A Guide to the Microfilm Edition of

NUCLEAR WEAPONS, ARMS CONTROL, AND THE THREAT OF THERMONUCLEAR WAR: SPECIAL STUDIES


UNIVERSITY PUBLICATIONS OF AMERICA
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# TABLE OF CONTENTS

Editorial Note ........................................................................................................ v
Initialism List .......................................................................................................... vi

## Reel Index

<table>
<thead>
<tr>
<th>Reel</th>
<th>Year</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>1983</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>1984</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td>1985</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td>1986</td>
<td>3</td>
</tr>
<tr>
<td>2–5</td>
<td>1986 cont.</td>
<td>7</td>
</tr>
<tr>
<td>6–9</td>
<td>1987</td>
<td>22</td>
</tr>
<tr>
<td>10</td>
<td>1987 cont.</td>
<td>39</td>
</tr>
<tr>
<td></td>
<td>1988</td>
<td>41</td>
</tr>
</tbody>
</table>

Subject Index ........................................................................................................ 47
EDITORIAL NOTE

The executive branch of the U.S. government requires a massive amount of information to make policy decisions. The many departments, agencies, and commissions of the government devote much of their energies to gathering and analyzing information. However, even the resources of the U.S. government are not adequate to gather all the information that is needed; therefore the government contracts universities, colleges, corporations, think tanks, and individuals to provide data and analyses. Because the great majority of these studies are difficult to find and obtain, University Publications of America (UPA) publishes some of the most important ones in its Special Studies series. The Nuclear Weapons, Fourth Supplement collection consists of studies on nuclear weapons, arms control, and the threat of nuclear war that became available during the period of 1987–1988.
INITIALISM LIST

The following acronyms and initialisms are found in this guide and are listed here for the convenience of the researcher.

ABM  Anti-ballistic missile
CTB   Comprehensive test ban
CTBT  Comprehensive test ban treaty
ICBM  Intercontinental ballistic missile
INF   Intermediate-range nuclear forces
LLNL  Lawrence Livermore National Laboratory
NATO  North Atlantic Treaty Organization
SALT  Strategic Arms Limitation Talks
SDI   Strategic Defense Initiative
SDIO  Strategic Defense Initiative Organization
SICBM Small intercontinental ballistic missile
USSR  Union of Soviet Socialist Republics
0001 The Environment of the Long-Range Theatre Nuclear Force Program, Its Opponents and the Effects of Specifics of the Program on Opposition.


This report examines West European opposition to the modernization of NATO intermediate range nuclear forces (i.e., the deployment of Pershing-Z ballistic missiles and ground-launched cruise missiles). Notable differences between U.S. and European perceptions of the peace movement are discussed.


This report considers certain historical and political aspects of the security community between the United States and Western Europe. The importance of Western Europe to the United States was recognized by American policymakers for fifty years prior to the founding of NATO. The vital U.S. interest in NATO security thus is not closely related to the brief period of overwhelming American nuclear superiority in the 1950s, but both preceded and followed that era. Recurrent NATO crises should be viewed in this light. American isolationism was never as absolute as is remembered and is unlikely to return, since its ethnic basis has been removed by world events. American volatility is a source of concern on both sides of the Atlantic, but this can be smoothed out by skillful leadership. Current arguments opposing the U.S. guarantees to NATO are examined by the author and found to be inadequate and unrealistic.
1984

0451 Battlefield Fires from Nuclear Weapons.
Fires from tactical weapon exchanges in open terrain can be an important factor in assessing casualties and damage as well as managing troop deployments and operations. In addition to prompt thermal effects and fire starts, spread may also be an important factor on the battlefield. In this report, a model describing the initiation and spread of battlefield fires is presented. The initial ignition distribution is related to the weapon yield, slant range, local atmospheric properties, fuel type, and ignition threshold. The fire spread analysis is based on an established U.S. Forest Service prediction algorithm. The present tactical ignition and fire spread model predicts the fire movement over variable terrains and accounts for ambient wind vectors, moisture, changing vegetation, and an arbitrary number of firebreaks. An example calculation illustrating the initial fire area and subsequent spread in a complex terrain is presented for a 10-KT explosion. The results show the fires extending the effective weapon-damage radius and identify regions to which the fires do not spread.

1985

0485 Safeguarding Our Space Assets.
The vulnerability of military space systems depends on their orbits, functions, and other characteristics. In particular, the high-altitude satellites needed for warning and communications could be vulnerable to prompt destruction by certain space-based systems and, in the future, possibly by ground-based, high power lasers. A combination of passive countermeasures and arms control agreements could give these satellites some protection against such attack. Deployment of strategic defensive systems with the capability to reach far into space would invalidate this approach.

0493 Nuclear Test Program.
An interview with Dr. Robert W. Kuckuck, deputy associate director for nuclear testing, is presented, which surveys the LLNL's efforts in nuclear testing, the need for testing, and the role of testing in the overall weapon design process. The complex activities coordinated in the fielding of a nuclear test at the Nevada Test Site are described. Advances in nuclear testing technology are highlighted, including: x-ray spectroscopy, development of electro-optical data transmission systems, electro-optical downhole imaging
systems, image data acquisition, diagnostics using charged-particle detectors, analyzing of radioactive nuclides, isotope mass spectrometry for nuclear test diagnostics, canister design, emplacing nuclear event cables with an automated system, the digital downhole surveyor, and measurements on subsurface rock.

1986

0540 The Strategic Defense Initiative and the Prospect for International Cooperation in Space.


While the nature of international cooperation in space is for politicians and diplomats to determine, the prospects for such cooperation have technical and economic bounds upon them. What these bounds are and how the SDI of the Western Alliance may impact them will be discussed. It is concluded that the SDI, due to its institutional youthfulness, its charter for large-scale research, and its de facto monopoly on such activity is likely to dominate the technical aspects of the prospects for cooperation in space for the next quarter-century, especially if it continues more-or-less as the current American administration contemplates. The author concludes that both the technical and the economic aspects of international cooperation in space are likely to be substantially enhanced due to the existence of the SDI.

0556 Strategic Defense Initiative.


This collection of vugraphs states that space power reactors, neutral beams, and flywheel energy storage technologies are important areas to be investigated for application to the SDI.

0574 Soviet Noncompliance.


Survivability of the Hardened Mobile Launcher When Attacked by a Hypothetical, Rapidly Retargetable ICBM System.


This thesis evaluates the survivability of the Hardened Mobile Launcher system against a hypothetical enemy ICBM system. The hypothetical system has two key capabilities: it can obtain near real-time intelligence information regarding the Hardened Mobile Launchers' location, and it can be retargeted in flight (as necessary) according to the intelligence information. Thus, the hypothetical ICBM threat systems can attack individual Hardened Mobile Launchers directly rather than rely on a "barrage attack" against Hardened Mobile Launcher bases. Monte Carlo simulation is used to approach the problem. The model is an MBASIC computer program written and run on an Apple Macintosh computer. The model simulates the flight of the attacking ICBMs (there may be as few as one or as many as fourteen warheads directed at each Hardened Mobile Launcher) and the random dispersal tactics of a single Hardened Mobile Launcher. The model determines the locations of the detonations and the location of the Hardened Mobile Launcher at time of detonation. Based on these locations, probability of kill due to peal blast overpressure is calculated. A key parameter in the model is intelligence/retargeting cycle time—the amount of time required to obtain intelligence and retarget accordingly. This time is varied from one to thirty minutes. The model also allows variations in Hardened Mobile Launcher speed and hardness and threat system circular error probability. A subroutine for examining the effects of neutron fratricide on the attacking warheads is also included (although the effects were found to be negligible). The main result of this thesis is that very small intelligence/retargeting cycle times are required for this to be an effective weapon system against the Hardened Mobile Launcher. Thus, with today's technology (or technology of the near future) the Hardened Mobile Launcher can be considered a very survivable system.

Small Intercontinental Ballistic Missile Modernization.


A task force considered a range of ICBM and basing alternatives, with emphasis on the question of survivability and stability. The following principal deployments were analyzed: (1) 500 SICBMs deployed in Hardened Mobile Launchers on four existing U.S. government complexes in the Southwest; (2) 50 MX ICBMs deployed in a variable number of superhard silos (patterned array); and (3) 50 MX ICBMs deployed in carry-hard configuration (i.e., in hardened cannisters deployed among a large number of low cost, vertical shelters). The task force concluded that there is at least one SICBM basing mode—and possibly one or more MX basing modes—which, although costly, have a high degree of survivability and accordingly are suitable candidates for deployment by the United States.
0750 Morality to Strategy: Perspectives on Offensive Weapons in Space.
Since President Reagan introduced the concept of the SDI in March 1983, space-based weapons have been a subject of broad national debate. To date, all consideration has focused on defensive applications, yet the technology that permits SDI is equally capable of supporting offensive weapons. This paper proposes increased consideration of offense-related space issues. It outlines the moral, political, and military implications of such weapons and identifies several potential applications. The military utility of these weapons is considered in the context of current military strategy. Shortfalls are identified between current capabilities and strategies for power projection, air-land warfare, and limited strategic warfare. For each shortfall, the possible contribution of space-based weapons is considered. The paper reviews space weapon's support requirements and identifies issues associated with institutional advocacy. It concludes by recommending further analysis and debate on the subject of offensive weapons in space.

0778 Battle Management In Space.
This paper asks whether the battle manager of the future will be a human or a computer and where he/it will be located. The sensors, weapons, and problems with the missile attack warning systems that the battle manager works with in today's airbreathing and missile threat need to be understood before decisions can be made about the future. The paper states that the technology driving the decisions and the time to make the decisions are key factors in space battle management. When and how to kill a missile launched either from Soviet soil or space and the myriad of things that must happen before the battle manager can make a decision is discussed, the first being that the missile(s) must be detected; then all the information about the missile(s) needs to be passed to the battle manager and all the decision makers in the chain of command including the National Command Authority. The author emphasizes that the communication process must be fast and not affected by either jamming or nuclear bursts and it also must be designed so that if a part is destroyed the system is still responsive to the battle manager. Questions are asked such as should only the United States be protected by this system or should it also include U.S. allies? who are they and should an international body control the system? The author concludes that the battle manager of the future will be located in space.

0803 Friction In the Development of Arms Control Policy.
This paper reviews the arms control policy and decision making process of the last several administrations with emphasis on how frictional forces, not
unlike those discovered by von Clausewitz, affected the process. Friction within administrations, as a result of congressional actions, from nongovernmental organizations, and from the media is discussed. Friction is present in every process involving individuals and organizations with differing views and objectives. It may not be desirable to remove all friction from the process, even if it were possible to do so, lest the decision makers stifle creativity and lose the benefit of a variety of views and approaches.

0855  
An Interim Strategic Defense Initiative Arms Negotiation Strategy.
This report comments on some of the pros and cons of the SDI. Key issues discussed relate to the projected cost of SDI and the potential violation of the 1972 ABM Treaty. A solution is proposed that has the potential to significantly reduce the total cost, which circumvents the treaty, resulting in the deployment of a more effective ballistic missile defense system.

0887  
Little Boy to Star Wars: The Evolution of American Deterrence.
This paper follows the historical and sociological development of the American deterrent posture in the nuclear age since its dawn at Alamagordo, New Mexico, July 16, 1945, and the use of the “Little Boy” over Hiroshima three weeks later. A description of Western man’s involvement in and reaction to pre-1945 catastrophic circumstance is followed by a comparative examination of the post-1945 changes in national policy in regard to the use and dangers of total war. Using Bernard Brodie as a theoretical deterrent baseline, the author analyzes the ethical and military shifts in U.S. declaratory (versus actual) nuclear policy through Paul Nitze’s statements of future policy in light of strategic defense. The author concludes that extremely effective—not necessarily perfect—defenses can have dramatically beneficial effects on arms control. But at the same time, such a condition must inevitably result in a de facto reversion of U.S. nuclear policy to that of a small, non-counterforce force de frappe deterrent—similar in effect to that of the present French posture. The implications of this upon the U.S.-Soviet force balance, the historical trends of the “American Way of War,” and the present “deterrent mind-set” of the officer corps, are left as a grave concern.
Restricting Production of Fissionable Material As an Arms Control Measure—An Updated Historical Overview. 

One of the earliest proposals for control of nuclear weapons was to restrict or control production of fissionable material. This paper reviews the evolution of this proposal from its initial appearance in 1946 to 1985.

Protecting U.S. Space Assets from Anti-Satellite Weapons. 
*Lawrence Livermore National Laboratory, Livermore, California. S. Fetter and M. M. May. [Conference on high technologies and reducing the risk of war, New York.] May 1986. 26pp.*

Over the years, the United States has become increasingly dependent on space-based assets to support its military policies. Satellite systems are required to a considerable extent to carry out nuclear operations and to support military forces during a conventional war. Current and future anti-satellite technologies may be capable of preventing these systems from carrying out their mission, thereby possibly decreasing the stability of deterrence. This paper explores what can be done to safeguard our space assets.

Attacking Relocatable Targets with the B-1B: A Methodology for Analyzing the Effectiveness of Alternative Weapons. 

