*Edward Lewis <i>Medicine</i>
*Kenneth J. Arrow <i>Economics</i>	*William N. Lipscomb <i>Chemistry</i>
*Julius Axelrod <i>Biochemistry</i>	Jessica T. Mathews <i>Public Policy</i>
*David Baltimore <i>Biochemistry</i>	Roy Menninger <i>Psychiatry</i>
Paul Beeson <i>Medicine</i>	Robert Merton <i>Sociology</i>
*Baruj Benacerraf <i>Immunology</i>	Matthew S. Meselson <i>Biochemistry</i>
*Hans A. Bethe <i>Physics</i>	Neal E. Miller <i>Psychology</i>
*J. Michael Bishop <i>Biology</i>	*Franco Modigliani <i>Economics</i>
*Konrad Bloch <i>Chemistry</i>	*Mario Molina <i>Chemistry</i>
*Nicolaas Bloembergen <i>Physics</i>	Philip Morrison <i>Physics</i>
*Norman Borlaug <i>Agriculture</i>	Stephen S. Morse <i>Virology</i>
*Paul Boyer <i>Chemistry</i>	*Joseph E. Murray <i>Medicine</i>
Anne Pitts Carter <i>Economics</i>	Franklin A. Neva <i>Medicine</i>
*Owen Chamberlain <i>Physics</i>	*Marshall Nirenberg <i>Biochemistry</i>
Morris Cohen <i>Engineering</i>	*Douglas D. Osheroff <i>Physics</i>
*Stanley Cohen <i>Biochemistry</i>	*Arno A. Penzias <i>Astronomy</i>
Mildred Cohn <i>Biochemistry</i>	*Martin L. Perl <i>Physics</i>
*Leon N. Cooper <i>Physics</i>	Gerard Piel <i>Publisher</i>
*E. J. Corey <i>Chemistry</i>	Paul Portney <i>Economics</i>
Paul B. Corneley <i>Medicine</i>	Mark Ptashne <i>Molecular Biology</i>
*James Cronin <i>Physics</i>	George Rathjens <i>Political Science</i>
*Johann Deisenhofer <i>Biology</i>	*Burton Richter <i>Physics</i>
Carl Djerassi <i>Chemistry</i>	David Riesman, Jr. <i>Sociology</i>
Ann Druyan <i>Writer/Producer</i>	*Richard J. Roberts <i>Biology</i>
*Renato Dulbecco <i>Microbiology</i>	Vernon Ruttan <i>Agriculture</i>
John T. Edsall <i>Biology</i>	Jeffrey Sachs <i>Economics</i>
Paul R. Ehrlich <i>Biology</i>	*J. Robert Schrieffer <i>Physics</i>
George Field <i>Astrophysics</i>	Andrew M. Sessler <i>Physics</i>
*Val L. Fitch <i>Physics</i>	*Phillip A. Sharp <i>Biology</i>
Jerome D. Frank <i>Psychology</i>	Stanley K. Sheinbaum <i>Economics</i>
*Jerome I. Friedman <i>Physics</i>	George A. Silver <i>Medicine</i>
*John Kenneth Galbraith <i>Economics</i>	*Richard E. Smalley <i>Chemistry</i>
*Walter Gilbert <i>Biochemistry</i>	Neil Smelser <i>Sociology</i>
*Donald Glaser <i>Physics-Biology</i>	*Robert M. Solow <i>Economics</i>
*Sheldon L. Glashow <i>Physics</i>	*Jack Steinberger <i>Physics</i>
Marvin L. Goldberger <i>Physics</i>	*Henry Taube <i>Chemistry</i>
*Joseph L. Goldstein <i>Medicine</i>	*James Tobin <i>Economics</i>
*Roger C. L. Guillemin <i>Physiology</i>	*Charles H. Townes <i>Physics</i>
*Herbert A. Hauptman <i>Chemistry</i>	Frank von Hippel <i>Physics</i>
*Dudley R. Herschbach <i>Physics</i>	Myron E. Wegman <i>Medicine</i>
*Roald Hoffmann <i>Chemistry</i>	Robert A. Weinberg <i>Biology</i>
John P. Holdren <i>Political Science</i>	*Steven Weinberg <i>Physics</i>
*David H. Hubel <i>Medicine</i>	*Torsten N. Wiesel <i>Medicine</i>
*Jerome Karle <i>Physical Chemistry</i>	Alfred Yankauer <i>Medicine</i>
Nathan Keyfitz <i>Demography</i>	Herbert F. York <i>Physics</i>
*H. Gobind Khorana <i>Biochemistry</i>	
*Arthur Kornberg <i>Biochemistry</i>	
*Edwin G. Krebs <i>Pharmacology</i>	*Nobel Laureate



