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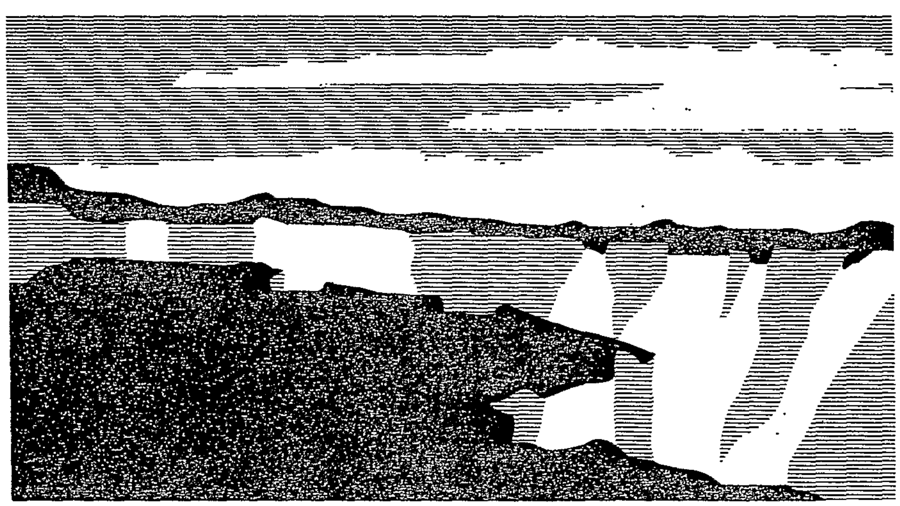

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POTENTIAL USES FOR LOW-YIELD NUCLEAR WEAPONS IN THE NEW WORLD ORDER (ROLES AND MISSIONS)

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ABSTRACT

The nation is facing a new world order in which the east-west confrontation of the past 45 years has been replaced with a potential for a wide spectrum of regional conflicts. In this new order, we see requirements for new low-yield weapons with capabilities that could deter "well-armed tyrants." We identify several weapon concepts, discuss relevant deterrent roles for these weapons, and describe their effectiveness.

In August of 1990 the nation abruptly came to realize that there was a dramatically different world "out there." President Bush announced a fundamental revision in national strategy at Aspen on the second day of that month, and Saddam Hussein validated the new strategy the same day by invading Kuwait. The threat had changed. We had endured the costs of containing Communism for 45 years, and we had finally won the cold war. The "impossible" of just two years before had come to pass. The Red Army was deploying back to its homeland, free elections had been held throughout Eastern Europe, the Warsaw Pact had disintegrated, and Germany was unified and under the umbrella of the North Atlantic Treaty Organization. Though its strategic arsenal was still awesome, the Soviet Union was no longer our most likely adversary. We needed to assess the international environment and to identify the new threats to US vital interests.[1]

THE NEW INTERNATIONAL SECURITY ENVIRONMENT

Even so, there were threats aplenty. The threat of Armageddon involving an East-West war in Europe had receded, but the threats of proliferation of weapons of mass destruction into the hands of tyrants around the world were growing.[2] The world had become so small, and our economy so intertwined with the economies of many other nations that our national security could be jeopardized by affairs taking place in many remote places.[3] As at no previous time in history, the vital interests of the United States are subject to threats in diverse regions of the world.

In view of these changing realities in the world order, the administration has been evolving a new national security strategy. The foundations of this new strategy recognize that the United States is facing a broad spectrum of threats in many places around the globe.[4] The new national strategy commits the US to maintain a modern and effective strategic nuclear deterrent. The sheer number of strategic nuclear weapons in the world will remain formidable, and such a deterrent force will be required for the foreseeable future. The US will also proceed with the development of Global Protection Against Limited Strikes (GPALS) to help deter threats posed by global ballistic-missile proliferation. Even as the cold war becomes a memory and as forward-based capabilities are reduced, the US is committed to maintain a forward presence along with our allies, although at reduced levels of forces, in regions of vital interest around the world. These forces will show our commitment, lend credibility to our alliances, enhance regional stability, and provide a crisis-response capability. Crisis-response capability, by both CONUS-based and forward-presence forces, is another foundation-stone of our new national strategy. World-wide contingency planning for crisis response will include situations where American troops are deployed into friendly nations to help defend their borders and situations where American troops will have to make a forced entry into a potential war zone. Finally, our national strategy requires that the US maintain a national capacity to reconstitute required forces.