This research effort developed a methodology to investigate the effectiveness of the B-1B using both conventional and nuclear weapons against a wide range of relocatable targets. An interactive Monte Carlo simulation was developed to model the B-1B sortie from takeoff through target destruction. Emphasis was placed on modeling relationships at a macroscopic level. An unclassified analysis of the Short-range Attack Missile, gravity nuclear bomb, conventional and nuclear cruise missile, and the SKEET conventional sensor fused weapon against the Soviet SS-20 Intermediate-range Ballistic Missile was conducted using this method. A single measure of effectiveness, the percentage of relocatable targets destroyed, was employed. Relationships among target dwell time, relocatable target location update time, target hardness, and probability of finding the relocatable target were examined for their impact upon weapon effectiveness.
Responsible Soldiering In the Nuclear Age: Inferences from the Catholic Bishop's Pastoral on Nuclear War.


This study is an attempt to develop an ethic for those who must perform soldierly duties in this era. It is an examination of core values, and how these values have been translated into military ethics and obligations within the context of western civilization. This study uses the most recent application of just war theory, the Catholic bishop's pastoral on nuclear war, "The Challenge of Peace: God's Promise and Our Response," and compares instruction to selected findings of another contemporary application, the Nuremburg Trial. The manner in which we construct and reinforce our moral values in conscience, coupled with appreciation for the sanctity of human existence, evolve as fundamental underlying principles. After having established the scope of authority from which the Catholic bishop's pastoral derives its credibility, these principles are compared against the United States Army Ethic and a contemporary ethic is proposed. The study concludes that ultimately we are responsible for the decisions and choices that we make. Soldiers are not absolved, especially within the Judeo-Christian context, from the obligation to make choices based upon sound moral reasoning, simply because they are engaged in activities that run against the grain of orderly human existence. In fact, because of the nature of soldierly obligations, the soldier's standard may be more stringent. If the foregoing logic holds, then a soldier must expect and be provided a guide or set of standards against which he can measure his contemplated action in the potential to actual nuclear environment. That set of standards, or code of ethics, in order to be truly professional, must allow for rule of conscience and assume a relationship that transcends national institutional and territorial integrity.

U.S. Arms Control Obligations under the Non-Proliferation Treaty.


Article VI of the Non-Proliferation Treaty obligates the nuclear weapon states parties to the treaty "to pursue negotiations in good faith on effective measures relating to cessation of the nuclear arms race...to nuclear disarmament, and on a treaty on general and complete disarmament under strict and effective international control." The preamble to the Non-Proliferation Treaty recalls the 1963 Limited Test Ban Treaty "determination... to achieve the discontinuance of...explosions." These provisions are interpreted by a majority of the non-nuclear weapon states parties to the treaty as an obligation of the nuclear weapon states party to the treaty to pursue a CTB. However, a review of the history of the Non-Proliferation Treaty negotiations and U.S. ratification proceedings makes clear that the Non-Proliferation Treaty imposes no legal obligation on the United States to pursue a CTB. The United States did not make a one-to-one correspondence between Article VI and any specific arms control measure; to the contrary, the United States argued
successfully that such a connection (to any specific measure) would be pernicious to the attempt to achieve agreement on the Non-Proliferation Treaty. This interpretation, which was sustained through the negotiations and the ratification proceedings, still reflects the limits of the legal obligations that the United States has accepted. But, in the absence of progress on other arms control measures, which would relieve the pressure for a CTB, the majority interpretation creates political difficulties for the United States and could threaten the Non-Proliferation Treaty regime in the future. These problems highlight the need for the United States to better defend its compliance with Article VI and to develop a long-term strategy that will permit necessary testing while assuring the survival of the Non-Proliferation Treaty regime in effective form.

United States' Arms Control Obligations under the Non-Proliferation Treaty.
Article VI of the 1968 Non-Proliferation Treaty obligates the nuclear weapon states parties to the treaty "to pursue negotiations in good faith on effective measures relating to cessation of the nuclear arms race... to nuclear disarmament, and on a treaty on general and complete disarmament under strict and effective international control." The preamble to the Non-Proliferation Treaty refers the 1963 Limited Test Ban Treaty "determination... to achieve the discontinuance of... explosions." These provisions are interpreted by many non-nuclear weapon states party to the NPT as an obligation of the nuclear weapon states party to the treaty to pursue a CTB. However, a review of the history of the Non-Proliferation Treaty negotiations and U.S. ratification proceedings makes clear that Article VI imposes no legal obligation on the United States to pursue a CTB. The United States did not make a one-to-one correspondence between Article VI and any specific arms control measure; to the contrary, the United States argued successfully that such a connection (to any specific measure) would be pernicious to the attempt to achieve agreement on the Non-Proliferation Treaty. The interpretation held through the negotiations and the ratification proceedings, however, a majority of Non-Proliferation Treaty signatories assert that Article VI does indeed imply a commitment to a CTB. In the absence of progress on other arms control measures, which would relieve the pressure for a CTB, this interpretation creates a political problem for the United States and could threaten the Non-Proliferation Treaty regime in the future. These problems emphasize the need for the United States to more clearly explain its compliance with Article VI and to develop a long-term strategy that will permit necessary testing while assuring the survival of the Non-Proliferation Treaty regime in effective form.
0360 **Defense and Stability.**
This study investigates prevenient stability. The effects of strategic defensive systems are analyzed. The exchange code is used to examine the changes in crisis stability and deterrence brought about by various levels of strategic defense for both U.S. and USSR cities. Results show that crisis instability rises slightly as either side alone increases its defense effectiveness, with maximum instability occurring at values of defense effectiveness approximating 80 percent. After that point, crisis stability increases until the situation can be regarded as more stable than it was initially. Results also show that when both superpowers increase their defense effectiveness simultaneously, crisis instability reaches a maximum at the same time mutual deterrence begins to decrease. These findings cast doubt on the wisdom of sharing strategic defense technology.

0375 **Possible Soviet Response to the Strategic Defense Initiative: A Functionally Organized Taxonomy.**
In the wake of the SDI, much effort has been devoted to estimating potential Soviet responses to it. There is general agreement that the Soviet response will (1) consist of attempts to stop, circumvent, emulate, and neutralize the SDI; (2) include political, military, and strategic efforts; and (3) vary over time, depending on several factors. Setting aside Soviet technological options, this note considers various factors that might interest or influence senior Soviet decision makers as they consider a range of programmatic, strategic, and political options for responding to the SDI. Its goal is to identify generic categories of Soviet response options rather than the specific forms those options may take.

0439 **Nuclear Explosives for Peaceful Purposes.**
The U.S. Plowshare program, designed to develop peaceful uses of nuclear explosives, was vigorous between 1957–1973 and was of concern during U.S. and USSR nuclear treaty negotiations within that period. In order to accommodate possible future applications, the Peaceful Nuclear Explosions Treaty was signed in 1976. The U.S. program explored the phenomenology of nuclear explosions and tested their use in industrial applications. Due to waning industrial interest and public concern over environmental issues, the U.S. program was terminated in 1977. The Soviet counterpart to the Plowshare program, which has involved roughly 100 experiments throughout the USSR, continued until the self-imposed moratorium in 1985. As any peaceful use of nuclear explosives has the potential of furthering weapons research, the United States takes the position that all such experiments would have to be banned in a CTBT.
SDI (Strategic Defense Initiative) and the U.S. Defense Posture.
Issues surrounding the SDI are discussed. Comments are made on the research and development program and the effect of this program on the defensive posture of the United States.

Nuclear Explosives for Peaceful Purposes.
The U.S. Plowshare program, designed to develop peaceful uses of nuclear explosives, was vigorous between 1957–1973 and was of concern during U.S. and USSR nuclear treaty negotiations within that period. In order to accommodate possible future applications, the Peaceful Nuclear Explosions Treaty was signed in 1976. The U.S. program explored the phenomenology of nuclear explosions and tested their use in industrial applications. Due to waning industrial interest and public concern over environmental issues, the U.S. program was terminated in 1977. The Soviet counterpart to the Plowshare program, which has involved roughly 100 experiments throughout the USSR, continued until the self-imposed moratorium in 1985. As any peaceful use of nuclear explosives has the potential of furthering weapons research, the United States takes the position that all such experiments would have to be banned in a CTBT.

On the Degree of Verification Needed to Support a Comprehensive Test Ban.
The military significance of nuclear explosive tests is discussed and illustrated with the aid of the recent (1980 thought 1984) U.S. nuclear testing record. It is concluded that nuclear tests with yields that are but a small fraction of a kiloton are militarily significant, particularly for purposes of nuclear weapons research. These could be conducted in fully decoupled seismically quiet, reusable cavities, and would be well below the threshold of reliable detection and identification by seismic or other means presently under consideration. For this reason it is concluded that the degree of verification needed to support a CTB is not available at the present time. A Threshold Test Ban with explosive yields limited to five kilotons, as proposed by Defense Secretary Harold Brown, appears to present a much more realistic near-term possibility.

This volume is a history of the Nuclear Testing Personnel Review program from 1978 to 1986. It identifies the origins, missions, and historical evolution.
of the effort, focusing on the contributions of the Defense Nuclear Agency, the Nuclear Testing Personnel Review teams, the Veterans Administration, and the Department of Energy. In addition, the narrative describes U.S. nuclear operations, including weapons testing and the atomic bombing of Hiroshima and Nagasaki, Japan, personnel participation in those operations; and radiation safety measures. The report also discusses radiation dose determination and medical studies of potential dose effects.

This study examines national interest theory in the light of the INF controversy. The perceptions and position of the United States, the Soviet Union, France, the United Kingdom, and several non-nuclear members of NATO are examined and analyzed. The analysis is concerned with alliance and transnational considerations, military capabilities, and domestic political constraints. Where necessary, the historical and cultural perceptions, as well as the strategic requirements of the nation involved, are factored in. The study concludes with an overview of the options available to the nations involved in the INF controversy.

One of the earliest proposals for control of nuclear weapons was to restrict or control production of fissionable material. This paper reviews the evolution of this proposal from its initial appearance in 1946 to 1985.

Reel 3

1986 cont.

Table of Contents.

As one of the nation's weapons design laboratories, LLNL plays a vital role in designing and maintaining the nuclear weapons that make up the U.S. nuclear deterrent. To fulfill this responsibility, the weapons program at LLNL has sustained the following four broad-based efforts: (1) ensuring that the weapons in the stockpile are safe and reliable, (2) developing warhead
options for new weapon systems, (3) maintaining expertise in nuclear weapons design and development, and (4) providing technical support for this nation's objectives in arms control and verification. The weapons program, philosophy, and process of developing nuclear weapons for the nation's strategic defense are discussed.

Research and development of nuclear weapons, supported by nuclear testing, serves a key role in maintaining the credibility of this nation's nuclear deterrent. The weapons design laboratories must ensure that the current weapons in the stockpile are safe and reliable. The laboratories also must develop options for warheads for the new weapon systems that are designed to ensure the safety, security, survivability, and military effectiveness of the U.S. deterrent. Nuclear testing is essential to this process; it is the only way to verify that the stockpile weapons will perform as expected and that the new weapons will function as designed. Without nuclear testing, the U.S. deterrent would still be based on nuclear weapons but at a significantly higher cost and with greater uncertainty.

The design, development, and production of the nuclear weapons that enforce our national policy of deterrence is a complicated, demanding, and long-term process. It is carried out jointly by the Department of Energy and the Department of Defense under the authority of the president and with the concurrence and budgetary support of the U.S. Congress. Three weapons laboratories, of which the LLNL is one, and seven production plants contribute to the effort. The development process itself is divided into eight phases: concept definition, feasibility studies, cost studies, development engineering, production engineering, production, stockpiling, and retirement. The LLNL plays a major part in the early phases and continues its involvement with the weapons until they are retired.

Energy and Technology Review. The Weaponization Program.
The Weaponization Program has responsibility for all LLNL-designed warheads from their development engineering, through production, to placement in the U.S. stockpile. This responsibility continues with the evaluation and confidence testing of stockpiled LLNL warheads until they are retired. Each nuclear warhead designed by the LLNL must meet its military specifications, be properly engineered for production, and be safe and reliable throughout its stockpile life. LLNL has developed expertise in many supporting technolo-
Frame

gies to accomplish these tasks, including warhead initiation systems, weapons safety and testing, engineering analysis, computer-integrated design and manufacturing, and accident response preparedness. The LLNL-designed warheads have an excellent history of safety and reliability under severe environments for long lifetimes.

The primary objective of U.S. strategic nuclear forces is deterrence of nuclear war. The deterrent value of U.S. strategic forces rests on their ability to retaliate with appropriate force after a surprise attack. To counter Soviet nuclear advances, President Ronald Reagan gave the highest priority to the modernization of strategic nuclear forces. This report concentrates on the status of land-based ICBM modernization with emphasis on the development of survivable means of basing for Peacekeeper (also referred to as MX) and SICBMs (also referred to as Midgetman). Important decisions are to be made in the near future on these systems. This report was prepared to assist the Congress in its consideration of these decisions. Survivable basing was emphasized because it has been and continues to be a key issue.

This report examines the public record of nuclear arms control debates in the United States—as reflected in speeches, testimony, editorials, and other public documentation—and formulates and tests hypotheses about arms control. Each hypothesis reflects the view of one or more important participants or constituencies in the policy-making process. The basis for analysis is provided by five case studies, negotiations, and agreements; viz., the 1969 Limited Test Ban Treaty, the 1971 Accident Measures Agreements, the 1972 SALT I ABM Treaty and Interim Agreement of Offensive, the 1979 SALT II Treaty, and the 1977–1979 negotiations on antisatellite weapons. The hypotheses deal with the following ten critical dimensions of arms control: (1) importance of bargaining from strength, (2) prospects for returning genies to their bottles, (3) effects of unilateral restraint, (4) linkage between arms control and other policy areas, (5) effects of arms control on arsenals, (6) uncertainties in estimates in the forces of the other side, (7) verification and compliance, (8) the lulling effect, (9) political support, and (10) asymmetries in American and Soviet benefits and risks. The historical evidence generally is mixed, and only rarely can a hypothesis be demonstrated unambiguously to be either true or false. But often the weight of evidence tips the balance strongly one way or the other.