Figure 3. A B2 bomber releases an unarmed B61-11 earth-penetrating bomb during tests in Alaska. Despite falling from an altitude of 40,000 feet, this bomb burrowed only approximately 20 feet into the soil. Any nuclear blast at this shallow depth would not be contained, and would produce intense local fallout.

Conventional Earth-Penetrating Weapons

The Pentagon already has a number of conventional weapons capable of destroying hardened targets buried within approximately 50 feet of the surface. The most well-known of these is the GBU-28 developed and deployed in the final weeks of the air campaign in the Gulf War. The Air Force was initially unable to destroy a well-protected bunker north of Baghdad after repeated direct hits. The 4000 lb GBU-28 was created from a very heavy surplus Army eight-inch gun tube filled with conventional explosive and a modified laser guidance kit. It destroyed the bunker, which was protected by more than 30 feet of earth, concrete and hardened steel.

The precision, penetrating capability, and explosive power of these conventional weapons has improved dramatically over the last decade, and these trends will certainly continue. Indeed, the GBU-37 guided bomb, a successor to the GBU-28, is already thought to be capable of disabling a silo based ICBM — a target formerly thought vulnerable only to nuclear attack. In the near future, the United States will deploy new classes of hard target penetrators which can land within one to two meters of their targets.

The B61-11 Nuclear Bomb

However, mini-nuke advocates — mostly coming from the nuclear weapons labs — argue that low-yield nuclear weapons should be designed to destroy even deeper targets.

The US introduced an earth-penetrating nuclear weapon in 1997, the B61-11, by putting the nuclear explosive from an earlier bomb design into a hardened steel casing with a new nose cone to provide ground penetration capability. The deployment was controversial because of official US policy not to develop new nuclear weapons. The DOE and the weapons labs have consistently argued, however, that the B61-11 is merely a “modification” of an older delivery system, because it used an existing “physics package.”

The earth-penetrating capability of the B61-11 is fairly limited, however. Tests show it penetrates only 20 feet

huge crater of radioactive material, creating a lethal gamma-radiation field over a large area.

Containment

Just how deep must an underground nuclear explosion be buried in order for the blast and fallout to be contained?

The US conducted a series of underground nuclear explosions in the 1960s — the Plowshare tests — to investigate the possible use of nuclear explosives for excavation purposes. Those performed prior to the 1963 Atmospheric Test Ban Treaty, such as the Sedan test shown in Figure 4, were buried at relatively shallow depths to maximize the size of the crater produced.

In addition to the immediate effects of blast, air shock, and thermal radiation, shallow nuclear explosions produce especially intense local



Figure 4. The 100 KT Sedan nuclear explosion, one of the Plowshares excavation tests, was buried at a depth of 635 feet. The main cloud and base surge are typical of shallow-buried nuclear explosions. The cloud is highly contaminated with radioactive dust particles and produces an intense local fallout.

or so into dry earth when dropped from an altitude of 40,000 feet. Even so, by burying itself into the ground before detonation, a much higher proportion of the explosion energy is transferred to ground shock compared to a surface bursts. Any attempt to use it in an urban environment, however, would result in massive civilian casualties. Even at the low end of its 0.3-300 kiloton yield range, the nuclear blast will simply blow out a

radioactive fallout. The fireball breaks through the surface of the earth, carrying into the air large amounts of dirt and debris. This material has been exposed to the intense neutron flux from the nuclear detonation, which adds to the radioactivity from the fission products. The cloud typically consists of a narrow column and a broad base surge of air filled with radioactive dust which expands to a