Simultaneously, the US is reducing the size of our armed forces. Table 1 depicts this drawdown, which may result in reductions totaling a half million soldiers, sailors, airmen, and marines. Table 1 shows, for several kinds of military forces, the numbers of units that comprised the US military forces in 1990, the numbers that are contained in the official baseline force of the future, and our estimate of how low these numbers might actually fall. The government has already mandated a 25% cut from our 1990 force levels, and many important members of Congress, as well as some other members of government, are proposing a second 25% cut. While the extent of any such second cut cannot now be foreseen, we would expect that it would affect most strongly the kinds of heavy combat forces that have been associated with the cold war, including heavy Army divisions, carrier battle groups, and supporting air wings. Light crisis-response forces would be affected only minimally.

On September 27, 1991, President Bush announced a number of new initiatives which will affect the potential fighting power of these smaller forces. He announced that the US would proceed, on a unilateral basis, to eliminate our worldwide inventory of ground-launched, short ranged nuclear weapons. This includes all Army and Marine nuclear artillery shells and Lance missiles. Further, all of the Navy's tactical nuclear weapons would be returned to stateside storage, including the nuclear Tomahawk land-attack missile. This would leave us with a number of air-delivered tactical nuclear bombs in Europe, but all other tactical nuclear weapons would be stored in CONUS or disassembled.

Table 1. Projections of numbers of US military units

TYPES OF FORCES	1990 NUMBERS	PROJECTED BASE FORCE	OUR LOWER ESTIMATE
AIR FORCE			
FIGHTER WINGS	34	26	20
STRATEGIC BOMBERS	200	200	100
NAVY			
CVBGS	15	12	9
MEFS	3	3	3
ARMY			
ACTIVE DIVS	18	12	10
RESERVE/CADRE DIVS	10	8	6

During his State of the Union Address in January, 1992, the President announced similar significant reductions in our strategic nuclear forces, and even those deep reductions were superseded by the Bush/Yeltsin agreement of June, 1992. It now looks as though the national nuclear stockpile in the new world order will contain only some 3500 strategic and some 1600 tactical nuclear weapons.

While our nuclear forces are being reduced by a combination of unilateral and negotiated steps, a debate is raging as to the proper role of these weapons in the national security policy. Some argue that all nuclear weapons should be eliminated and nuclear use "de-legitimized." Others argue that the traditional purposes for nuclear weapons are still valid, that we still need to be able to fight a war in order to deter the war from happening. Our work over the past eighteen months has focused on low-yield nuclear weapons, why America needs them, and what they could do for us.[1,5]

We have found four overall reasons for having low-yield nuclear forces. The sequence of presentation in this paper is not intended to imply any relative priority among the four.

The first purpose for having low-yield nuclear forces is to provide stability, insurance, and deterrence over the long term. We cannot predict the future political and technological developments around the world, and the US must be able to counter any unpleasant surprises. We need to maintain our core technical competence in nuclear weapons, and we can help do this by continuing research and development in low-yield nuclear weapons, including prototyping certain concepts and producing limited numbers of others.

The second purpose for having low-yield nuclear forces is to meet our forward-deployed commitments to NATO. These commitments promote stability within Europe, contribute to a US presence in Europe and help deter any general war in Europe. We believe they can contribute to non-proliferation by giving extended-deterrence guarantees to major European nations, thus diminishing any incentives they may feel towards developing their own nuclear capabilities. At present, we are committed to keep a few hundred nuclear weapons in NATO.

The third purpose for having low-yield nuclear forces is as added insurance against any resurrected post-USSR threat. While four of the new republics initially shared the old Soviet force of thousands of non-strategic nuclear weapons, all but Russia have stated that they will dispose of them. At the present time we are hopeful that the leadership of the Russian republic will be able to maintain their present benevolent relationships with the free world. But we recognize that the Communist influences have not been obliterated, and there is a continuing threat of resurgent authoritarianism, which may become expansionist.