This study updates the author’s technical report, “Soviet Exploitation of the ‘Nuclear Winter’ Hypothesis,” June 5, 1985, and is based on Soviet open-source materials and papers given at various scientific seminars. It examines and analyzes Soviet-published research on and propaganda uses of the “nuclear winter” phenomenon during the period of mid-1984 to mid-1986. In particular, the study seeks to ascertain the character, limitations, and degree of seriousness of Soviet research on nuclear winter, the validity of Soviet claims of having independently confirmed Western findings, and the extent to which Soviet work on nuclear winter is intended to serve political propaganda rather than serious scientific objectives. The analysis of Soviet source materials shows that Soviet scientists have made only minimal contributions to nuclear winter research and that much of the published work has continued to be based on worst case war scenarios, parameters, and values, and projections of climatic changes derived from seriously flawed 1983 models and computations in the United States and Soviet Union. For political and propaganda reasons, most Soviet open sources on nuclear winter have continued to ignore new Western and even some Soviet projections of more moderate climatic effects. It appears that Soviet efforts to model nuclear winter have run their course and that more emphasis will be placed on the synergistic effects of nuclear war on the ecology and atmosphere.

Strategic Defenses and the Transition to Assured Survival.


This report details the anatomy and calculus of the ballistic missile portion of the transition to a robust nationwide strategic defense posture, as proposed by President Reagan on March 23, 1983. To provide insight into the policy issues surrounding the transition, the authors develop an analytic format based on ballistic missile defense potential. The defense potential format demonstrates that, if highly survivable strategic defenses were deployed as an adjunct to current superpower ballistic missile forces, the United States could make the transition to the president’s goal of assured survival from ballistic missile attack without having to pass through a period during which either the United States or the USSR would have great incentive to launch a first strike against the other. If, however, the defenses are vulnerable to attack and/or both superpowers continue to deploy weapons capable of destroying hard targets but fail to adopt corresponding offensive force survivability measures, a stable transition would become less likely.
Space: The Fourth Military Dimension.

This study considers space as the fourth and newest military dimension and examines the implications of spacepower and new technologies on land warfare to the mid-twenty-first century. A resurgence of interest in military space operations among the senior leadership of the army began around 1983. Studies had established that, while the army was not fully exploiting the potential capabilities of space to support land combat, it was already more dependent on space systems than was readily apparent on the surface. This dependence was increasing yearly without any planning having been done to evaluate its impact on future land combat operations’ overall goals and objectives for army participation in space activities. The army has begun to correct these shortcomings but many far-reaching decisions need to be made in the near future. This study examines some aspects of space as the fourth military division which need to be considered in making these decisions as space systems become operational military systems. The author concludes that the army does not have the qualified personnel or organizational structure to use space and space-based systems to their fullest potential. This is an immediate requirement, and meeting this challenge will greatly help in the longer range requirements of assessing and incorporating military operations in space and space technologies into land warfare, preparing the army to fight in a four-dimensional environment, and establishing the proper perspective in the army for space operations.

Changing Soviet Doctrine on Nuclear War.

In January 1977, Soviet General Secretary L. I. Brezhnev delivered an address in the city of Tula, and the impact on Soviet doctrine and capabilities continues to this day. By rejecting the possibility of a means of defense against nuclear weapons, or a damage-limiting capacity in nuclear war, Brezhnev closed the door on a debate that had lasted for over a decade in Soviet military thought. Since Tula, the Soviet politico-military leadership has presented a consensus on the reality of “Mutual Assured Destruction” in present-day conditions. The Soviet debate on the viability of nuclear war as an instrument of policy was likewise resolved by a consensus: nuclear war is so unpromising and dangerous that it remains an instrument of policy only in theory, an instrument of policy that cannot be used. While the Soviet consensus on the diminishing military utility of nuclear weapons represents a ground-breaking shift in doctrine since the heyday of Marshal Sokolovkiy, there is scant evidence of any dispute on the new correlation of war and policy in a nuclear age. Marshal N. V. Ogarkov and other hard-minded military figures have themselves emerged as the architects of the Soviet shift away from a nuclear war-fighting and war-winning strategy, while General Secretary Gorbachev has fashioned a corresponding arms control agenda.
On-Site Inspection for Verification of a Comprehensive Test Ban Treaty.

A seismic monitoring system and on-site inspections are the major components of a verification system for a CTBT to give parties assurance that clandestine underground nuclear weapon tests are not taking place. The primary task lies with the seismic monitoring system, which must be capable of identifying most earthquakes in the magnitude range of concern as earthquakes, leaving a small number of unidentified events. If any unidentified event on the territory of one party appeared suspicious to another party, and thus potentially an explosion, an on-site inspection could be invoked to decide whether or not a nuclear explosion had taken place. Over the years, on-site inspections have been one of the most contentious issues in test ban negotiations and discussions. In the uncompleted test ban negotiations of 1977–1980 between the United States, the United Kingdom, and the USSR, voluntary on-site inspections were established as a basis for negotiation. Voluntary on-site inspections would require a common interest and cooperation between the parties toward resolving suspicions if on-site inspections were to serve the purpose of confidence building. On the technical level, an on-site inspection could not assure identification of a clandestine test, but an evader would probably reject any request for an on-site inspection at the site of an evasive test, rather than run the risk of an on-site inspection. The verification system does not provide direct physical evidence of a violation. This could pose a difficult and controversial decision on compliance.

The Strategic Context for Assessing Long Range Offensive and Active Defense.

This technical report discusses the relation between systems for attack and systems for active defense, assessing various courses of action, and identifies critical technologies. It warns against certain forms of arms agreements, and points out the paralyzing effects of a belief in mutual assured destruction. It also discusses the consequences of nuclear proliferation.

Nuclear Explosives for Peaceful Purposes.

The U.S. Plowshare program, designed to develop peaceful uses of nuclear explosives, was vigorous between 1957–1973 and was of concern during U.S. and USSR nuclear treaty negotiations within that period. In order to
accommodate possible future applications, the Peaceful Nuclear Explosions Treaty was signed in 1976. The U.S. program explored the phenomenology of nuclear explosions and tested their use in industrial applications. Due to waning industrial interest and public concern over environmental issues, the U.S. program was terminated in 1977. The Soviet counterpart to the Plowshare program, which has involved more than 100 experiments throughout the USSR, continued until the self-imposed moratorium in 1985. As any peaceful use of nuclear explosives has the potential of furthering weapons research the United States takes the position that all such experiments would have to be banned in a CTBT.

The primary charter of the workshop was to consider the design of the ground-to-orbit launch systems (as opposed to, e.g., orbit-changing propulsion). The first three days of the workshop were devoted to talks on various aspects of laser propulsion and related areas such as free electron lasers. The remainder of the workshop was devoted largely to discussions of specific issues in the design of laser-energized thrusters and laser launch systems. The development of any type of laser propulsion would significantly expand the range of feasible space missions. Several types of laser propulsion are thus mentioned herein, and work on all types of laser thrusters is recommended. True low-cost access to space, however, will require a laser launching system that is as simple and robust as possible. To this end, the summary emphasizes the extremely simple detonation-wave thruster concept, defined originally by Dennis Reilly and in its current form by Arthur Krantrowitz, on which the latter part of the workshop concentrated.

The U.S. Air Force proposes to deploy an advanced land-based SICBM to improve the nation’s strategic deterrent force. Development of this missile system was recommended by a presidential commission and directed by Congress. The commission recommended that this missile be smaller and lighter than previous ICBMs, be compatible with both mobile and fixed basing modes, and meet modern performance and survivability goals. The Legislative Environmental Impact Statement identifies and compares potential regional impacts of deployment and peacetime operations of the ICBM in three alternative basing modes. This is to support decisions on full-scale development of the ICBM and selection of the basing mode(s) and deployment area(s). Two of these modes involve special vehicles known as Hardened Mobile Launchers that can transport and launch the missiles. The
third basing mode involves deployment of the missiles in underground silos that are also hardened against attack. The Hardened Mobile Launcher in random movement basing mode, the first mobile mode, involves day-to-day operation of Hardened Mobile Launchers on existing Department of Defense or Department of Energy installations. The second mobile mode involves situating Hardened Mobile Launchers primarily at existing Minuteman ICBM launch facilities. The final alternative, the hard silo in patterned array basing mode, involves underground silos situated in staggered rows within fenced arrays. One or more of these basing modes may be selected. Six different deployment areas are under consideration for each of the three basing modes. The areas under consideration for the Hardened Mobile Launcher in random movement basing mode are in Arizona, California, Florida, Nevada, New Mexico/Texas, and Washington; those at Minuteman facilities are in Missouri, Montana, North Dakota (two areas), South Dakota, and Wyoming/ Nebraska/Colorado; and the areas for the hard silo in patterned array basing mode are in Arizona (three areas), California, New Mexico/Texas, and Wyoming. The number of missiles that have been analyzed in any given area ranges from 50 to 250. The total force to be eventually deployed could range from 250 to 1,000 missiles. The direct employment in any given area during the year of peak-construction activities could range from approximately 2,100 workers to more than 5,000, depending on the basing mode selected and the number of missiles deployed in the area. Potential project-induced environmental impacts in each area and for each basing mode are identified in the Legislative Environmental Impact Statement by the following categories: socioeconomics, utilities, transportation, land use, cultural and paleontological resources, biological resources and threatened and endangered species, air quality and noise, water resources, and geology and soils.

This thesis discusses the impact of the atomic bomb on traditional naval strategy as that strategy has developed under the influence of Captain Alfred T. Mahan, how traditional naval strategy was modified by the development of naval aviation, the lessons of World War II and the leadership of James Forrestal, and how the adoption of atomic weapons into naval strategic planning was integrally tied to naval aviation. The growth of the Soviet Union as a threat to world peace, and interservice rivalry over roles and missions are compared as factors that influenced the development of post-World War II naval strategic thinking. The navy's reaction to the adoption of massive retaliation as the foundation of the national strategic nuclear policy is discussed and analyzed.


This paper discusses Soviet political responses to Trident and the Tomahawk nuclear land-attack missiles (TLAM-N). Soviet strategy in arms control is reviewed and attention placed on linkage to U.S. strategic offensive forces to the SDI. Possible Soviet responses to U.S. proposals are explored.


The military significance of nuclear explosive tests is discussed and illustrated with the aid of the recent (1980 through 1984) U.S. nuclear testing record. It is concluded that nuclear tests with yields that are but a small fraction of a kiloton are militarily significant, particularly for purposes of nuclear weapons research. These could be conducted in fully decoupled seismically quiet, reusable cavities, and would be well below the threshold of reliable detection and identification by seismic or other means presently under consideration. For this reason it is concluded that the degree of verification needed to support a CTB is not available at the present time. A threshold test ban with explosive yields limited to five kilotons, as proposed by Defense Secretary Harold Brown, appears to present a much more realistic near-term possibility.


This monograph examines the ability of the Army of Excellence heavy division's command and control function to support tactical operations on the
nuclear battlefield envisioned in AirLand Battle Doctrine. To determine the adequacy of this function, the monograph describes both U.S. and Soviet doctrines for tactical operations on the integrated battlefield and implications of Soviet doctrine for the command and control of U.S. forces. Current U.S. doctrine for the organization, process, and facilities of the heavy division's command and control function provides the basis for establishment of criteria to judge this system. The criteria fall into two general areas: the process, which includes the way of thinking, and the physical structure. Consideration of the adequacy of the heavy division's command and control function, then, occurs within the framework provided by defensive and offensive tactical situations. The monograph draws the conclusion that although the decentralized command and control method Auftragstaktik appears to be a strength of the system, overall the heavy division falls short in its capability to provide an assured capacity for performance of critical tasks within a nuclear environment. Major deficiencies include a questionable ability to generate plans and mission orders during combat operations and an inadequate physical structure to provide for continuity of command and control.

The purpose of this act is to give effect to Australia's obligations as a party to the South Pacific Nuclear Free Zone Treaty of August 6, 1985. The act is supplemented by the provisions of the Environment Protection (Sea Dumping) Act of 1981 as amended in 1986 as regards dumping of radioactive material into the sea. The act repeats the substantive provisions of the treaty and lays down prohibitions in relation to nuclear explosive devices.

Nuclear Weapon R&D and the Role of Nuclear Testing.
There are four fundamental reasons for nuclear testing: (1) to maintain confidence in the existing stockpile; (2) to modernize the stockpile for improved safety, security, survivability, and military effectiveness; (3) to assess the vulnerability of weapons to the nuclear threat environment posed by the weapons of adversaries; and (4) to avoid technological surprise by maintaining the scientific judgement necessary to understand the limits of weapon potential. These four reasons are individually discussed in this report.
Crisis Management in the Nuclear Age.
This report examines the management tasks and problems that face leaders of the superpowers in international crises: gathering and assessing information, indentifying and evaluating options, coordinating the functions of huge complex organizations communicating with adversaries and allies, and implementing decisions through far-flung human and technological organizations, all in a compressed period of time and with immensely high stakes. It also discusses various ideas for improving crisis management. The report emphasizes, however, that crisis resolution sometimes competes with other goals of national leaders. Although the report raises more issues than it resolves, it is hoped that increased recognition of the problems can aid crisis management by making decision makers more consciously aware of the complex bureaucratic, psychological, and technical interactions that can affect the success of their efforts.

