A Guide to the Microfilm Edition of

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

Fifth Supplement, 1989–1990

UNIVERSITY PUBLICATIONS OF AMERICA
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Guide compiled by
Paul Kesaris

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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, Fifth Supplement* collection consists of studies on nuclear weapons, arms control, and the threat of nuclear war that became available during the period of 1989–1990.
ABBREVIATIONS

The following abbreviations or acronyms are used frequently throughout this guide and are reproduced here for the convenience of the user.

ABM  Antiballistic missile
CFE  Conventional Forces in Europe
C3   Command, control, and communications
DOE  U.S. Department of Energy
DOD  U.S. Department of Defense
FY   Fiscal year
ICBM Intercontinental ballistic missile
INF  Intermediate Range Nuclear Force(s)
LPS  Limited Protection System
NATO North Atlantic Treaty Organization
NWC  Nuclear Weapons Complex
R and D Research and development
SBI  Space-based interceptor
SDI  Strategic Defense Initiative
SDIO Strategic Defense Initiative Organization
SLBM Small ballistic missile; submarine launched ballistic missile
SNLV Strategic nuclear launch vehicle
SRBM Short range ballistic missile
SSBN Ohio-class nuclear powered ballistic missile submarine
START Strategic Arms Reduction Talks
REEL INDEX

Reel 1

Frame

1983

This document summarizes analytical work done in support of an effort to determine the proper role for TLAMN (Tomahawk Land Attack Missile-Nuclear) in the Nuclear Reserve Force (NRF). In particular, this document summarizes the evolution of nuclear weapon employment policy and nuclear reserve force concepts, presents scenarios for strategic contact for the NRF, examines TLAMN employment concepts, and presents a targeting, campaign, and attrition analysis to determine the best match between TLAM/N capabilities and force requirements in both a theater and NRF context.

0198 Tomahawk Land Attack Missile-Nuclear (TLAM/N), Force Management.
The work done in this report will assist in the formulation of detailed policies associated with the introduction and employment of TLAM/N. These efforts are concentrated in two major areas: (1) development of concepts to guide Navy commanders in the management of TLAM/N forces, and (2) the development of recommendations to be submitted to the Joint Chiefs of Staff on integration of TLAM/N into the Non-Strategic Nuclear Force and the Nuclear Reserve Force.

0325 An Assessment of the Utility of On-Site Inspection for INF Treaty Verification.
This report analyzes the utility of on-site inspection (OSI) for enhancing Intermediate Range Nuclear Force (INF) treaty verification of Soviet compliance with U.S.-proposed collateral limits on short-range ballistic missiles.
(SRBMs). It outlines a detailed verification regime that relies on manned OSI teams to help verify limitations on Soviet SRBM deployments. It also assesses the OSI regime’s potential impact on U.S. Pershing deployments. Finally, the report reviews the history of American policy concerning on-site inspection and evaluates the overall utility of OSI in support of national technical means (NTM).

1985

0415 Nuclear Weapon Personnel Reliability Program.  
Office of the Deputy Under Secretary of Defense for Policy, Washington, D.C.  
This directive reissues DoD directive 5210.42, April 23, 1981, to update policy governing the Nuclear Weapon Personnel Reliability Program, which is designed to ensure the highest possible standards of individual reliability in personnel performing duties associated with nuclear weapons and nuclear components.

1986

0435 Nuclear Winter Source-Term Studies. Volume I—Ignition of Silo-Field Vegetation by Nuclear Weapons.  
Smoke produced by the ignition and burning of live vegetation by nuclear explosions has been suggested as a major contributor to a possible nuclear winter. This report considers the mechanics of live vegetation ignition by a finite-radius nuclear fireball. For specified plant properties, the amount of fireball radiation absorbed by a plant community is calculated as a function of depth into the stand and of range from the fireball. The spectral regions of plant energy absorption and the overlap with the emitted fireball thermal spectra are discussed. A simple model for the plant response to the imposed thermal load is developed. Results show the development of a variable depth ignition zone.

0452 Nuclear Winter: Asymmetrical Problems and Unilateral Solutions.  
Nuclear winter creates a dilemma for policy makers. This dilemma and its solution are the subject of this paper. Through the analysis of “nuclear winter asymmetries,” it uncovers systematically the nature of the problem we face and shows why joint efforts to solve it are in the best interest of both superpowers. Such joint activity should be one part of a two-part solution to
the nuclear winter problem. The second part would be accomplished by force structure changes, which could be made without first developing detailed knowledge of what it would take to cause a nuclear winter and to make sense whether or not a nuclear winter is possible. Since joint activity between the superpowers may not be possible, it is also important to understand that these force structure changes may be made independent of bilateral cooperation.