continued on p. 4

Crater Formation As A Function Of Depth Of Burial

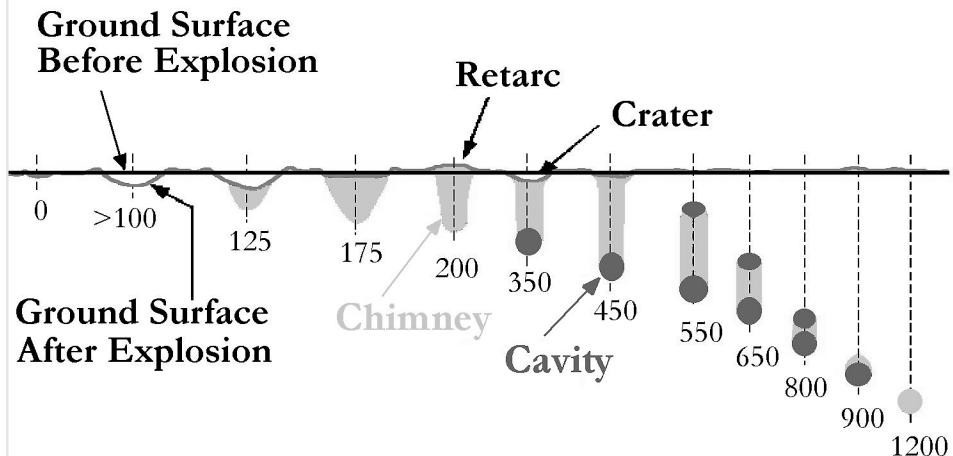


Figure 5. Underground nuclear tests must be buried at large depths and carefully sealed in order to fully contain the explosion. Shallower bursts produce large craters and intense local fallout. The situation shown here is for an explosion with a 1 KT yield and the depths shown are in feet. Even a 0.1 KT burst must be buried at a depth of approximately 230 feet to be fully contained. (Adapted from Terry Wallace, with permission.)

radius of over a mile for a 5 kiloton explosion.¹ In the Plowshare tests, roughly 50 percent of the total radioactivity produced in the explosion was distributed as local fallout — the other half being confined to the highly-radioactive crater.

In order to be fully contained, nuclear explosions at the Nevada Test Site must be buried at a depth of 650 feet for a 5 kiloton explosive — 1300 feet for a 100-kiloton explosive.² Even then, there are many documented cases where carefully sealed shafts ruptured and released radioactivity to the local environment.

Therefore, even if an earth penetrating missile were somehow able to drill hundreds of feet into the ground and then detonate, the explosion would likely shower the surrounding region with highly radioactive dust and gas.

Long-Rod Penetration

It is straightforward to show, however, that the maximum penetration depth is severely limited if the missile casing is to remain intact. One

can make reasonably accurate estimates of the penetration depth based on the well-developed theory of “long-rod penetration.” The fundamental parameter R is the ratio of the projectile ram pressure to the yield strength of the material.³ The target material yields, and penetration occurs, when R is greater than one. For a steel rod to penetrate concrete, the minimum velocities for penetration is about one half a kilometer per second (1100 miles per hour). For ductile materials, the kinetic energy lost from the penetrator can deform the target and dig out a penetration crater.

Fundamentally, however, the depth of penetration is limited by the yield strength of the penetrator — in this case, the missile casing. Even for the strongest materials, impact velocities greater than a few kilometers per second will substantially deform and even melt the impactor.

An earth-penetrating nuclear weapon must protect the warhead and its associated electronics while it burrows into the ground. This severely limits the missile to impact velocities of less than about three kilometers per

second for missile cases made from the very hardest steels. From the theory of “long-rod penetration,” in this limit the maximum possible depth D of penetration is proportional to the length and density of the penetrator and inversely proportional to the density of the target. The maximum depth of penetration depends only weakly on the yield strength of the penetrator.⁴ For typical values for steel and concrete, we expect an upper bound to the penetration depth to be roughly 10 times the missile length, or about 100 feet for a 10 foot missile. In actual practice the impact velocity and penetration depth must be well below this to ensure the missile and its contents are not severely damaged.

Given these constraints, it is simply not possible for a kinetic energy weapon to penetrate deeply enough into the earth to contain a nuclear explosion.

The Weapons Labs and the CTBT

The most vocal proponents of new small-yield weapons come from the nation’s nuclear weapons laboratories, at Los Alamos and Livermore.