Strategic Defense, Deterrence, and Arms Control.

Nuclear Weapon R&D and the Role of Nuclear Testing.
As one of the nation's weapons design laboratories, LLNL plays a vital role in designing and maintaining the nuclear weapons that make up the U.S. nuclear deterrent. To fulfill this responsibility, the weapons program at LLNL has sustained the following four broad-based efforts: (1) ensuring that the weapons in the stockpile are safe and reliable, (2) developing warhead options for new weapon systems, (3) maintaining expertise in nuclear weapons design and development, and (4) providing technical support for this nation's objectives in arms control and verification. John D. Immele, deputy associate director for nuclear design, James V. Tyler, assistant deputy associate director for military applications, and Paul S. Brown, assistant associate director for arms control, discuss the weapons program at LLNL and the philosophy and process of developing nuclear weapons for the nation's strategic deterrent.


Nuclear testing is receiving much public attention recently because of the Soviet moratorium. From a nuclear weapon scientist's perspective, nuclear tests are essential to maintain the credibility of the U.S. nuclear deterrent. Nuclear tests are necessary for modernization of weapon systems in a world of rapidly advancing technology and changing conditions, they are necessary for ensuring that weapons are safe from accidental detonation, and they are necessary for determining that weapons are reliable and will perform as designed. Whereas non-nuclear tests and computer simulations are valuable tools, there is no substitute for experimental data from nuclear tests. Nuclear testing is required to maintain the competence of weapon scientists and engineers, is the only way they can gain necessary experience, and verifies the adequacy of their judgements. Confidence in U.S. nuclear forces now and in the future is based on the competence of weapon scientists and engineers. As long as the nuclear deterrent continues to be the major ingredient in U.S. defense policy, a CTB is not in the U.S. interest.


All nuclear tests conducted and announced by the United States from July 1945 through December 1986 are listed chronologically and alphabetically by event name, with the exception of the GMX experiments. The listing for each event provides the event name, date, location, type of test, purpose, and yield range. Total numbers of tests are also given by year, type, detection of radioactivity, location, and purpose.


This progress report summarizes the activities of the Division of Applied Seismology during 1986. In detection seismology the work at the division has been greatly influenced by the agreement by the Ad Hoc Group of Scientific Experts at the Conference on Disarmament in Geneva to redesign the global verification system to routinely utilize waveform data. This is a most significant agreement towards the establishment of a modern high quality global seismological network. The development of this new system involves considerable technical as well as scientific challenges.
Comparison of Open and Closed Multimegawatt Space Power and Weapon Systems.

One of the major questions that is being addressed at present by SDI's Multimegawatt Space Power Project is whether or not space weapon power systems must be closed, i.e., whether effluents from the systems are tolerable. If they are not tolerable, the major penalty that must be paid to close space systems is increased mass. Open systems remove waste heat by producing effluents, e.g., hot hydrogen gas. Closed systems require radiators, thermal storage masses, effluent storage, or refrigeration to remove waste heat. The mass penalty incurred by addition of these devices is so severe, that the option of closing space power systems should be avoided if at all possible. The mass penalty is even more severe if the weapon system itself must also be closed.

The Legality of Nuclear Weapons Employment under the International Humanitarian Law of Coercion Control.

This thesis analyzes the legality of nuclear weapons employment under international humanitarian law. Factual background data is given on present strategical and tactical nuclear arsenals; nuclear war strategies; targeting categories; and principle effects of nuclear weapons, including types of nuclear explosions and combined effects of multiple nuclear detonations, including the potential for environmental disaster. The legal framework is then set forth: the sources of humanitarian law (law of war), basic principles of humanitarian law (military necessity, humanity, proportionality, unnecessary suffering, and indiscriminate weapons), sanctions for violations of humanitarian norms, the impact of modern warfare, and a summary of views on the application of humanitarian norms to nuclear weapons. A tripartite analysis of the legality of nuclear weapons use is then made using express international treaty limitations, implied treaty limitations, and limitations from customary humanitarian norms. Pro and con arguments are examined in each area. The thesis concludes that express treaty limitations on nuclear weapons do not inhibit probable military uses; implied treaty limitations are questionable; but customary norms legally apply to nuclear weapons and limit lawful uses, except in the case of reprisals. Specific contextual situations for nuclear weapons use are then examined. Further conclusions are: nuclear weapons could be lawfully used against nonurban military targets, both strategic and tactical, and against urban targets in reprisal for prior nuclear attacks on cities, but even lawful uses could lead to disproportionate, and therefore illegal, results, especially given the probability of escalatory responses and the problem of unintended, but widespread environmental impacts.
A response is given to the defense by J. W. Rosengren of his report that argues that, judging from past experience, a ban on the underground testing of nuclear weapons could be expected to severely undercut the capability of the United States to maintain a reliable nuclear weapons stockpile. The response advances the view that none of the examples cited in the Rosengren report support the thesis that nuclear explosive testing is necessary to maintain confidence in the reliability of the existing U.S. stockpile of thoroughly tested nuclear weapons. It is argued that no nuclear tests were required either to identify or to correct problems encountered in stockpile with the W56, W58, and W68. It is further argued that the W45, W47, and W52 were not adequately tested prior to stockpile entry. It is finally concluded that, if indeed there are nuclear weapons in the stockpile that have not been thoroughly tested, then those should be identified and appropriate corrective action taken.

Application of the Modular Command and Control Evaluation Structure to a Strategic Defense Initiative Command and Control System.  
This thesis focuses on relating a generic evaluation structure, the Modular Command and Control Evaluation Structure, to the battle management and command, control and communication issues of the SDI. The areas of SDI battle management, command and control, and communications are reviewed and explained as well as the Modular Command and Control Evaluation Structure.

Military Space Station Implications.  
Justifying the relevancy of a manned military space station and subsequently proposing its deployment to capitalize upon the United States' national security interests is the essence and purpose of this group study project. The manned military space station is intended to perform a two-fold purpose: (1) facilitate military peacetime operations while simultaneously supporting and promoting civilian space initiatives; and (2) act as a force multiplier for space and terrestrial force operations in the event of conventional, theater nuclear, and/or strategic nuclear war. Data to support the future value of the manned military space station was obtained from individual and group research using unclassified sources such as professional journals, books, U.S. Air Force Staff College reference material, and information from the U.S. Air Force space coordinating staff in Washington, D.C. The importance of space to our future and especially of a manned military space station by America's
The significance of space and its nexus to the United States’ national security has been growing dramatically in importance since the launching of the Sputnik in 1957 by Russia. Space, as the fourth dimension, cannot and should not be understated in importance as it relates to commercialism, deterrence to war, and to the stability of world order. The United States should, therefore, take the following five initiatives toward promoting the manned military space station: (1) gain a commitment of national will for space advances, (2) allocate sufficient resources for the continuance of exploiting space to enhance our national security interests, (3) regain America’s preeminence in world hegemony, (4) use the manned military space station to promote space commercialism, and (5) use space as a deterrent to world conflict (negotiate from a position of strength).

The SDI is an investigation by scientists, military leaders, and technologists of the feasibility of strategic defenses against ballistic missiles. Whether strategic defense is the way to go in the future remains to be seen. Although the capability of the envisioned layered, ground- and space-based defensive systems is not specifically addressed, the SDI research program’s affect on national security strategy and its formulation is examined. If found to be feasible and cost-effective, SDI will require a drastic change in our military strategy. This essay reviews how that strategy was formulated in the past in terms of a model and how strategic defense strategy would be used in the future. More importantly, a discussion of how the SDI impacts on present U.S. national strategy and enhances deterrence is presented. Its influence on technology, conventional defense, and arms controls are addressed. Finally, some personal comments are offered on this evolving strategic concept and the renewed vigor and interest it has provided in strategy formulation.
literature. In addition to the issue of technical feasibility, other main issues affecting the level of acceptance and support for SDI are its degree of conformity with the ABM Treaty of 1972, and the associated debate on its potential impact on future arms control negotiations. The Reykjavik Conference in October 1986 brought SDI to the forefront of U.S. congressional and Allied concern when the summit ended without having achieved an arms control agreement after President Reagan made it clear that SDI would not be a bargaining chip. Technological achievements, congressional support, and Allied acceptance will play a major role in the future of the SDI program.

0682

Just War Tradition in the Nuclear Age: Is It More Moral to "Push the Button?"

Because of the massive destruction of nuclear weapons, many nuclear ethicists have asserted that their use in war is contrary to just war traditions that have guided Western moral thought since at least the fifth century. This position creates a significant dilemma for U.S. officials who must keep their fingers on the nuclear trigger as part of our national defense strategy. On the one hand, these are honorable men desiring to maintain the same moral standards as the rest of society. On the other hand, they are charged by the office they hold with the defense of the nation. Since there is at present no effective defense to the use of nuclear weapons other than the threat to use nuclear weapons in retaliation (the nuclear deterrent), and since such a deterrent threat cannot be effective unless it is supported by the will to implement the threat in appropriate circumstances, the president of the United States and many of his military officers are confronted with a major moral dilemma. This essay examines the dimensions of that dilemma by reviewing the principles of the just war tradition and applying them to modern total war concepts. It concludes by examining three possible solutions to the dilemma: (1) deployment of a strategic defense system, such as that contemplated by the SDI; (2) arms control; and (3) establishment of a world police authority under the auspices of the UN to enforce nuclear disarmament and to intervene, if necessary, to prevent a total conventional war between the great powers.

0722

The Strategic Defense Initiative and the Prisoner’s Dilemma.

A Prisoner’s Dilemma is a model used to assess certain situations where individuals or competitors have choices to make, the possible payoff combinations of which conform to a characteristic pattern. For nearly forty years the United States and Soviet Union have been in a Prisoner’s Dilemma as they have pursued military strategies of deterrence based in large measure on nuclear ballistic missiles. President Reagan initiated the SDI program in 1983 in hopes that it would lead to defensive capabilities that would intercept and
destroy ballistic missiles before they reached the United States, and in so
doing, allow the United States to adopt a military strategy based on security
from ballistic missile attack. Information was gathered using a review of the
literature and through analysis of the views of key military and civilian leaders.
While a strong case was made for the proposition that possession of a nuclear
arsenal truly does represent a Prisoner's Dilemma for the United States and
the Soviet Union, the evidence did not support the proposition that SDI
provides a means to escape the dilemma.

0753

**Soviet Short-Range Nuclear Forces: Flexible Response or Flexible Aggression?**


The USSR and its policies are an enigma to the West. This mystery is a result
of two principle factors: (1) an ethnocentric Western viewpoint that tends to
project its own values and beliefs into an interpretation of Soviet policies and
intentions, and (2) the way that Soviet statements and actions are frequently
in conflict with each other. These two factors frequently result in a Western
misinterpretation of Soviet capabilities and intentions. This essay takes a
critical look at Soviet short-range nuclear forces in an effort to identify Soviet
capabilities to fight a limited nuclear war with NATO. From an analysis of
Soviet military art, weapon system capabilities and tactics, the author
concludes that the Soviets have developed a viable limited nuclear attack
option. Unless NATO reacts to this option, the limited nuclear attack may
become the favored Soviet option and result in the rapid defeat of NATO.

0809

**An Analysis of the Soviet Response to the Strategic Defense Initiative.**


Since President Reagan announced the SDI in March 1983, the USSR has
consistently condemned it. This study examines the Soviet response to SDI
and provides an explanation for their response. The study identifies military,
political, and economic factors that influence the Soviet response to SDI. The
author concludes that the Soviets have a genuine concern about SDI, and
they will continue their attempts to stop the SDI program at the arms control
negotiations.

0839

**A Methodology for Determining the Intent of a Limited Nuclear Attack.**


The purpose of this study is to develop a methodology for determining the
intent of a limited nuclear attack. An investigation of possible methodologies
for determining intent lead to research in Bayesian analysis. It was thought
that the answer to intent could be found by taking prior beliefs of the decision
maker and then using Bayes' Theorem to update those beliefs with ground-
based radar information obtained over time. Unfortunately the use of Bayes-
ian analysis as proposed here did not prove to be robust when the radar in-
formation was inaccurate. The desired answer was the proportion of the attack that was against each class of targets: city/industrial, "other" military, strategic military, and critical command and control or communications. The results at the current radar accuracies yield an inaccurate estimate of the proportion of the attack that is against each of the target classes. When the accuracy of the radar is improved, the proposed methodology does converge to the correct proportions. The reason for the inability of the proposed methodology to perform under the inaccurate radar parameters is that the methodology ignores too many of the complicating issues in determining intent. Also, the accuracy of the predicted impact points improves as the warhead gets closer to impact but the proposed methodology does not account for this change in the accuracy of the impact points. Some refinements to the proposed methodology are offered as an attempt to reduce the inaccuracy in the estimates of the proportions. Essentially these refinements involve generating weighting functions to be used in the Bayesian analysis, which modify the amount that the prior probabilities are modified by the observed samples. When the estimated impact points are inaccurate and thus the confidence in the sample is low, then the weighting function will be close to unity so that the priors are modified very little. When the predicted impact points are accurate, then the weighting function should allow the prior probabilities to be significantly modified.