1987

Prospects and Directions for Improvements in International Safeguards.
The report identifies and analyzes concepts for increasing, in an evolutionary rather than revolutionary manner, the effectiveness and efficiency of the application of safeguards by the International Atomic Energy Agency (IAEA) and for strengthening the IAEA as an institution. A quite broad and extensive set of analyses and recommendations on possible means of improvement is included. In general, these are relevant for consideration not only for the remainder of the '80s but also well into the '90s.

1987 cont.

Nuclear Weapons Effects Seminar.
The purpose of the seminar is to provide the following information to newly assigned material management survivability engineers: (a) An awareness of the magnitude and complexity of the varied nuclear threats; (b) An overview of general and specific Air Force policies and procedures in these areas: 1, Air Force Tech Order system, 2, Maintenance Data Collection system, 3, Hardness Maintenance/Hardness Surveillance, 4, Configuration control; (c) A detailed look at the electronic threat, Electromagnetic Pulse (EMP), and how to safeguard against it; (d) Methods of detecting degradations in the hardness of a system or sub-system through testing and inspection.

This document contains technical papers presented at the Defense Nuclear Agency Review of Global Effects held at Mission Research Corporation, Santa Barbara, CA 7–9 April 1987. Section 1 deals with Mesoscale, Section 2, Global Climate Simulations, and Section 3, Lodi Canyon Experiment.
This is volume 1 of two unclassified volumes of the Proceedings of the Fourth Symposium on Containment of Underground Nuclear Explosions. The symposium was a meeting of workers at all levels in the containment community. Papers on containment and related geological, geophysical, engineering, chemical, and occupational topics are included.

Reel 3

1987 cont.

This is volume 2 of two unclassified volumes of the Proceedings of the Fourth Symposium on Containment of Underground Nuclear Explosions. The symposium was a meeting of workers at all levels in the containment community. Papers on containment and related geological, geophysical, engineering, chemical, and occupational topics are included. Topics covered in volume 2 include Geology, Logging, and Databases; Geophysics and Medium Properties; Cavity, Pressure and Chemistry; Late-Time Gas Flow; Hydrology and Radionuclide Migration; and Collapse Phenomena.

Musketeer was the name assigned to a series of underground nuclear experiments conducted at the Nevada Test Site from October 1, 1986 through September 30, 1987. This report includes those experiments publicly announced. Remote radiation measurements were taken during and after each nuclear experiment by a telemetry system. Monitors with portable radiation detection instruments surveyed reentry routes into ground zeros before other planned entries were made. Continuous surveillance was provided while personnel were in radiation areas and appropriate precautions were taken to protect persons from unnecessary exposure to radiation and toxic gases. Protective clothing and equipment were issued as needed. Complete radio-
logical safety and industrial hygiene coverage were provided during drilling and mineback operations. Telemetered and portable radiation detector measurements are listed. Detection instrumentation used is described and specific operational procedures are defined.

0637 **Nuclear Winter and Nuclear Policy: Implications for U.S. and Soviet Deterrence Strategies.**
Nuclear weapons were rapidly incorporated into the policies for maintaining the national security objectives of both the Soviet Union and the United States—in spite of poorly understood nuclear weapons effects. The nuclear winter hypothesis, the basis of which was first proposed in 1982, directed scientific research into the consequences of massive amounts of dust and smoke from nuclear detonations on the earth’s climate and subsequently on the ecology of the earth. This thesis presents this evolution of the nuclear winter hypothesis in order to elucidate its unique aspects for global devastation and the consensus of plausibility that the hypothesis holds in the scientific community. With the historical aspects of the nuclear era as a backdrop, the question of incorporating new scientific information on the consequences of nuclear war into policy is discussed. The observed responses of the United States and Soviet Union and the implications for future actions in response to the nuclear winter hypothesis are examined—leading to the conclusion that the hypothesis will have little or no impact on U.S. and Soviet nuclear policy.

0763 **Nuclear Weapons Development Guidance, CY1987 Program Review.**
The purpose of the effort was to evaluate the Nuclear Weapon Development Guidance (NWDG) process. Deficiencies in the process were identified, and solutions researched to correct them. Based on the research, options/courses of action were nominated. The effort recommended proposed revisions to the NWDG program. Overall the program assessment reflects a growing consensus that the NWDG serves a useful purpose. However, sharp differences in opinion continue to exist on how to proceed. The bottom line remains to codify the NWDG, strengthen the TAT (Technical Assistance Team) precursor visits, establish reverse TATs, and strengthen the long-range planning focus.
NATO’s Anti-Tactical Ballistic Missile Requirements and Their Relationship to the Strategic Defense Initiative.
This report attempts to structure the broad range of issues affecting the potential development of anti-tactical ballistic missile (ATBM) systems by evaluating the relationship among NATO’s potential needs for ATBMs, the technologies under development in the Strategic Defense Initiative (SDI) Program, and the political constraints in the Federal Republic of Germany (FRG), where ATBMs would be deployed. The authors conclude that planners attempting to improve NATO’s air defenses and those attempting to advance SDI research goals are faced with distinctly different problems. Since NATO’s requirements have little connection to SDI, an ATBM system intended to advance SDI goals must be based almost entirely on SDI objectives and could cause controversy in the FRG. Conversely, the limited systems of most interest to NATO stand outside the political debate.