However, it is on the fourth purpose for having low-yield nuclear weapons that we wish focus. Low-yield nuclear forces carried on non-strategic aircraft and missiles can be vital in deterring nuclear-armed third-world nations. Such low-yield nuclear weapons could provide appropriate, credible usage options which would add to regional deterrence. They could be used to deter war by threatening the sanctuary of nuclear-armed third-world leadership. If deterrence fails, they could be used to protect US forces during the early stages of deployment when available conventional forces are inadequate to deter enemy aggression. Thus low-yield nuclear weapons on non-strategic carriers would fill a now-critical gap in our overall strategy of deterrence.

Within the past decade the US has been involved in several operations in the third world, including Grenada, Panama, and Kuwait. Operation Desert Shield/Desert Storm, the latest and most dramatic of these operations, is being studied intensively by military staffs around the world. Americans are not the only ones who will learn lessons from Operation Desert Shield/Desert Storm. It seems possible that some future tyrant would draw lessons from that operation concerning the costs of delay, and when the US deploys paratroopers, Marines, and airmen across his path, he might decide to attack our forces while they still lack the fighting power required to stop him. In a future world, he might even use nuclear weapons against our forces.

A STOCKPILE OF USABLE WEAPONS

What could the US do in the face of an overwhelming onslaught by a nuclear-armed enemy, whether or not that onslaught is supported by the actual use of those nuclear weapons? How could we respond in the future to a strong conventional force that is overrunning our light, advanced forces? Or how could we deter a tyrant who possesses nuclear weapons from using them against our deployed troops? If we are facing the impending annihilation of our under strength formations, how can we protect them at remote places around the globe? If available conventional weaponry is inadequate, could we use nuclear weapons effectively in order to restore a balance of forces? Unless we make changes to our national strategic stockpile, the answer is probably "No."

There were many reasons for rejecting the possible use of nuclear weapons against Iraq, even had Hussein used chemical weapons against our troops. Foremost, of course, was our reluctance to employ nuclear weapons at all, especially against a non-nuclear state. But there was also the clear belief that the destructive power of available nuclear weapons is so great that the peace-loving societies of the world, including our own, might perceive such use as disproportionate to the attack which provoked it. The strategic stockpile of the United States was designed to deter a war with the Soviet Union, and, if deterrence fails, to help us win the ensuing war. The nature of the threat then being deterred led us to deploy an arsenal of high-yield nuclear weapons, although some of them also do have selectable yields that are smaller than that of the Hiroshima weapon The political cost of using nuclear weapons that would destroy vast urban centers or cause radioactive fallout over large areas, even in response to Iraqi chemical attacks on our troops, would have been too great. Our stockpile, in the third-world context, consists of largely self-deterring weapons. We are now faced with the prospect of being armed with a nuclear arsenal that we would be unwilling to use in future third-world contingencies, even against nuclear-armed enemies. Had Saddam Hussein not allowed the coalition the time required to build up adequate defensive forces, had he attacked with all of his strength before we had deployed the air power required to rule the skies and the ground power required to stop his army, we might have been faced with having to choose between the annihilation of the 82d Airborne Division and the employment of nuclear weapons which would cause disproportionate collateral damage.

We believe that the US should have another option. We believe that we should also have the option of using nuclear weapons that are militarily effective, but which cause so little collateral damage that they are not self-deterring. Low-yield, low-collateral-damage weapons, because they might be perceived as being "usable" against a nuclear-armed tyrant in a third-world crisis, would add greatly to the overall deterrent capability of our armed forces. Their mere existence would greatly diminish any possibility that we would ever face a situation where they would be needed.

We have been considering possible roles for nuclear weapons with explosive yields between those of non-nuclear munitions and current nuclear weapons. Whereas today's non-nuclear weapons have explosive yields measured in the hundreds of pounds of high explosive, the Hiroshima bomb had an explosive yield measured in the tens of millions of pounds of high explosive. Between these two highly disparate capabilities, we have been looking at ways weapons of intermediate power could be used in third world conflicts. Specifically, we have been investigating ways to use weapons with explosive yields equivalent to 10 tons of high explosive, which we term "micronukes," 100 tons, termed "mininukes," and 1000 tons, termed "tinynukes."

POSSIBLE ROLES FOR "MICRONUKES"

As with all nuclear weapons, the primary role of micronukes would be deterrence. In the case of a micronuke, it would be deterrence of any attack by a nuclear-armed third-world tyrant. This would include, but not be restricted to, a nuclear attack.