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0001 Perceptions of Nuclear War.
Mutual deterrence has been the keystone of U.S. nuclear strategic policy with respect to the Soviet Union. But for mutual deterrence to be viable, the perceptions of nuclear weapons and nuclear war must be shared by both nations. There are currently many misconceptions in the West about Soviet views of nuclear war. These misconceptions have been reinforced over the years by Soviet public pronouncements. Through an examination of the mindset of the Soviet people, Soviet doctrinal literature, and Soviet offensive and defensive systems, this paper provides compelling evidence for the way the Soviet Union really perceives nuclear war.

0060 The Threats to Survival In a Nuclear Environment.
This paper provides a description of the primary threats to survival during and after a nuclear attack, focusing on the weapons effects of blast, thermal, and short- and long-term radiation. It includes discussion of simple rules for self-
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protection from fallout, and discussions of myths, facts, and some philosophy on how to survive a nuclear attack.

0118 Compendium of Arms Control Verification Proposals. Volume 1. Department of National Defense, Operational Research and Analysis Establishment, Ottawa, Ontario, Canada. A. Crawford, et al. June 1987. 443pp. This three-volume work is intended to serve as a quick reference catalogue to over 690 arms control verification proposals originating in the publications and statements of governments and intergovernmental bodies as well as the academic literature on the subject. Each proposal has been abstracted and classified according to two main criteria: the arms control objectives with which it is concerned and the types of verification methods involved. Included are a subject index and an author index that permit easy access by the reader to any proposal abstract in which they may be interested. Chapters in the compendium are organized according to methods of verification. Each chapter includes an introductory discussion of the method followed by the proposal abstracts that deal prominently with that verification method. A general introduction to the work is also provided.

0561 Compendium of Arms Control Verification Proposals. Volume 2. Department of National Defense, Operational Research and Analysis Establishment, Ottawa, Ontario, Canada. A. Crawford, et al. June 1987. 464pp. This is the second in a three-volume work intended to serve as a quick reference catalogue to over 690 arms control verification proposals originating in the publications and statements of governments and intergovernmental bodies as well as the academic literature on the subject. Each proposal has been abstracted and classified according to two main criteria: the arms control objectives with which it is concerned and the types of verification methods involved. Included are a subject index and an author index that permit easy access by the reader to any proposal abstract in which they may be interested. Chapters in the compendium are organized according to methods of verification. Each chapter includes an introductory discussion of the method followed by the proposal abstracts that deal prominently with that verification method. A general introduction to the work is also provided.

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0001 Compendium of Arms Control Verification Proposals. Volume 3. Department of National Defense, Operational Research and Analysis Establishment, Ottawa, Ontario, Canada. A. Crawford, et al. June 1987. 449pp. This is the third of a three-volume work intended to serve as a quick reference catalogue to over 690 arms control verification proposals originating in the publications and statements of governments and intergovernmental bodies as well as the academic literature on the subject. Each proposal has been
abstracted and classified according to two main criteria: the arms control objectives with which it is concerned and the types of verification methods involved. Included are a subject index and an author index that permit easy access by the reader to any proposal abstract in which they may be interested. Chapters in the compendium are organized according to methods of verification. Each chapter includes an introductory discussion of the method followed by the proposal abstracts that deal prominently with that verification method. A general introduction to the work is also provided.

0450


This study focuses on the Soviet perceptions and decision-making processes that influence Soviet reaction to U.S. initiatives in modernizing or developing theatre nuclear systems. Beginning with a discussion about the consequences of previous U.S. misperceptions of Soviet intentions, the study supports the need for ongoing analysis of Soviet actions from the Soviet perspective. The Soviet view of the world is examined in terms of Marxist-Leninist ideology, Soviet fears of encirclement and invasion, and the Soviet perception of world power relationships or “correlation of forces.” The affects of Soviet military theory on reactions and responses to the subject U.S. military developments is assessed, specifically in the areas of military doctrine and military science. The influence of military art is discussed with emphasis on strategy and operational art. The party political controls on Soviet military matters are described, including a breakdown of the military decision-making process. Soviet responses to U.S. nuclear weapons initiatives, including the Pershing II and Ground-Launched Cruise Missile and Enhanced Radiation Weapons, are discussed in terms of military and political reactions. Soviet use of propaganda is highlighted. The importance of superiority and technology as an integral part of that superiority are examined, as is the Soviet use of “technology transfer.” This study hypothesizes that any Soviet reaction to U.S. action is based upon unique Soviet perceptions that are strongly influenced by Marxist-Leninist ideology, insecurity, military theory, party bureaucracy, and world correlation of forces. The findings of this thesis indicate that any U.S.-NATO force modernization initiative that alters the Soviet perception of the correlation of forces in Europe will evoke some form of response. There is no indication, however, that this response will be a mirror image of the U.S. initiative. The thesis concludes with a discussion of the political and military responses the Soviets may undertake.
Semiannual Report on Strategic Special Nuclear Material Inventory Differences.
This twentieth periodic semiannual report of unclassified Inventory Differences covers the second six months of fiscal year 1986 (April 1, 1986, through September 30, 1986) for all key Department of Energy and Department of Energy contractor-operated facilities possessing strategic special nuclear materials. Data for the Rocky Flats and Y-12 nuclear weapons production facilities are not included in the report in order to protect classified nuclear weapons information; however, classified Inventory Differences data from these facilities receive the same scrutiny and analyses as the unclassified data.

Under-examined Aspects of the Potential Environmental Effects of Nuclear War.
In addition to destroying the area near the explosions, a nuclear war would lead to injection of a wide-range of substances into the environment, both as a result of the delivery systems and explosions themselves and as a consequence of the blast, fires, and resulting destruction and disruption. While addressing the many remaining uncertainties concerning the effects of smoke injections on climate, which is the major topic of present research, there are a number of other potential impacts that could have major consequences, but which are currently poorly understood and have not yet been carefully examined. These underexamined effects include perturbations to atmospheric chemistry, the effects of injections of dust and water (which could create ice particles), the consequences of emissions from the smoldering phase of the fires, resuspension of materials due to perturbed surface conditions, and a range of other potential consequences.

The Soviet Military on SDI (Strategic Defense Initiative).
Numerous Western analysts have suggested that all American assessments of SDI should proceed not only from a consideration of American intentions, but also from the outlook of Soviet perceptions. Since March 23, 1983, the prevailing tone of Soviet military writings on SDI has been overwhelmingly negative. Myron Hedlin has concluded that this harsh reaction to a U.S. initiative still years from realization suggests both a strong concern about the ultimate impact of these plans on the strategic balance and a perceived opportunity for scoring propaganda points. Indeed, the present review of Soviet writings since President Reagan’s so-called Star Wars speech has yielded both objective Soviet concerns and regressions to psychological warfare. This, in turn, has necessitated a careful effort to separate rhetoric from more official assessments of SDI. While there has long been dispute in
the West over the validity of Soviet statements, they have time and again been subsequently confirmed in Soviet hardware, exercises, and operational behavior. Some Western analysts will nonetheless contend that the Soviet statements under examination in this study are merely a commodity for export.

0728 Nuclear Nonproliferation: Department of Energy Needs Tighter Controls Over Reprocessing Information.


This report examines the Department of Energy's activities that may assist foreign countries in the development of nuclear weapons material. Specifically, it focuses on the area of reprocessing and assesses the department's controls over (1) dissemination of reprocessing information, (2) cooperative research activities it conducts with foreign countries, and (3) involvement of foreign nationals in sensitive nuclear activities and research.

0783 Strategic Defense Initiative: Demonstration/Validation Program—Environmental Assessment Summary.


The SDIO and its proponents (the U.S. Army and U.S. Air Force) plan to conduct demonstration/validation tests of six technologies to demonstrate their respective ability to perform their required tasks and to validate the requirements to determine their feasibility for a future decision on whether to proceed with full-scale development. Demonstration/validation tests would be conducted at fourteen government facilities across the United States and the Republic of the Marshall Islands, and at contractor facilities. Tests would include analyses, simulations, component/assembly tests, and flight tests. This document summarizes the findings expressed in the six environmental assessments for demonstration/validation testing of the individual technologies, and analyzes the potential cumulative environmental consequences of testing multiple technologies at a given facility. In the event that any other technology is ready for entry into demonstration/validation at a later date, an environmental assessment will be prepared for that technology and this summary will be updated.

Reel 9

1987 cont.

0001 Boost Surveillance and Tracking System (BSTS): Demonstration/Validation Program—Environmental Assessment.


The SDIO and its proponents (U.S. Army and U.S. Air Force) plan to conduct demonstration/validation tests of the boost surveillance and tracking system.
technology. These tests will demonstrate the ability of the technology to perform required tasks and will validate a future decision on whether to proceed with full-scale development. Demonstration/validation tests would be conducted at the National Test Facility, Cape Canaveral Air Force Station/Eastern Test Range, and at contractor facilities. Tests would include analyses, simulations, component/assembly tests, and flight tests. This document addresses the potential environmental consequences of the demonstration/validation testing of the boost surveillance and tracking system technology.

**Space-Based Surveillance and Tracking System (SSTS): Demonstration/Validation Program—Environmental Assessment.**


This document is based on the premise stated at frame 0001. Demonstration/validation tests would be conducted at the Arnold Engineering Development Center, Nevada Test Site, Vandenberg Air Force Base/Western Test Range, Cape Canaveral Air Force Station/Eastern Test Range, Kennedy Space Center, National Test Facility, and at contractor facilities. Tests would include analyses, simulations, component/assembly tests, and flight tests. This document addresses the potential environmental consequences of the demonstration/validation testing of the space-based surveillance and tracking system technology.

**Ground-Based Surveillance and Tracking System (GSTS): Demonstration/Validation Program—Environmental Assessment.**


This document is based on the premise stated at frame 0001. Demonstration/validation tests would be conducted at the Nevada Test Site, National Test Facility, Vandenberg Air Force Base/Western Test Range, U.S. Army Kwajalein Atoll, and at contractor facilities. Tests would include analyses, simulations, component/assembly tests, and flight tests. This document addresses the potential environmental consequences of the demonstration/validation testing of the ground-based surveillance and tracking system technology.

**Space-Based Interceptor (SBI): Demonstration/Validation Program—Environmental Assessment.**


This document is based on the premise stated at frame 0001. Demonstration/validation tests would be conducted at the Elgin Air Force Base, Edwards Air Force Base, U.S. Army Kwajalein Atoll, National Test Facility, and at contractor facilities. Tests would include analyses, simulations, component/assembly tests, and flight tests. This document addresses the potential environmental consequences of the demonstration/validation testing of the space-based interceptor technology.
Exoatmospheric Reentry Vehicle Interception System (ERIS): Demonstration/Validation Program—Environmental Assessment.
This document is based on the premise stated at frame 0001. Demonstration/validation tests would be conducted at the Arnold Engineering Development Center, National Test Facility, Nevada Test Site, Harry Diamond Laboratories, Vandenberg Air Force Base/Western Test Range, U.S. Army Kwajalein Atoll, U.S. Naval Pacific Missile Range at Barking Sands, and at contractor facilities. Tests would include analyses, simulations, component/assembly tests, and flight tests. This document addresses the potential environmental consequences of the demonstration/validation testing of the exoatmospheric reentry vehicle interception system technology.

This document is based on the premise stated at frame 0001. Demonstration/validation tests would be conducted at the Advanced Research Center, Electronic Systems Division, National Test Facility, Rome Air Development Center, Nevada Test Site, Harry Diamond Laboratories, and at contractor facilities. Tests would include analyses, simulations, and component/assembly tests. This document addresses the potential environmental consequences of the demonstration/validation testing of the battle management/command and control, and communications technology.

The Impact of Deployment Rates on the Effectiveness of Strategic Defenses.
The effectiveness of a ballistic missile defense layer of space-based kinetic kill vehicles is examined relative to a threat with increasing numbers of fast-burn boosters over the years 1994–2004. A methodology for evaluating ballistic defense layer effectiveness and required deployment rates over time is developed.

NATO's Theater Nuclear Weapons [TNWs] and the Defense of Europe: Past Patterns and Future Prospects.
The goal of this research was to analyze and order the controversy and ambiguity surrounding the theater nuclear weapon modernization started by NATO in 1979. To place the ground launched cruise missiles/Pershing II deployment within its historical context, this thesis reviews significant events pertaining to NATO since its inception. Three basic questions guided this study: Why did the NATO allies agree in 1979 to modernize their theater
nuclear force? Why did the United States actually begin this theater nuclear weapon deployment in 1983? Is the theater nuclear weapon program accomplishing its goals? The research itself is divided into three periods. The first section (1948–1959) is considered in terms of the United States' initial deployment of theater nuclear weapons into Europe, the Soviet force buildup following World War II, and the creation of NATO in 1949. Section two traces NATO's changing attitudes towards theater nuclear weapons from 1960 to 1974. The third section (1975–present) discusses the conventional and nuclear force balance, NATO's growing divisions during this period, and the role of the ground launched cruise missiles/Pershing II deployment within this environment of change for NATO. An examination of NATO's patterns of response over the last thirty-eight years reveals that NATO has failed to develop formal organizational goals, choosing instead to react to each Soviet provocation on a case-by-case basis.