In a 1991 *Strategic Affairs* article entitled “Countering the Threat of the Well-armed Tyrant,” Los Alamos weapons analysts Thomas Dowler and Joseph Howard II, argued that the US has no proportionate response to a rogue dictator who uses chemical or biological weapons against US troops. Our smallest nuclear weapons — those with Hiroshima-size yields — would be so devastating that no US president could use them. We would be “self-deterred.” To counter this dilemma, they argued the US should develop “mininukes,” with yields equivalent to 0.01-1 KT: “... nuclear weapons with very low yields could provide an effective response for countering the enemy in such a crisis, while not violating the principle of proportionality.”

More recently, in a speech to the Nuclear Security Decisionmakers Forum, Sandia Laboratory Director Paul Robinson stated

“The US will undoubtedly require

a new nuclear weapon ... because it is realized that the yields of the weapons left over from the Cold War are too high for addressing the deterrence requirements of a multi polar, widely proliferated world. Without rectifying that situation, we would end up being self-deterred.”

A more cynical interpretation of these statements is that the laboratory staff and leadership simply feel threatened by the current restrictions on their activities, and want to generate a new mission (and the associated funding) to keep them in operation indefinitely. Indeed, beginning in 1990 with the collapse of the Soviet Union and the end of the Cold War, there was serious discussion of closing one of the bomb labs.

Moreover, President Clinton ended US nuclear testing in 1993, and signed the Comprehensive Test Ban Treaty (CTBT) — a permanent worldwide ban on nuclear testing — in 1996. Despite the Senate’s failure to ratify the CTBT in 1999, its proponents believe the treaty will eventually come into force. The major nuclear powers continue to abide by the world moratorium on nuclear testing, and even India and Pakistan appear to have joined the moratorium after their May 1998 nuclear tests.

The nuclear weapons labs are particularly threatened by the CTBT, since it will probably limit them to maintaining the stockpile of weapons already in our arsenal. Keeping young scientists interested in the weapons program is especially difficult when their main job is the relatively mundane task of assuring reliability. The labs desire the challenge of designing new nuclear weapons, simply for the scientific and technical training experience the effort would bring. Hence, there is tremendous pressure to create a new mission that justifies a new development program.

But could the US deploy a new low-yield nuclear earth-penetrating weapon without testing it? Under continued political pressure to support the Test Ban and its related Stockpile Stewardship Program, Los Alamos

Associate Director Steve Younger has stated, “one could design and deploy a new set of nuclear weapons that do not require nuclear testing to be certified. However, ... such simple devices would be based on a very limited nuclear test database.”

On the other hand, it seems unlikely that a warhead capable of performing such an extraordinary mission as destroying a deeply buried and hardened bunker could be deployed without full-scale testing. First, even if the missile casing were able to withstand the high-velocity ground impact, the warhead “physics package” and accompanying electronics must function under extreme conditions. The primary device must detonate and produce a reliable yield shortly after suffering an intense shock deceleration. Second, there must be great confidence that the actual nuclear yield is not greater than expected. Since the natural energy scale for a fission nuclear weapon is of order 10 KT, much lower yield weapons must be sensitive to exacting design tolerances; the final yield is determined by an exponentially growing number of fission-produced neutrons, so the total number of neutron generations must be finely-tuned. Given that these weapons may be used near population centers, it thus seems highly unlikely that designers could certify a low-yield warhead without actually testing it.

What would be the consequence if the US decides to go ahead and test a new generation of nuclear weapons? As House Democrats expressed in a letter to Rep. Ike Skelton of Missouri, the ranking Democrat on the House Armed Services Committee,

“The resumption of nuclear test explosions that will result from such a program involving nuclear weapons would decrease rather than increase our national security and undermine US and international non-proliferation efforts.”

If the US abandons the moratorium, Russia and China will almost certainly respond in kind — destroying prospects for eventual passage of the CTBT.

Conclusion

Proponents of building a new generation of small nuclear weapons have seldom been specific about situations where nuclear devices would be able to perform a unique mission. The one clear scenario is using these warheads as a substitute for conventional weapons to attack deeply buried facilities. Based on the analysis here, however, this mission does not appear possible without causing massive radioactive contamination. No American president would elect to use nuclear weapons in this situation — unless another country had already used nuclear weapons against us.