Micronuke weapons could be effective in several roles. Perhaps the most interesting is the deployment of a micronuke as an earth-penetrating warhead (EPW). A micronuke EPW would be capable of destroying leadership facilities and command centers that are too deep to be successfully attacked with conventional weapons. While intelligence difficulties preclude using such a weapon to kill any specific leader, the capability to destroy these buried sanctuaries could be a very effective deterrent. In another role, micronuke EPWs could be effective in helping understrength early-deployed air forces fight superior enemy formations by cratering runways so effectively as to stop or interfere with air operations from those bases for a week or two at a time.

Micronuke EPWs could be militarily effective and still cause very little collateral damage. It is the combination of very low yield with burial that accounts for this. Fig. 1 shows the depths to which a 10-ton weapon would cause stresses of 1/4 kilobar (about 3500 psi) for a surface burst, for a burst buried 10 meters, and for a burst buried 15 meters. Stresses of this level would destroy most buried command facilities. As the weapon is buried to 10 or 15 meters the depth to effect goes from about 6 meters, for a surface burst, to 25 or 32 meters in a particular geology. The geology which we used for our calculations included of a layer of moraine, sandy loam with gravel, down to the water table at a depth of 20 meters, below which was a layer of sand, loam, clay, and gravel.

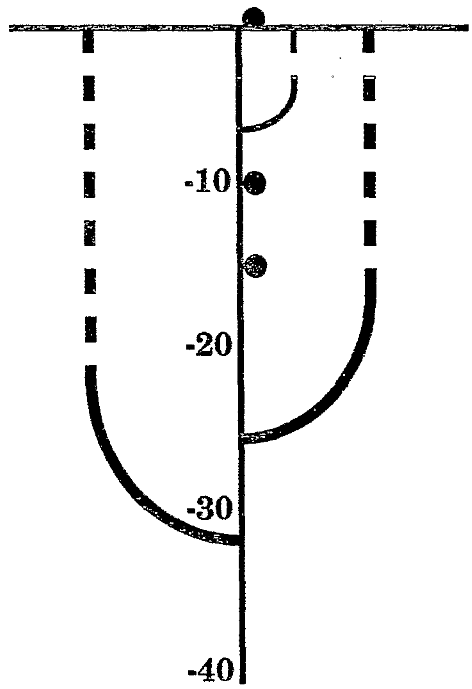

Figure 1 1/4 kilobar stress contours from micronukes

Concurrently with increasing the military effectiveness, burial reduces the collateral damage caused by the weapon. Fig. 2 shows that the radius to a radiation dose level of 100 rads decreases from about 600 meters to about 150 meters as the weapon is buried. Of course, people who are shielded by structures or other objects will receive an even smaller dose. Whole-body doses up to about 100 rads will generally produce blood changes but seldom will produce any illness.[6] Fig. 2 also shows that the radius to an overpressure level of 1 psi reduces from about 300 meters to about 80 meters as the micronuke is buried. An overpressure level of 1 psi is considered to cause only light damage to structures. Thus the prompt collateral damage from a micronuke EPW is likely to be constrained within one city block.