**0630**

**Purposes, Achievements, and Priorities of Arms Control.**


Arms control purposes include strengthening the framework of deterrence and reducing the threat of the use of nuclear weapons, reducing the dangers of attack and accidental nuclear war, and allowing more resources for the civilian economy. This paper briefly describes achievements in arms control since World War II. These include the Limited Test Ban Treaty, Nonproliferation Treaty, Anti-Ballistic Missile Treaty-SALT I, SALT II, Threshold Test Ban Treaty, Peaceful Nuclear Explosions Treaty, and Nuclear-Free Zones treaties. The author also discusses his views on what the priorities of arms control activities should be.

**0651**

**Atmospheric and Climatic Consequences of a Major Nuclear War: Results of Recent Research.**


During the last several years, comprehensive three-dimensional atmospheric circulation models, including detailed parametric formulations of a wide range of climatologically significant processes, have been applied to study the potential consequences of a major nuclear war involving the injection of smoke, which could result from the large-scale fires ignited by such an exchange. For plausible smoke injections during the warm seasons of the year, all model calculations suggest that a significant climatic perturbation would result. In the lower range of smoke injection scenarios (producing of order 10 Tg of highly carbonaceous smoke), smoke would act primarily to inhibit convection and rainfall, especially over land areas, including possibly some disruption of the summer monsoon. The upper range of smoke scenarios (of order 100 Tg of highly carbonaceous smoke) would cause not only rapid and sharp decreases in land temperature and precipitation (a mid-latitude average land-temperature drop of the order of 20 sup 0 C, up to
perhaps twice this amount in continental interiors), but also seems likely to leave enough smoke in the atmosphere to persist into the following warm season, inducing a cooling of several degrees.

0680 Maintaining the U.S. Stockpile of Nuclear Weapons during a Low-Threshold or Comprehensive Test Ban.
Results are reviewed of several classes of U.S. nuclear weapons tests conducted within the principal strengths and weaknesses of nuclear weapons themselves. It is found that a high degree of confidence in the reliability of the existing stockpile is justified, and that it is sufficiently robust to permit confidence in the reliability of remanufactured warheads in the absence of nuclear explosive-proof-tests. Also reviewed are problems encountered with the fourteen nuclear weapon designs since 1958 that have been frequently and prominently cited as evidence that a Low-Threshold Test Ban or a CTB would preclude the possibility of maintaining the reliability of the stockpile. It is concluded that that experience has little if any relevance to the question of maintaining a reliable stockpile of nuclear weapons that exists in 1987. Further, actions necessary to assure the future availability of materials needed to remanufacture nuclear weapons in the existing stockpile and the reliability of repackaged nuclear weapons are discussed. It is recommended that the Department of Energy be encouraged to undertake the formulation and execution of a readiness program whose purpose is to ensure that the United States is prepared to maintain the reliability of its stockpile of nuclear weapons in the absence of nuclear explosive tests, and that funds earmarked for this purpose be provided.

This report has been prepared in response to a request from Congress to Dr. Roger Batzel, the director of the LLNL, and addresses two major issues: (1) "whether past warhead reliability problems demonstrate that nuclear explosive testing is needed to identify or to correct stockpile reliability," and (2) "whether a program of stockpile inspection, nonnuclear testing, and remanufacture would be sufficient to deal with stockpile reliability problems." Dr. George Miller, associate director for defense systems at LLNL, prepared this report analyzing these issues. Chapter 1 examines the reasons for nuclear testing. Although the thrust of the request from Congress has to do with the need for nuclear testing as it relates to stockpile reliability and remanufacture, there are other very important reasons for nuclear testing. Since there has been increasing interest in the U.S. Congress for more restrictive nuclear test limits, the overall need for nuclear testing and the potential impact of further nuclear test limitations is addressed. Chapter 1 also summarizes the major
conclusions of a recent study conducted by the Scientific and Academic Advisory Committee for the president of the University of California entitled "Nuclear Weapon Tests: The Role of the University of California-Department of Energy Laboratories." The committee spent many days at LLNL and Los Alamos National Laboratory in direct discussions with numerous experienced weapon design personnel. The depth of the study far exceeds that of any other independent review of these topics. Chapter 2 presents a brief history of stockpile problems that involved post-deployment nuclear testing for their resolution. Chapter 3 addresses the problems involved in remanufacturing nuclear weapons, and Chapter 4 discusses measures that should be taken to prepare for possible future restrictive test limits.

Modernizing U.S. Strategic Offensive Forces: Costs, Effects, and Alternatives.
United States strategic forces are primarily intended to deter the Soviet Union from initiating a nuclear war. To do so, U.S. policy calls for them to be able to survive a Soviet nuclear strike and retaliate in an appropriate and timely manner. Since the 1960s, the Soviets have upgraded and significantly expanded the capabilities of their strategic forces. The administration believes that, in response, the United States must increase not only the numbers of its forces and their chance of surviving a Soviet strike, but also their destructive capability, endurance, and responsiveness.

Strategic Defense Initiative Program: Status of Space Surveillance and Tracking System.
The SDI is the Department of Defense's program to determine the feasibility of developing and deploying a defense against nuclear ballistic missiles. The program envisions a layered defense system capable of destroying a nuclear ballistic missile during any of its four phases of flight-boost, post-boost, midcourse, or terminal. The report contains information on the status of the SDIO's research on the Space Surveillance and Tracking System.

Strategic Planning for Counterforce Options.
The first objective of this report is to explore the disparity between United States declaratory policy and actual force capabilities. This report secondarily poses questions and purpose decision-making criteria that are essential to ensure successful future nuclear strategic force employment and planning. This report is primarily concerned with the gap in U.S. declaratory and operational (or action) policy as it applies to current counterforce targeting problems. It is important to distinguish between declaratory policy and actual operational policies to appreciate the complexities of the debate and to resolve questions concerning future force planning.
Soviet Objectives in the INF Negotiations and European Security.

On December 12, 1979, NATO officials announced the decision to deploy 108 Pershing II nuclear missiles and 464 Ground-Launched Cruise Missiles, in response to the Soviet deployment of SS-20 nuclear missiles. The NATO decision was met by a determined Soviet effort to prevent the deployment of the new missiles. The Soviet effort consisted of negotiations, diplomatic propaganda, and covert measures. When it was clear that the deployment was not going to be stopped, the Soviets agreed to formal INF arms reduction talks. It is this author's opinion that the Soviet negotiation tactics, during the INF talks, supported the long-range goals of reducing the military effectiveness of NATO, and also supported the goal of reducing U.S. influence in Europe.

Conventional Arms Control Revisited: Objectives In the New Phase.

Conventional arms control policy ought to be closely coordinated with defense policy, but the Western allies have been unable to do so. Linkage is difficult because of the institutional differences between force planners on the one hand, and arms controllers on the other. Aggravating the problem is the lack of a unifying framework by which outcomes in both areas can be assessed. The authors outline a three-step process for designing a unified concept for defense and arms control planning, describe the long-term coordination of the process, and identify principles that should guide NATO's conventional arms control planning.

American Perspectives on the Vagaries of Soviet Negotiating Behavior.

Because of their behavior in negotiations from World War II through the 1960s, the Soviets have been widely perceived in the United States as predictably uncooperative. In the 1980s it is important to determine whether this popular image of Soviet negotiating behavior remains consistent, or, as this thesis examines, the possibility that there are significant variations in more recent Soviet arms control negotiating behavior that must be recognized and addressed. Variations in Soviet negotiating behavior may yield important insights regarding Soviet arms control objectives. This thesis attempts, first, to produce a comprehensive picture of post–World War II Soviet negotiating behavior prior to the Limited Test Ban Treaty negotiations. This consists of a detailed analysis of specific Soviet negotiating techniques.
Through studying the frequency of Soviet use of these techniques a comprehensive picture of what may be considered typical Soviet negotiating behavior may be derived. What may be considered significant variations in Soviet negotiating behavior may then be identified by applying/comparing post-World War II typical behavior with usage in subsequent negotiating encounters. Specific arms control negotiations examined are those of the Limited Test Ban Treaty and the first set of SALT I talks.


Results of several classes of U.S. nuclear weapon tests conducted within the past decade are reviewed, together with the principal strengths and weaknesses of nuclear weapons themselves. It is found that a high degree of confidence in the reliability of the existing stockpile is justified, and that it is sufficiently robust to permit confidence in the reliability of remanufactured warheads in the absence of nuclear explosive-proof tests. Also reviewed are problems encountered with the fourteen nuclear weapon designs since 1958 that have been frequently and prominently cited as evidence that a Low-Threshold Test Ban or a CTB would preclude the possibility of maintaining a reliable stockpile. It is concluded that the experience has little if any relevance to the question of maintaining the reliability of the stockpile of nuclear weapons that exists in 1987. Work can be done in areas relating to, and including, nuclear weapons research, engineering, and effects during a Low-Threshold Test Ban. A significant and challenging scientific and engineering program could be conducted at the weapons laboratories that would engage the interest and maintain the skills of weapons scientists and engineers. They would, therefore, have little incentive to leave the weapons laboratories, and their expertise would continue to be available when needed to monitor the stockpile and the quality of remanufactured warheads. A CTB would severely limit such a program, but if it were preceded by a Low-Threshold Test Ban, there would be time to make necessary changes to reduce the present reliance of the production complex upon the advice and counsel of weapons lab personnel. It is recommended that the Department of Energy be encouraged to undertake the formulation and execution of a readiness program whose purpose is to ensure that the United States is prepared to maintain the reliability of its stockpile of nuclear weapons in the absence of nuclear-explosive tests, and that funds earmarked for this purpose be provided.


Considerable controversy and fierce political and military debate have surrounded the development and potential employment of tactical battlefield nuclear weapons. This paper seeks to trace the historical evolution of these weapons, with specific emphasis upon the enhanced radiation family of
tactical nuclear arms. This approach is useful because so little is actually known about enhanced radiation weapons as compared to their conventional nuclear weapons counterparts. Subsequent discussions will address the capabilities and characteristics of nuclear and enhanced radiation weapons with an associated analysis of the Soviet-Warsaw Pact threat that currently faces NATO and Western Europe. It was this specific threat that proved to be the driving force that initially prompted the United States to develop a tactical enhanced radiation nuclear capability. The paper also addresses the current array of U.S. tactical nuclear weapons, with emphasis upon specific systems and NATO stockpile data. Finally, an analysis of employing this weapon is explored with respect to current army nuclear weapons doctrine, systems capability, and enemy threat. This culminating discussion demonstrates that it has been, and continues to be, in our best interest to retain the present strategy option of preemptive use of enhanced radiation and tactical nuclear weapons should the NATO battlefield commander be faced with no other alternative to avoid defeat.

1988

Due to the pulsed nature of burst power demands in space-based SDI applications, energy storage can be used to effect reductions in overall power system mass and reduce area requirements for radiators. Incorporation of energy storage allows subsystems (i.e., radiator, power conversion cycle, etc.) to be sized for orbital average duty. Without storage, these systems must be sized to meet peak demands. The value of energy storage was judged primarily by comparing the mass of power systems (or subsystems) with and without a storage component. The assessment of thermal energy storage, using a packed bed of encapsulated LiH shapes, coupled with a radiator, indicated that thermal energy storage is beneficial for generation times of up to 1700 s. Mass savings increase with decreasing total generation time and a heavier radiator. They are maximized when the thermal energy storage unit operating mode allows heat rejection and storage to take place during sprint operation. Radiator area reductions are larger than the mass savings and accrue even when the storage component represents a mass penalty. Regenerable electrical storage and thermal energy storage were examined in conjunction with nuclear Rankine, solar Brayton and Rankine, and thermionic concepts. Flywheels, fuel cells, and batteries were found to be the regenerable electrical storage technologies applicable to the storage mission. The nuclear Rankine analysis indicated that regenerable electrical storage could produce mass savings for generation times as long as 1150 s. The solar power cycles required excessively large concentrators and a 100-orbit recharge was required to reduce the concentrator area to a value comparable
with the nuclear Rankine radiator. Sink-side thermal energy storage was the storage technology of choice for the thermionic system. The thermionic system also proved to be the lightest closed cycle system. A comparison of closed and open cycle systems indicated that radiator specific mass was a critical consideration. With radiators at 10 kg/m² the mass penalty to close the power system was only 16 percent for a generation time of 200 s. With a heavier radiator, the mass penalty increases; at a radiator specific mass of 20 kg/m², the mass penalty increases to 27 percent. Storage can also provide benefits not associated with system mass. Reductions in the size of the radiator and the thermal signature may yield maneuverability and survivability enhancements more important than mass savings. In addition, operational flexibility associated with testing requirements and operational readiness may result in a more robust system. Mitigation of system transients may also play a critical role in easing design constraints within the primary power systems. Inclusion of storage in sprint power systems can yield overall mass savings and the mass penalty to close the power system, thus eliminating effluents, can be modest. Thermal and regenerable electrical storage can each play a role in the various prime power system concepts.

West European Arms Control Policy.
This report focuses on the executive decision making systems in four major European countries, namely the United Kingdom, France, West Germany, and Italy. The focus on arms control decision making in Western Europe necessitated conducting extensive interviews with a wide range of West European government and opinion elites.

Organizational Structure for a Mobile ICBM Combat Unit.
President Reagan has directed the air force to continue with the development of the Peacekeeper missile utilizing the rail garrison concept of mobility. This has tasked the Strategic Air Command with developing an organizational structure that will create the optimal combat effectiveness for the system. This study reviews the present and past mobile missile systems and their organizational structures. This includes systems deployed by both the U.S. Army and Air Force. A proposed structure based on the analysis of those systems is presented for consideration.