The end of the Cold War should allow us to place further limits on the development and use of nuclear weapons. The danger of moving from a conventional to a nuclear war is so enormous, that the US refrained from using nuclear weapons in Korea even when US troops were in danger of being overwhelmed. Attempts to develop a new generation of low-yield nuclear weapons would only make nuclear war more likely, and they seem cynically designed to provide legitimacy to nuclear testing - steps that would return us to the dangers of Cold War nuclear competition, but with a larger number of nations participating. □

Robert W. Nelson, a theoretical physicist who works on technical arms control issues, is on the research staff of Princeton University and a consultant to FAS.

NOTES:

¹ The base surge radius scales roughly as $4000 W_{kt}^{1/3}$ feet, where W_{kt} is the yield in kilotons.

² In general, NTS tests are buried at depths of $D \geq 450 W_{kt}^{1/3.4}$ feet to be fully contained.

³ $R = \rho v^2 / 2Y = (v/v_c)^2$ where ρ is the projectile density, v is its velocity, Y is the yield strength of the material, and the critical velocity $v_c = (2Y/\rho)^{1/2}$

⁴ For a penetrator which is much stronger than the target, $D/L \approx (\rho_p / \rho_t) \ln(Y_p / Y_t)$, where L is the length of the penetrator, ρ is the material density, and Y is the material strength to plastic yielding; the subscripts p and t stand for the penetrator and target.

FAS Welcomes Sherman to Staff

Robert Sherman has joined FAS as Director of the Nuclear Security Program. With degrees in both chemistry and social psychology, Bob began his public life on the staff of Sen. George McGovern (D-SD), working in opposition to the Vietnam war. He became a national security specialist to several prominent House members of the Armed Services Committee and the Defense Appropriations Subcommittee, including Robert Leggett (D-CA), Bob Carr (D-SD), and Tom Downey (D-NY).

Bob's first priority has been prevention of the use of weapons of mass destruction. He played major parts in Congressional support for the SALT II agreement and opposition to the MX missile and the B1 bomber. Working with Rep. Les AuCoin, Bob was the key staffer behind the 1985 flight test ban on anti-satellite weapons. Most amazingly, in 1988 Bob persuaded Rep. "B1 Bob" Dornan, one of the most determined opponents of arms control, to be the principal Republican sponsor of a flight test ban on depressed trajectory ballistic missiles. (The ban passed the House by a 102-vote margin, was accepted in conference, vetoed by President Reagan, but became US policy under the first President Bush.)

In 1993, Bob joined the Arms Control and Disarmament Agency, which later merged with the State Department. Bob served as Executive Director of the Arms Control and Nonproliferation Advisory Board, which provided technology-intensive confidential advice to Under Secretary John Holum. Bob also did intensive negotiation on landmines, and is responsible for the provision in the Convention on Conventional Weapons that requires unmarked anti-personnel mines to self-destruct and self-deactivate. □

"A Faith-Based Science Policy?"

continued from p. 1

else gets down to dealing with the serious issues of the day.

The absence of sound scientific advice is becoming increasingly dangerous. There's much at stake and less room for error in science policy. It's hard to find a major policy issue that doesn't hinge in some important way on advances in computers and communication, biotechnology, nanotechnology, and a host of fields defined by other mouth-filling terms. Technical advances play a central role in economic growth, in national security, and finding affordable ways to improve the natural environment.

The price being paid is already visible. The administration's budget increases spending for NIH by \$2.8 billion but dangerously shortchanges research in most other areas. A \$50 million increase is requested for NSF—not enough to cover inflation. The DOE's civilian research programs will certainly be hurt—squeezed between an overall cut in the DOE budget and a requested increase for stockpile stewardship. Defense research may be highly focused on a crash effort to develop and deploy a ballistic missile system—at the expense of much needed long-term research in DARPA and other agencies. The irony, of course, is that medical research relies in essential ways on advances in physics, chemistry, information technology, and other areas supported outside of NIH—areas weakened in the current budget. The administration's very public reversal on policy about climate change appears to have been made without any serious effort to consult the scientific community—in or outside the administration.