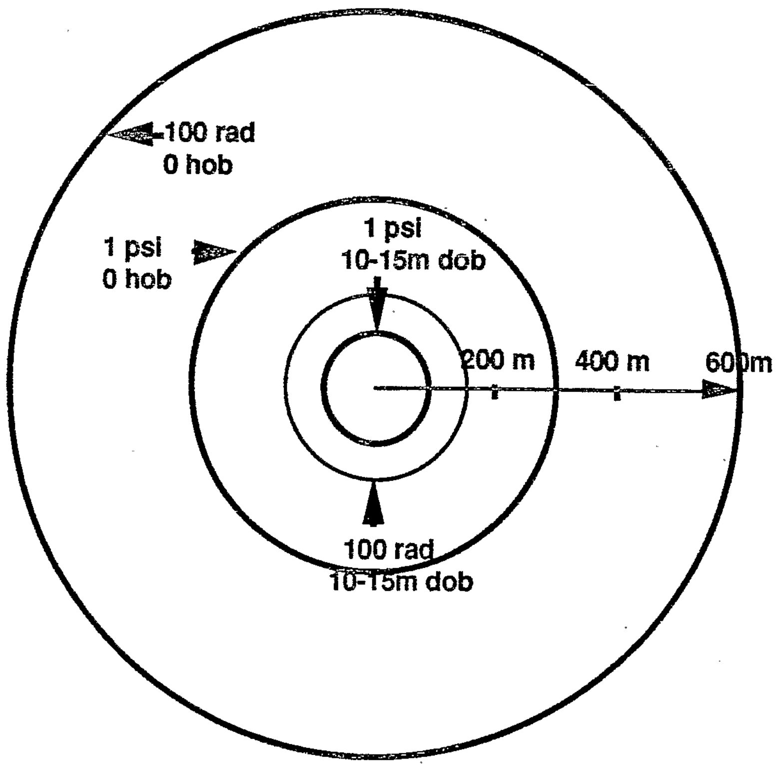

Figure 2 Radii of prompt collateral effects from micronukes

Fig. 3 shows the collateral prompt-effects radii from three weapons, each of which drives 1/4 kilobar to a depth of 32 meters. As we have seen, this can be achieved by a 10-ton EPW buried at 15 meters. It can also be achieved by a 30-ton EPW buried at 10 meters, but a surface-burst weapon would require a yield of 6500 tons to achieve the same depth to effect. Fig. 3 shows the radii to 100 rads and to 1 psi for each of these three options.

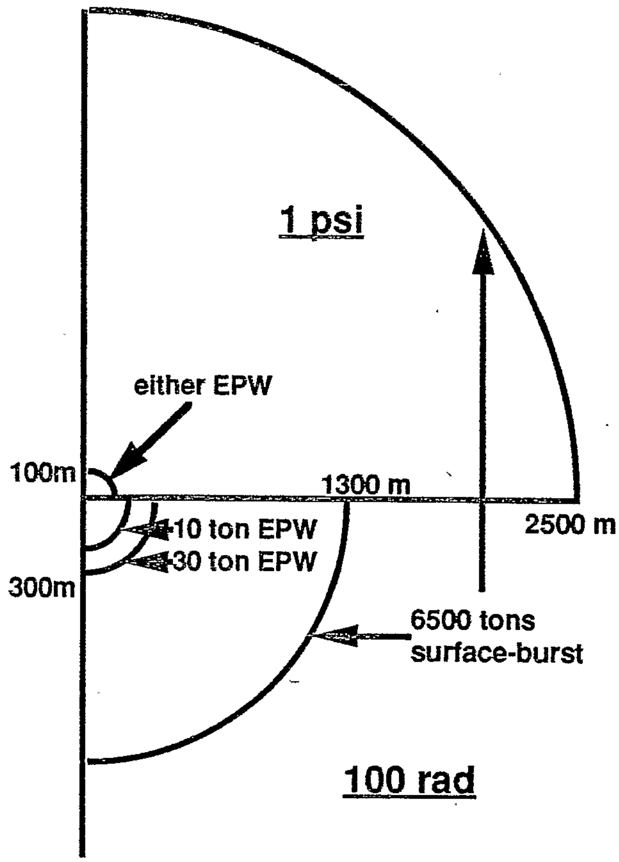

Figure 3 Radii of collateral damage from three equally-effective nuclear weapons

Fig. 4 depicts the relative fallout areas from these same three options. Fallout of at least 10 rad/hour at H+1 hours would give a lifetime dose of 70 rads to anyone continuously exposed from 5 minutes after the burst onward. The 10 rad/hour iso-dose rate contour from a 6500 ton surface burst would cover some 300 square kilometers, that from a 30 ton EPW buried 10 meters would cover some 2 square kilometers, and that from a 10 ton EPW buried 15 meters would cover only about 0.05 square kilometers, for the assumed wind conditions.[7]