Where Directed Energy Stands In Strategic Defense.
Direct energy concepts can play unique, significant roles in strategic defense. This report reviews the various stages in their prior development, assesses their current status, and indicates the key indicators of offensive system
development that determine the time frame in which they will be needed. Directed energy concepts are significantly less sensitive to kinetic energy countermeasures, for which they could be ready.

0468 Reykjavik and Beyond: Deep Reductions in Strategic Nuclear Arsenals and the Future Direction of Arms Control.
In the spring of 1987, members of the National Academy of Sciences Committee on International Security and Arms Control presented a seminar for the academy audience to explore the implications of the proposals for very deep cuts in strategic nuclear arsenals that had been discussed by President Reagan and General Secretary Gorbachev at the Reykjavik summit in 1986. This collection of seminar talks by scientific, military, and political experts explores the meaning of 50 percent or greater cuts in the superpower strategic nuclear arsenals and how very deep cuts would affect other aspects of the military balance and the political and international order more broadly. Individually authored chapters discuss the purpose and effect of deep strategic force reductions, the impact of defenses and of new technologies and non-central systems on offensive reduction regimes, and the political and military implications for Europe of deep cuts in the superpower strategic arsenals.

0547 Withholding and Attacking SSBN.
This report examines the role of strategic missile-carrying submarines (SSBNs) in deterrence and the mission of attacking these forces during the conventional phase of war. It includes discussion of varying locations for submarine deployments impacting on potential antisubmarine warfare, anti-submarine warfare campaigns, and also analyzes possible arms control regulation of antisubmarine warfare.

0571 What to Do about ASAT?
Although the SDI currently dominates the military space issue scene, the development of an antisatellite program is another critical issue that must be reckoned with. This study addresses several of the outstanding questions, issues, and concerns about the antisatellite program, including its rationality, military essentiality, impact on arms control pursuits, and relationship with Ballistic Missile Defense initiatives. The purpose is to highlight the diversity and significance of the issues and opinions, and demonstrate the need for immediate and serious discussion and resolution.
**Free Electron Lasers in Strategic Defense.**
This report discusses the basis for free electron laser operation, roles electron laser operations could play in strategic defense, expected effectiveness, and status of key components. The constellation sizes needed to meet evolving threats are derived, and the trade-offs between space and ground basing of electron laser operations are discussed, leading to a conclusion that electron laser operations could be available for and play complementary roles to those of kinetic energy concepts.

**Flexible Response and the INF Treaty: What Next?**
The prospect of the INF treaty led the former supreme allied commander, Europe, Gen. Bernard Rogers, to claim that NATO would lose weapons vital to the Alliance's defense when Pershing II and ground-launched cruise missiles were withdrawn from Europe. Nuclear weapons and the NATO strategy of flexible response are inseparably dependent upon each other. Rogers' comments focus directly on the capability that Pershing II and ground-launched cruise missiles provided NATO to strike Soviet territory in event of conflict and if such an escalatory step was deemed necessary. Various sources were researched to determine if the INF treaty will cripple the flexible response strategy; while it should not, certain changes in NATO's approach to defense are suggested. Specifically, conventional and nuclear improvements, the latter within the terms of the INF treaty, are suggested, as are conventional force reduction negotiations and the "Europeanization" of NATO.

**Future SDI Decision Making.**
Nearly five years have lapsed since President Ronald Reagan made his now famous speech launching the SDI. Yet, polarized debate continues over the program's feasibility, desirability, affordability, goals, and direction. Some claim the program's goals have changed over time, and that today the primary goal is for an enhanced deterrence rather than providing a population defense as originally envisioned. Although the Congress has provided continuing and expanded funding for SDI, a consensus does not exist between the Congress and the administration over the program's direction and goals. Some concerns exist within the Congress that the administration is rushing too quickly to reach a decision on initial system development. Others would like to see initial development of a more limited defensive capability than that envisioned by the SDI program. This paper examines the evolution of SDI from a policy standpoint and addresses a series of questions that, taken together may suggest parameters for future decision making.
The Strategic Defense Initiative—Strategic Implications.
In March 1983, during his address to the nation, President Reagan initiated a major shift in U.S. strategic policy, as he indicated his desire to move away from the condition of mutual vulnerability as the primary deterrent to nuclear war. The SDI, as the vehicle for this shift, has become the focus of debate over implications of a new strategic policy. This study seeks to examine the strategic implications in terms of stability of the U.S.-USSR relationship, and the role of arms control during a transition from an offensive-dominant strategy to a defensive-dominant strategy. The methodology for the study is to present arguments for and against SDI, as they relate to the issues of stability and arms control, evaluate their validity, draw conclusions, and provide recommendations that may enhance international security during a transition period of SDI.

Who Is Going to Shoot Down the First ICBM—Man or Machine?
The short time available to attack ballistic missiles with an SDI weapon will preclude traditional national-level decision making. A unique command and control concept is required to best serve the balance between effectiveness and weapon system safety. This article develops that concept with a blend of autonomous operation with man in the loop and advocates early resolution to ensure command and control strategy and tactics push technology development.

Minuteman Rapid Retargeting.
The Strategic Air Command has validated a requirement to decrease the time it takes to retarget the Minuteman missile. Air Force System Command Ballistic Missile Office contracted with four aerospace companies to develop concepts to satisfy the Minuteman rapid retargeting requirements. The method that will be incorporated into the ICBM Integrated Electronics Upgrade program is still being debated. This analysis looks at the four studies, compares the study results against a base timeline, and recommends a solution that will save the most time from targeting information generation in the launch control center to when the new targeting information is loaded into the missile's memory.

The Role of Air Base Operability In Tactical Missile Defense.
The emergence of a new generation of Soviet short-range, conventional, tactical ballistic missiles (FROG, SS-1, SS-12, SS-21, SS-22, SS-23) threatens U.S./NATO air bases in Central Europe. The United States has initiated
a comprehensive, long-term Tactical Missile Defense program to counter the threat. At the same time, the U.S. Air Force has refocused attention on the need to improve air base survivability through its Air Base Operability program. This research paper examines the threat, discusses the concepts and realities of tactical missile defense, and analyzes the role of air base operability in tactical missile defense. In addition, it highlights the impact of the U.S.-Soviet INF treaty upon the U.S. Tactical Missile Defense program.

Seismic Verification of Nuclear Testing Treaties,
Office of Technological Assessment, Washington, D.C. May 1, 1988. 148pp. To a great extent, the capabilities of any given seismic monitoring networks are determined by how the monitoring network is determined, by how the monitoring task is approached, and what supplementary provisions are negotiated within the treaty. If agreements can be negotiated to reduce uncertainty, then seismology can be very effective and extremely low yields could be monitored with high confidence. The report addresses the following two key questions: (1) down to what size explosion can underground testing be seismically monitored with high confidence, and (2) how accurately can the yields of underground explosions be measured seismically. The answers to these questions provide the technical information that lies at the heart of the political debate over (1) how low a threshold test ban treaty with the Soviet Union the authors could verify, (2) whether the 1976 Threshold Test Ban Treaty is verifiable, and (3) whether the Soviet Union has complied with present testing restrictions.
The following index is a guide to the major subjects of this collection. The first Arabic number refers to the reel, and the Arabic number after the colon refers to the frame number at which a particular document begins. Therefore, 9: 0651 directs the researcher to the document that begins at Frame 0651 of Reel 9. By referring to the Reel Index located in the initial part of this guide, the researcher can find the main entry for the document.

**ABM systems**
1: 0574

**ABM Treaty of 1972**
1: 0855; 6: 0651; 9: 0630

**Accident Measures Agreements**
3: 0096

**Air Force, U.S.**

Air Base Operability Program
10: 0797

ICBM 4: 0053

mobile missile systems 10: 0400

SDI support by 8: 0783; 9: 0001–0422

space coordinating staff of 8: 0422

**Alabama**

Advanced Research Center—SDIO testing 9: 0422

**Alamagordo, New Mexico**
1: 0887

**Allies, Western**

arms control policy of—defense planning and 10: 0079

SDI—opposition to 6: 0651

**Antisatellite technologies**

arms control—impact on 10: 0571

Ballistic Missiles Defense—relation with 10: 0571

general 2: 0076; 10: 0571

negotiations (1977–1979) 3: 0096

**Antisubmarine warfare**

10: 0547

**Applied Seismology, Division of**

6: 0146

**Arizona**

heavy division on the nuclear battlefield—studies of 5: 1029

Hardened Mobile Launcher systems use in 4: 0053

**Arms control**

agreements 1: 0485; 2: 0317–0344; 6: 0194, 0682

antisubmarine warfare 10: 0547
defense planning and 10: 0079
general 2: 0001, 0783–0929; 3: 0096, 0903; 10: 0468

history of 9: 0630

negotiations 1: 0855; 2: 0783; 3: 0096; 6: 0809

policy 1: 0803; 10: 0352

problems of 6: 0030

proposals 7: 0118–8: 0001

SDI’s impact on 6: 0608–0651; 10:0711

**Army, U.S.**

military systems in space 3: 0708

mobile missile systems 10: 0400

nuclear doctrine 10: 0224

SDI support by 8: 0783; 9: 0001–0422
Atomic bombs
- general 1: 0887; 2: 0523
- naval strategy—impact on 5: 0864

Australia
- nuclear treaty—obligations 5: 1084

Aviation
- naval strategy—impact on 5: 0864

Ballistic missiles
- see Ballistic Missiles Defense; ICBM; Missiles; SDI

Ballistic Missiles Defense
- antisatellite technologies—relation with 10: 0571

Battle Management/Command, Control, and Communications
- identifying and measuring 6: 0330
- testing of 9: 0422

Batzel, Roger
- nuclear testing 9: 0715

B-1B
- effectiveness of 2: 0102

Biological and Toxin Weapons Convention
- in 1972 1: 0574

Boost Surveillance and Tracking System
- SDIO testing of 8: 0783; 9: 0001

Brezhnev, Leonid
- 3: 0806

Brodle, Bernard
- 1: 0887

Brown, Harold
- Threshold Test Ban 2: 0510; 5: 1013

Brown, Paul S.
- LLNL 3: 0001; 6: 0047

California
- Edwards Air Force Base—SDIO testing 9: 0230
- hard silo in patterned array 4: 0053
- Hardened Mobile Launchers use in 4: 0053
- western test range—SDIO testing 9: 0056–0145, 0311

Catholicism
- Bishop's pastoral on nuclear war 2: 0241

Climate
- see Environment; Nuclear Winter

Colorado
- Hardened Mobile Launchers use in 4: 0053
- national test facility—SDIO testing 9: 0001–0422

Congress, U.S.
- arms control policy 1: 0803
- ICBM 3: 0037; 4: 0053
- nuclear weapons 3: 0001
- SDI 6: 0651; 10: 0678

Crisis management
- during nuclear age 6: 0001

CTBT
- 2: 0439; 3: 0879; 4: 0001; 6: 0062
- see also Nuclear testing

Defense
- long range 3: 0903

Defense, U.S. Department of
- installations—Hardened Missile Launchers 4: 0053
- nuclear weapons 3: 0001

Defense Nuclear Agency
- contributions to Nuclear Test Personnel Review 2: 0523

Deterrence
- general 6: 0030–0047
- military strategies of 6: 0722
- mutual 7: 0001
- nuclear 6: 0651
- SDI's impact on 6: 0608

Disarmament
- conference on (1986) 6: 0146
- nuclear 6: 0682

Energy, U.S. Department of
- contributions to Nuclear Test Personnel Review 2: 0523
- facilities for nuclear materials 8: 0639
- foreign aid from—nuclear material development 8: 0728
- installations—Hardened Missile Launchers 4: 0053
- nuclear weapons 3: 0001; 9: 0680; 10: 0198
Energy and Technology Review
3: 0001-0028

Environment
Battle Management/Command, Control, and Communication testing and 9: 0422
Boost Surveillance and Tracking System testing and 8: 0783; 9: 0001
Exoatmospheric Reentry Vehicle Interception System testing and 8: 0783; 9: 0311
Ground-Based Surveillance and Tracking System testing and 8: 0783; 9: 0145
ICBM's impact on 4: 0053-5: 0001 nuclear explosions and 2: 0439, 0481; 4: 0001; 6: 0194 nuclear war's effect on 3: 0570; 8: 0675; 9: 0651
Space-Based Surveillance and Tracking System testing and 8: 0783; 9: 0056

Ethics
nuclear 6: 0682
soldiers 2: 0241
U.S. Army 2: 0241

Europe, Central
air bases in 10: 0797

Europe, Western
INF 2: 0783
NATO intermediate range nuclear weapons—opposition to 1: 0001 peace movement—perception of 1: 0001 security—U.S. role in 1: 0382 Soviet-Warsaw Pact—threat of 10: 0224

Exoatmospheric Reentry Vehicle Interception System testing of 8: 0783; 9: 0311

Fires
nuclear weapon—in battlefields 1: 0451
Tactical Ignition and Fire Spread 1: 0451

Fissionable material
production control of 2: 0001, 0929

Florida
Eastern Test Range, Cape Canaveral 9: 0001-0056
Eglin Air Force Base 9: 0230
Hardened Missile Launchers use in 4: 0053

Forest Service, U.S.
fire prediction algorithm 1: 0451

Forrestal, James
Naval strategy 5: 0864

France
arms control policy 10: 0352
INF controversy 2: 0783 nuclear policy 1: 0887