The delay in picking a science advisor may result from the administration's inability to find a respectable scientist willing to support positions where dogma collides with the positions of the scientific community. I'd suggest the following questions for anyone chosen:

◆ Are you willing to defend tax cuts even if this clearly translates into deep reductions in federal R&D budgets? The hypothetical budget surpluses the administration proposes to give away through tax cuts are based on an

assumption that domestic spending will be tightly controlled. If tax cuts go through but the surpluses are not realized, there will be a frantic search for savings. Things will be worse if there are sharp increases in defense spending. Research funding always looks like something that can be postponed.

◆ Are you willing to tell the truth about the feasibility of ballistic missile defense systems? If there's anything clearly worse than being undefended against missile attacks, it is believing that you're safe when you're not. Will you have the courage to speak the truth on this issue?

◆ Will you prevent Americans with Alzheimer's disease, spinal cord injuries, diabetes, and other debilitating illnesses and injuries from enjoying the benefits of medical advances that can be achieved using stem cells? Anti-abortion extremists want to block promising research because of misinformed fears that it would encourage abortions. Will you have the courage to stand up to this hysteria?

◆ Will you recognize the critical role federal funding plays in ensuring that federal research helps ensure a clean environment and a secure, affordable energy supply? Drilling for oil in every US park will not come close to providing the amount of energy that can be saved by advances in technology possible in our automobiles, appliances, and industrial equipment. Will you be able to stand up to zealots who argue that the federal government has no role in applied research and explain that private incentives to invest in major innovations are seldom strong enough and federal funding is essential?

The new White House Office of Faith-Based and Community Initiatives began work quickly but the White House Office of Science and Technology Policy is still being manned by Clinton holdovers who, for obvious reasons, are largely shut out of the decision making process. An effective science and technology advisor can ensure that America's best scientific minds are brought to bear on critical national issues. Is the administration uninterested—or is it afraid—of the advice they might offer? □

R&D A Priority For FAS Newest Project

By Marianne Bakia

FAS's new Learning Technology Project is off to a running start. Our mission is to encourage the research and development needed to ensure that advances in computers, communication, and other information technologies make learning more productive, more accessible, and more fun for people of all ages. We are working to strengthen the community of scholars interested in R&D of educational technologies. This includes gathering information on worldwide R&D efforts in learning technology and making it available on our website (www.fas.org/learn/index.html should be up and running soon). Project information will include descriptions, funding levels, and contact information. Both the inter-institutional relationships and knowledge developed through such a project will be used to forge new alliances and improve sharing of

information in a nascent field where researchers often feel isolated. This work is made possible by a grant from the Spencer Foundation.

We are also working to encourage greater public funding in learning technology research. Research investment in this critical field is tiny compared with the size and importance of the education enterprise. We are working in close collaboration with other organizations to start the *Learning Federation** (a government-industry partnership in learning research) and the *Digital Opportunity Investment Trust* (a proposed resource for providing public support of the development of educational and cultural materials that could be delivered over new communication networks).

A key task has been to develop a prioritized research agenda, or "road map," for research that would create

revolutionary new ways of using technology to learn science, math, engineering, and technology education at the post-secondary level. This research would define the challenges that must be overcome to build compelling, effective and efficient learning systems using advanced information technologies and introduce new ways to evaluate them. Under NSF sponsorship, we invited thirty of the world's most prominent educational technology leaders to a workshop focused on this project. A summary of our conclusions is available on the FAS website.

If you have any questions, comments, or would like to get involved in these evolving activities, please don't hesitate to contact Marianne Bakia, Director, Learning Technologies Project at mbakia@fas.org. □

* More information can be found at www.learningfederation.org

Defense Export "Reforms" Revisited

By Tamar Gabelnick

As part of the US arms industry's never-ending quest to reduce barriers on overseas sales, they have come up with the ultimate in specious rationalizations. They claim that the current US export system – originally designed to enhance US national security and advance foreign policy goals – is now actually *weakening* US defenses.