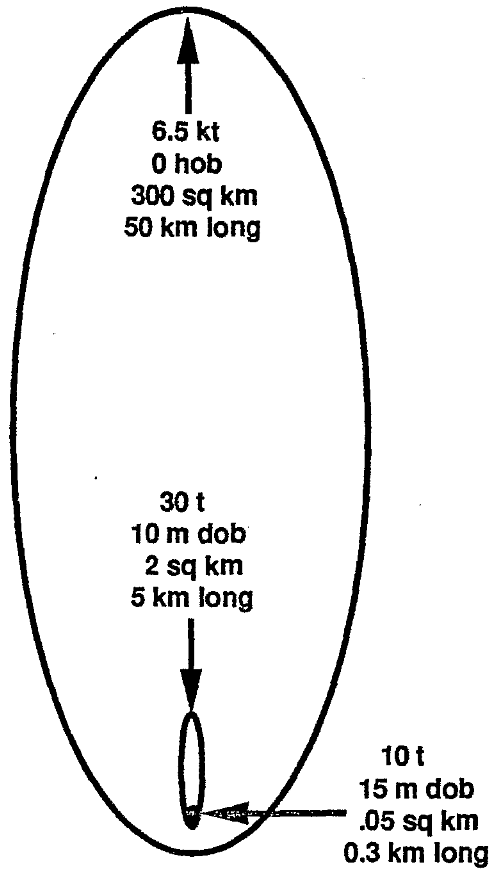

Figure 4 Relative fallout areas from three equally-effective nuclear weapons

In addition to being useful for destroying underground leadership and command/control bunkers, micronuke EPWs can be used to create militarily-effective craters. Such craters could be about 15 meters in radius with a total volume of about 3000 cubic meters, and the craters would be highly radioactive.[8] The dose rate inside one of these craters would be on the order of 6000 rads/hour at H+1 hours. The biggest problem in repairing a runway crater is the compaction of the material as it is being placed to fill the crater. Because of the depth and steepness of a crater caused by a micronuke EPW, refilling and recompaction would be a time-consuming affair. However, the radiation environment is such that even after waiting a day to begin, workers can work for only short periods before they become ill.[9] Even with the realization that under exceptional conditions individual humans will sacrifice themselves heroically, our estimates are that it would take one to two weeks before aircraft could again operate over the cratered area.

This is in stark contrast to the lack of effectiveness of runway craters caused by conventional weapons. The experience of Desert Storm repeated the experience of World War II; conventional craters can be repaired overnight. In a difficult air war, when our outnumbered, initially-deployed forces may be fighting for their existence, this increased effectiveness might make the difference between winning and losing. A few low-collateral-damage micronukes could shut down an enemy airfield for a significant period of time. Shutting down several such fields should allow the US time to deploy the conventional forces required to achieve air superiority.

Some have asked why we would not just make a 10 ton conventional EPW. The answer is that a conventional EPW with 10 tons of high explosive might have a total weight of 25 tons. If such a weapon could be carried, it could not be guided accurately to its target as a micronuke EPW could, and thus would not provide the same military effectiveness.

POSSIBLE ROLES FOR "MININUKES"

Mininukes could be used in a number of roles, including those described above for micronukes and those described below for tinynukes. We shall discuss the role of a mininuke in an advanced anti-ballistic missile for theater defense.

The Gulf war demonstrated the value of being able to defend against short- to intermediate-ranged ballistic missiles. It also demonstrated that a conventional high-explosive warhead is of limited effectiveness in this role. Two alternatives have been proposed, a "hit to kill" interceptor and an interceptor armed with a small nuclear weapon.

Of course, the nuclear weapon offers several distinct advantages over the "hit to kill" interceptor. Unlike the other concept, a nuclear warhead offers a significant lethal radius, which may become even more valuable as third world nations learn to deploy countermeasures and penetration aids with their warheads.

Another concern about "hit to kill" interceptors is that they might not make the incoming warhead ineffective. This concern is highlighted when nuclear, chemical, or biological warheads are considered. A nuclear interceptor can destroy each of these types of warheads outright, so that they will not be able to inflict damage even if they do come to earth. An incoming nuclear warhead can be destroyed by the neutron radiation from the interceptor. Chemical and biological warheads can be destroyed by the x-ray and gamma-ray radiation created by the interceptor. This radiation can neutralize the agents in the warheads as well as damage or destroy the agent container.

A nuclear-tipped theater anti-ballistic missile could be integrated into an overall theater ballistic missile defense which could include both space-based and point-defense assets. Thus integrated, these defensive weapons could contribute significantly to deterring the use by a third-world tyrant of ballistic missiles carrying weapons of mass destruction.