Free electron lasers
general 4: 0034 strategic defense—role in 10: 0615

General Accounting Office (GAO)
ICBM—report on 3: 0037

Geneva Protocol (1925)
1: 0574

Germany, West
arms control policy 10: 0352

Gorbachev, Mikhail
3: 0806

Ground-based surveillance and tracking system testing of 8: 0783; 9: 0145

Ground-launched cruise missile/Pershing II
general 2: 0783
NATO and 9: 0563; 10: 0001 Soviet response to 8: 0450 withdrawal from Europe 10: 0644

Hardened Mobile Launcher System
general 1: 0721 ICBM system and 1: 0596; 4: 0053
Hawaii
U.S. Naval Pacific Missile Range—SDIO testing 9: 0311
Hedlin, Myron
Soviet response to SDI 8: 0688
Helsinki Final Act of 1975
Conference on Security and Cooperation in Europe 1: 0574
Hiroshima, Japan
1: 0877; 2: 0523
Humanitarian laws
6: 0194
ICBM
air force’s role in 4: 0053
economic impact of 4: 0053—5: 0001
environmental impact of 4: 0053—5: 0001
general 1: 0574; 3: 0037; 10: 0749
Hardened Mobile Launchers
1: 0596; 4: 0053
hard silo in patterned array 4: 0053
Integrated Electronics Upgrade program 10: 0769
SICBM 1: 0721; 5: 0001
survivability of 1: 0721
Immele, John D.
LLNL 3: 0001; 6: 0047
INF
controversy 2: 0783
talks 10: 0001
Tactical Missile Defense Program—impact on 10: 0797
treaty 10: 0644
Intermediate-Range Ballistic Missiles
Soviet SS-20 2: 0102
Italy
arms control policy 10: 0352
Just war tradition
6: 0682
Kantrowitz, Arthur
detonation-wave thruster concept 4: 0034
Kuckuck, Robert W.
1: 0493
Land warfare
3: 0708
Lasers
general 1: 0485
propulsion 4: 0034
of 1969 3: 0096
LLNL
nuclear testing 1: 0493; 9: 0715
nuclear weapons design 3: 0001—0028; 6: 0047
Mahan, Alfred T.
naval strategy of 5: 0864
Manned Military Space Station
6: 0422
Marshall Islands
SDI testing in 8: 0783
U.S. Army Kwajalein Atoll—SDIO testing 9: 0145, 0230, 0311
Maryland
Harry Diamond Laboratories—SDIO testing 9: 0311—0422
Massachusetts
Electronic Systems Division—SDIO testing 9: 0422
Media
arms control policy and 1: 0803
SDI—reports of opposition to 6: 0651
Miller, George H.
nuclear testing 9: 0715
Missiles
ballistic—defense system 1: 0855; 3: 0642; 6: 0608—0651, 0722;
9: 0499
ground-launched cruise 1: 0001
mobile 10: 0400
Minuteman 10: 0769
MX 3: 0037
nuclear cruise 2: 0102
Peacekeeper 3: 0037; 10: 0400
50
Pershing-Z ballistic 1:0001
SS-20 2: 0102; 10: 0001
TLAM-N 5: 1000
Trident 5: 1000
warning systems 1: 0778
see also Ballistic Missiles Defense;
Ground-launched cruise missile/Pershing II; ICBM
Missouri
Hardened Mobile Launchers—use
in 4: 0053
Montana
Hardened Mobile Launchers—use
in 4: 0053
Mutual Assured Destruction (MAD)
3: 0903
Nagasaki, Japan
2: 0523
National Academy of Sciences
arms control seminar 10: 0468
NATO
arms control policy 10: 0079
Central European air bases—threat to 10: 0797
flexible response strategy 10: 0644
force modernization 8: 0450
ground-launched cruise missiles/
Pershing II 10: 0001
INF controversy 2: 0783
intermediate nuclear weapons of—
West European opposition to
1: 0001
security of 1: 0382
Soviet military policy—reaction to
6: 0753
Soviet-Warsaw Pact—threat of
10: 0224
theater nuclear force modernization
9: 0563
Naval strategy
impacts on planning of 5: 0864
Navy, U.S.
deterrence 10: 0547
nuclear policy of 5: 0864
Nebraska
Hardened Mobile Launchers—use
in 4: 0053
Nevada
Hardened Mobile Launchers—use
in 4: 0053
hard silo in patterned array 4: 0053
New Mexico
Hardened Mobile Launchers—use
in 4: 0053
Nietz, Paul
nuclear policy—statements on
1: 0887
Non-Proliferation Treaty of 1968
2: 0317; 9: 0630
North Dakota
Hardened Mobile Launchers—use
in 4: 0053
Nuclear bomb
gravity 2: 0102
Nuclear explosions
environmental effects of 6: 0194
industrial uses of 2: 0439, 0481;
4: 0001
nuclear weapons—use in testing of
2: 0510; 9: 0680–0715; 10: 0198
types of 6: 0194
Nuclear-Free Zone treaties
general 9: 0630
South Pacific (1986) 5: 1084
Nuclear material
inventory differences of 8: 0639
Nuclear testing
banning of 1: 0574; 2: 0317–0344,
0439, 0481–0510; 3: 0879;
4: 0001; 5: 1013; 6: 0062, 0311;
9: 0630, 0680; 10: 0198
diagnostics 1: 0493
general 1: 0493; 2: 0523; 3: 0001;
6: 0146, 0311; 9: 0680–0715
Nuclear testing cont.
  imaging systems 1: 0493
  limitations to 9: 0715
  on-site inspections 3: 0879
  purpose of 5: 1113; 6: 0062
  transmission systems 1: 0493
  types of 10: 0198
  in U.S. 2: 0510; 5: 1013; 6: 0072
  see also Seismic monitoring

Nuclear Test Personnel Review
  2: 0523

Nuclear war
  Bayesian analysis of nuclear attack
    6: 0839
  environmental effects of 3: 0570;
    8: 0675; 9: 0651
  perceptions of 7: 0001
  prevention of 6: 0030
  strategies 6: 0194
  survival from nuclear attack 7: 0060

Nuclear warheads
  3: 0001; 6: 0047

Nuclear weapons
  arsenals 6: 0194; 10: 0468
  history of 10: 0224
  legality of 6: 0194
  NATO’s flexible strategy’s
dependence on 10: 0644

Nuclear winter
  3: 0570

Nuremberg trial
  2: 0241

Oceans
  radioactive dumping into 5: 1084

Ogarkov, N. V.
  3: 0806

Orbit-changing propulsion
  4: 0034

Peaceful Nuclear Explosions Treaty
  in 1976 2: 0439, 0481; 4: 0001
  9: 0630

Pershing II
  see Ground-launched cruise
  missile/Pershing II

Plowshare program, U.S.
  2: 0439, 0481; 4: 0001

Prisoner’s Dilemma
  6: 0722

Radiation
  enhanced—weapons 8: 0450;
    10: 0224
  long-term 7: 0060
  medical studies of dose
determinations 2: 0523

Reagan, Ronald
  ICBM 3: 0037
  Peacekeeper missiles 10: 0400
  SDI 1: 0750; 6: 0651, 0722;
    10: 0678–0711
  Star Wars speech 8: 0688
  strategic defense policy 3: 0642

Reilly, Dennis
  detonation-wave thruster concept
    4: 0034

Reykjavik, Iceland
  1986 conference 6: 0651; 10: 0468

Rocky Flats
  nuclear material in 8: 0639

Rogers, Bernard
  NATO 10: 0644

Rosengren, J. W.
  nuclear testing ban—opposition to
    6: 0311

SALT I (1972)
  1: 0574; 3: 0096; 9: 0630; 10: 0101

SALT II (1979)
  1: 0574; 3: 0096; 9: 0630

Satellites
  high-altitude 1: 0485
  nuclear operations—use in 2: 0076

SDI
  applications to 1: 0556
  balance control concept 10: 0749
  battle management 6: 0330
  command, control, communication
    6: 0330
  energy storage 10: 0283
  flywheel energy storage technology
    1: 0556
future of 6: 0651; 10: 0678
general 6: 0608, 0682; 9: 0883
Modular Command and Control     Evaluation Structure 6: 0330
neutral beams 1: 0556
opposition to 6: 0651
pros and cons 1: 0855; 10: 0711
Soviet response to 2: 0375; 6: 0809; 8: 0688
in space 1: 0540, 0750; 6: 0182; 10: 0283, 0571
space power reactors 1: 0556
strategic offense and 5: 1000
testing of 8: 0783
U.S. defense policy and 2: 0462; 6: 0722
SDIO         
Space-Based Surveillance and Tracking System research 9: 0883
validation tests conducted by 8: 0783; 9: 0001-0422
Seismic monitoring
general 3: 0879
network 6: 0146
nuclear testing and 5: 1013; 10: 0840
Short-range Attack Missile 2: 0102
SKEET 2: 0102
Sokolovskly, Vaslly Damilovich 3: 0806
South Dakota
Hardened Mobile Launchers—use in 4: 0053
Soviet Union
arms control 3: 0096; 5: 1000; 10: 0101
Backfire bombers 1: 0574
correlation of forces—perception to 8: 0450
force power of—U.S. and 1: 0887
FROG 10: 0797
INF 2: 0783; 10: 0001, 0797
Marxist-Leninist ideology 8: 0450
military strategies of 6: 0722; 8: 0450; 10: 0001
missile launching from 1: 0778
negotiating behavior 10: 0101
nuclear battlefield 5: 1029
nuclear explosions testing—
    industrial uses 2: 0439, 0481; 4: 0001
nuclear forces of 3: 0037; 6: 0753; 9: 0563
nuclear test ban negotiations 3: 0879
nuclear testing—compliance with 10: 0840
nuclear war doctrine 3: 0806; 7: 0001
nuclear winter research 3: 0570
propaganda 8: 0450, 0688; 10: 0001
radar 1: 0574
SDI—response to 2: 0375; 6: 0809; 8: 0688
Sputnik 6: 0422
SS missiles 10: 0797
SS-20 2: 0102; 10: 0001
strategic defense of 2: 0360; 3: 0642
strategic forces of 9: 0775
TLAM-N—response to 5: 1000
Trident—response to 5: 1000
U.S.—relation with 10: 0711
U.S. and—nuclear treaty negotiations (1957–1973) 2: 0439
U.S. and—views on sharing defense technology 2: 0360
U.S. nuclear policy—response to 8: 0450
Warsaw Pact 10: 0224
Western misinterpretation of 6: 0753; 7: 0001; 8: 0450
world peace and 5: 0864
Space
battle management in 1: 0778
international cooperation in 1: 0540
military systems in 1: 0485; 2: 0076
Space cont.
Sputnik 6: 0422
strategic defense systems 1: 0485, 0750; 6: 0182
U.S. Army's interest in 3: 0708
U.S. national security—importance to 6: 0422
see also Manned Military Space Station
Space-Based Interceptor
testing of 8: 0783; 9: 0230
Space-Based Surveillance and Tracking System
testing of 8: 0783; 9: 0056, 0883
Star Wars
1: 0887
see also SDI; SDIO
Strategic Air Command
Minuteman missile 10: 0769
Strategic defense
directed energy concepts 10: 0440
general 2: 0360; 3: 0037, 0642; 6: 0030
kinetic energy 10: 0440
see also SDI
Strategic offense
3: 0903; 5: 1000; 9: 0775
Surface-to-air missile systems
1: 0574
Tactile Missile Defense Program
Air Base Operability Program role in 10: 0797
INF treaty's impact on 10: 0797
initiation of 10: 0797
Tennessee
Arnold Engineering Development Center 9: 0056, 0311
Texas
hard silo in patterned array 4: 0053
Hardened Missile Launchers—use in 4: 0053
Threshold Test Ban
Treaty of 1976 10: 0840
see also Nuclear testing

Tyler, James V.
LLNL 3: 0003; 6: 0047

United Kingdom
arms control policy 10: 0352
INF controversy 2: 0783
nuclear test ban negotiations 3: 0879

United Nations
nuclear disarmament 6: 0682

United States
arms control debates in 3: 0096
arms control policy in 1: 0803; 2: 0317-0344; 3: 0096
Central European air bases—threat to 10: 0797
defense policy 6: 0062, 0682
defense policy—SDI and 2: 0462; 6: 0608
force power of 1: 0887; 9: 0889
INF 10: 0797
isolationism in 1: 0382
military policy 2: 0076; 6: 0722; 10: 0224, 0797
nuclear operations of 2: 0523
nuclear policy 1: 0887; 8: 0450; 9: 0563, 0775, 0899
nuclear test ban negotiations 3: 0879
nuclear testing 2: 0510-0523
nuclear weapons of 1: 0382
peace movement—perception of 1: 0001
role in European security 1: 0382
Soviet relations with 10: 0711
Soviet Union and—nuclear testing negotiations (1957–1973) 2: 0439, 0481
Soviet Union and—views on sharing defense technology 2: 0360
strategic defense of 2: 0360; 3:0001–0037; 7: 0001; 10: 0711
strategic forces of 9: 0775
Veterans Administration
contribution to Nuclear Testing Personnel Review 2: 0523
Virginia
  Harry Diamond Laboratories—SDIO
testing 9: 0311–0422
Washington, state of
  Hardened Mobile Launchers—use
  in 4: 0053
World War II
  impact on naval strategy 5: 0864

Wyoming
  hard silo in patterned array 4: 0053
  Hardened Mobile Launchers—use
  in 4: 0053
Y-12
  8: 0639
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