The Pentagon's Defense Acquisition and Technology last year endorsed this argument and pushed through a series of far-reaching "reforms" to the US export system, called the Defense Trade Security Initiative (see <http://www.fas.org/asmp/campaigns/control.html> for more information). But those changes are minor compared to the proposals being put forth in a report by the Center for Strategic and International Studies (CSIS) due out at the end of

March. "Effective Export Controls for the 21st Century" makes the counter-intuitive argument that US national security would be enhanced by *eliminating* most of the current controls on arms exports. They propose not only cutting all but the most sensitive items from the controlled US Munitions List, but also eliminating the need for most export licenses. Their solution would be to replace the current transaction licensing system – where items for export are approved individually by the State and Defense Departments – to a "process" system where companies would be granted advance approval for most exports. The companies would then be trusted to comply with whatever export rules are left on the books.

The gist of the CSIS argument goes something like this. The US arms

export and technology transfer licensing system is so long, burdensome, and over-restrictive that US allies are starting to get fed up and shop elsewhere. In the CSIS' view, inflexible US controls have instigated development of an industry consolidation process in Europe that threatens to cut the US industry out of the market and leave the US hopelessly behind on technology development. This is bad for US security because interoperability with the Allies requires Europeans to rely on the US for arms and technology, not the opposite.

The report rests on inaccurate facts and less logic. Under the current system, the US arms industry maintains a large market share in Europe, making \$9.5 billion worth of new government to government sales deals

continued on p. 8

“Export Reforms Revisited”

continued from p. 7

to Europe and receiving \$56.8 billion worth of licenses for commercial arms exports in fiscal years 1996-99. The idea of European weapons technology surging past US systems is ludicrous given the amount of relative spending on research and development. Indeed, the US government blasted Europeans for a technology gap in the other direction during the Kosovo conflict.

The GAO already criticized DoD last year for putting forward reforms based on “very little data or analysis” and on examples filled with “factual errors.” The CSIS report shows the same weaknesses, relying on the using the smoke and mirrors of “a national security risk” to throw everyone off the real point: promoting the agenda of the weapons industry.

Although the CSIS report was not commissioned by the government, the ideas it puts forth are gaining a

worrisome level of support among pro-industry forces in the administration and Congress. Fortunately key congressional aides in the House International Relations and Senate Foreign Relations Committees, who would have to review any changes to arms export laws, have shown reluctance to further reduce controls for security reasons. But developments, especially regulatory changes that can circumvent Congress, bear close watching. □

Government Secrecy

FAS Obtains First Bush Presidential Directive

By Steven Aftergood

In a small victory over bureaucratic secrecy, the FAS Project on Government Secrecy obtained a copy of the Bush Administration’s first presidential directive, which the Administration had refused to officially release.

Such Presidential directives are used to establish and implement national security policy. Although they frequently authorize the commitment of government resources, they tend to escape any kind of oversight or accountability. They are often classified and more often than not are withheld from public disclosure. Even Congress is not routinely notified of their existence or contents.

According to a 1992 General Accounting Office study, the previous Bush Administration did not declassi-

fy any of its presidential directives in its first three years. (Several have been declassified since then.)

This habitual secrecy had been partially overcome in the Clinton Administration. Although most Clinton directives, then known as “Presidential Decision Directives,” remain classified, President Clinton did authorize release of his first two directives in 1993 with no fuss at all.

But in a reversion to past practice, “the White House did not publicly release the directive, even though it is an unclassified document,” the *New York Times* reported on February 16.

Nevertheless, FAS managed to obtain a copy of the document, designated National Security Presidential Directive 1 and entitled “Organi-

zation of the National Security Council System,” from a public-spirited source.

The directive is hardly a state secret. But it is an important policy document, since it defines the structure of the national security decisionmaking process, which can sometimes be a major factor in shaping policy outcomes.

One hopes that the Bush Administration will still adopt a responsible policy concerning public access to official information. Until then, the text of National Security Presidential Directive 1 is available on the FAS web site at <http://www.fas.org/irp/offdocs/nspd/nspd-1.htm>. □

FAS PUBLIC INTEREST REPORT (202) 546-3300
307 Mass. Ave., N.E., Washington, D.C. 20002; fas@fas.org
JANUARY/FEBRUARY 2001, VOLUME 54, No. 1

ADDRESS CORRECTION REQUESTED
Return Postage Guaranteed

**Periodicals
Paid at
Washington, D.C.**