POSSIBLE ROLES FOR "TINYNUKES"

In the early stages of deployment into a crisis region, our troops might face overwhelming enemy forces. The situation in such a circumstance would be exactly parallel to that in which the US found itself in Europe in the 1950s. At that time the overwhelming numbers of Soviet tank formations threatened our forces. Theater nuclear weapons were developed to deter those formations from attacking, and to restore the balance of the battlefield if deterrence failed. In case a third-world tyrant were to attack our light early-entry forces, available conventional weaponry might not be adequate to prevent the annihilation of our troops. To deter any such an attack, and to defeat it if deterrence fails, we should have the capability of employing suitable nuclear weapons directly against the enemy forces, whether or not those forces had actually used nuclear weapons in their attack. To succeed in these roles, the available weapons would have to be both militarily effective and politically usable. We believe that the high lethality and low collateral effects offered by air-delivered, low-yield nuclear weapons could meet both these criteria, and they might be the only weapons systems that could save our forces from annihilation.

Fig. 5 shows the lethal radii from a tinynuke to troops in tanks and troops in the open. We observe that these radii would be quite effective against company formations, even if the weapon were aimed at an individual element of the company instead of being aimed at its centroid. Fig. 5 also shows the negligible risk radius for unwarned, exposed troops from a tinynuke. This radius is small enough to consider employing this weapon against enemy formations directly in contact with our forces.[10]

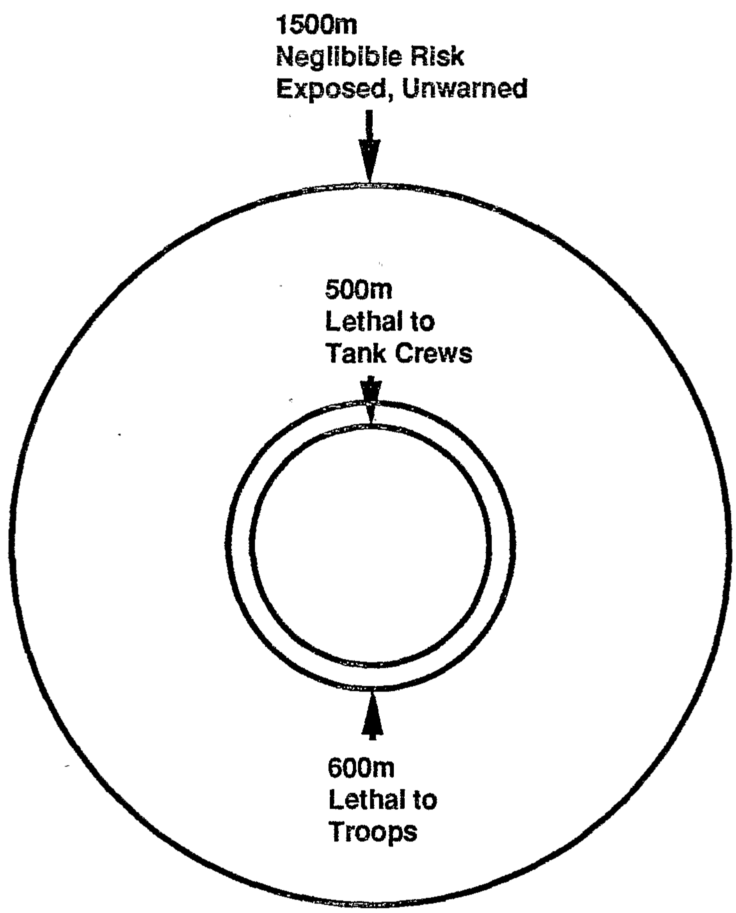

Figure 5 Lethal and negligible-risk radii from tinynukes

If the weapon were carried on a short-standoff missile, it could be employed accurately as an airburst. With the effective radii shown on Fig. 5, precision accuracy is not needed for military effectiveness, but we must have high confidence that the weapon does not fall on our own troops. In addition to the physical effectiveness of employing several such nuclear bursts, the psychological effects on enemy troops of the "flashes in the sky" would surely be devastating.

An airburst would be needed to preclude significant fallout. Fallout goes in unpredictable directions, and the radiation that results endures for a considerable time. A surface burst of a tinynuke would cause fallout of at least 10 rads/hour at H+1 hours to cover as much as 60 sq km and extend almost 20 km downwind. The Chernobyl disaster was basically a demonstration of the catastrophic and enduring effects of radioactive fallout, and causing such long-term collateral effects over a large area in a third-world crisis would probably be unacceptable

Significant organizational changes will be required in order to acquire an effective battlefield capability with tinynukes. With the pending elimination of Army and Marine nuclear weapons, any tactical nuclear weapons support will have to come from the Air Force or from the Navy. This may require formal tasking of one or both of these services to provide this support. It will certainly require changes in battlefield target-engagement concepts and upgraded planning procedures, command and control, and communications for joint operations.

SUMMARY

We believe that the long-term nuclear stockpile of the US should include several hundred low-yield nuclear weapons. These weapons would help provide long-term stability and deterrence against world-wide contingencies, as well as insurance against technological surprises. They could be used to meet our forward-deployed commitments to NATO and to provide insurance against any possible resurrection of a tactical nuclear threat from the former Soviet Union. But their main role would be to help deter aggression by future third-world nuclear states.

These low-yield nuclear weapons systems should include a spectrum of weapons, including stand-off tinynukes for battlefield deterrence, theater-ballistic-missile-defense missiles carrying mininukes, and accurate micronuke EPWs to deter tyrants by being able to threaten third-world leadership facilities and to create militarily-effective craters for shutting down airfields, among other things.

NOTES

(1) Thomas W. Dowler and Joseph S. Howard, II, "Countering the Threat of the Well-Armed Tyrant: A Modest Proposal for Small Nuclear Weapons," Strategic Review, Fall 1991.

(2) Robert L. Pfaltzgraff Jr., "The Army as a Strategic Force in 90s and Beyond," Army, February 1990, pp. 20 - 26; and David Rubenson and Anna Slomovic, "The Impact of Missile Proliferation on U. S. Power Projection Capabilities," The RAND Corporation report N-2985-A/OSD, Santa Monica, CA, June 1990.

(3) Steven R. David, "Why the Third World Matters," International Security, Summer 1989 (Vol. 14, No. 1), pp. 50 - 85; Fred C. Ikle and Albert Wohlstetter, "Discriminate Deterrence: Report of the Commission on Integrated Long-Term Strategy," U. S. Government Printing Office, Washington, DC, January 1988; and Robert J. Art, "A Defensible Defense: America's Grand Strategy After the Cold War," International Security, Spring 1991 (Vol. 15, No. 4), pp. 5 - 53.

(4) National Military Strategy of the United States, U.S. Government Printing Office, Washington, DC, January 1992.

(5) Joseph S. Howard, II, and Thomas W. Dowler, "Battlefield Nuclear Deterrence: Vital and Viable, Without Army Weapons," Los Alamos Report LA-UR:92-24, January 1992.

(6) Samuel Glasstone and Philip J. Dolan, The Effects of Nuclear Weapons, prepared and published by the United States Department of Defense and the Energy Research and Development Administration, Washington, DC, 1977

(7) The weapons effects were calculated by the authors. They used the DNA code DUG1C for ground shock (J. L. Drake and A. C. Remson, "DUG1C

User's Guide," DNA-TR-88-196, September 6, 1988); air blast is based on Plowshare data (ADM Employment, US Army Special Text 5-26, US Army Engineer School, Fort Belvoir, VA, November 1969, p. 98); prompt radiation was calculated with the Los Alamos prompt-radiation-dose code DOSRNG; and fallout was calculated with the Los Alamos fallout code, LASEER.

(8) Crater dimensions were calculated from ADM Employment, *op cit,* p. 164.

(9) Fallout doses as a function of time are derived from Samuel Glasstone and Philip J. Dolan, *op cit*, p. 401.

(10) Lethal and troop-risk radii are derived based on many calculations by the authors using Los Alamos codes DOSRNG and LADCAR

THE AUTHORS

Thomas W. Dowler served 20 years in the US Army Corps of Engineers, serving in both the Korean and Viet Nam conflicts. His last Army assignment was on the Joint Strategic Target Planning Staff. For the past 20 years he has been a member of the technical staff at the Los Alamos National Laboratory where he has been performing weapons-effects and force-effectiveness analyses. He is an alumnus of the United States Military Academy at West Point and the Massachusetts Institute of Technology.

Joseph S. Howard II has been involved in economic analyses and nuclear weapon conceptual studies as a member of the technical staff at Los Alamos National Laboratory since 1974. He is currently a theater force analyst. He has continued in the Army Reserve within the nuclear weapons field following active duty during 1972-1974. His undergraduate work was at the Virginia Military Institute, while his Ph.D. was earned at Virginia Tech.

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