The Strategic Defense Initiative In Soviet Planning and Policy.
This report analyzes the nature and depth of Moscow’s concern about the Strategic Defense Initiative (SDI) and its implications for future Soviet responses. The authors consider the political-military and technical issues raised for the Soviets by SDI. The study assesses the Soviet declaratory stance on SDI; reviews the evolution and current state of Soviet attitudes toward homeland defense; summarizes key trends in Soviet antiballistic missile and antisatellite technology; considers the actual concerns that may underlie Moscow’s propaganda line on SDI; reviews the range of technical responses the Soviets have said they might undertake; and examines the various political, strategic, institutional, and economic determinants that will shape whatever counter-SDI choices the Soviets ultimately adopt.

The Threat of Nuclear Terrorism: A Re-examination.
This Note reports the final results of the first phase of a two-part study, the purpose of which is to describe the spectrum of capabilities of individuals and groups that could be considered likely to attempt the takeover or theft and misuse of a nuclear weapon over the next 10–15 years. The Note first analyzes the motivations that might inspire various acts of nuclear terrorism. Second, it reviews the altered contexts that might affect terrorists’ decisions to go nuclear.
0001 Post-INF: Toward Multipolar Deterrence.  

The NATO nations have never had enough conventional forces to deter the Soviets in Europe, and they have relied on NATO's nuclear forces—primarily American—for deterrence. As Soviet conventional and nuclear forces have grown larger and more threatening, the credibility of using U.S. forces in response to Soviet aggression in Europe has eroded. The decision to place U.S. Pershing II (Pll) missiles and ground-launched cruise missiles (GLCM) in Western Europe was intended to bolster this credibility. The intermediate nuclear forces agreement, which removes these missiles, although necessary for political reasons, is likely to further erode the credibility of the U.S. threat to use nuclear weapons in the defense of Europe. In the short run, some technical fixes could compensate somewhat for the removal of the Pll and GLCM missiles. But in the longer run the current deterrence system, which relies on U.S. nuclear weapons to deter the Soviet Union, is likely to increasingly evolve toward a multipolar system including France, the United Kingdom, and China, which possess growing nuclear arsenals playing a larger role in deterrence. This report analyzes the elements of deterrence and examines how U.S. nuclear forces have produced extended deterrence in Europe.

0034 The INF Treaty and Flexible Response.  

This paper examines how the Intermediate Range Nuclear Forces (INF) Treaty affects NATO's military strategy of flexible response, a discussion of which is provided as background for the reader. Relevant terms of the treaty are then addressed, followed by an assessment of the treaty's impact on the military strategy of the alliance.

0061 START—The Road to Nuclear Stability?  

President Reagan committed the United States to reaching a strategic nuclear arms control agreement that would enhance nuclear deterrence stability between the United States and the Soviet Union. By accepting the premise that nuclear stability had eroded over the last decade, the author discusses the various schools of view for enhancing stability and the various factors that
affect the stability of nuclear deterrence. This sets the stage for an evaluation of a START (Strategic Arms Reductions Talks) Treaty based on United States' Geneva proposals as to whether or not stability is enhanced by using likely START Treaty constrained force structure. In the author's opinion, the proposed START Treaty provisions are generally neutral to general stability, but the same provisions leave openings for both sides to exploit that would erode crisis stability. Included are recommendations for both unilateral U.S. actions and START Treaty proposals that, if adopted, would lead to increased crisis stability.

0136 Introduction to the Operational Nuclear Survivability Assessment Process.
The objective of this document is to introduce the AFOTEC project analyst to the process of conducting an operational assessment of weapon system performance in the nuclear threat environment. A Nuclear Assessment Methodology (NAM) has been developed and implemented to assess weapon system operational effectiveness. The goal of the operational nuclear survivability process is to assess the weapon system performance characteristics and employment techniques that are impacted by operation in the nuclear threat environment. The focus of this document is how this methodology is implemented for various types of weapon systems from both a technical and management perspective. The intent is to provide the project analyst with a basis for effectively managing operational test and evaluation nuclear survivability assessments and with a top level understanding of the technical requirements. This section presents a brief discussion of the AFOTEC role in the acquisition process of major Air Force systems and presents an overview of the OT&E NAM. Subsequent sections will describe how the methodology is implemented and the types of results the project analyst may expect from an assessment. A brief description of nuclear effects is provided to familiarize the project analyst with the terminology and environments related to nuclear weapons.

0195 Picking Up the Shield: Incorporating Defense into Strategic Nuclear Doctrine.
This is an account of the evolution of strategic nuclear doctrine and the challenge faced as defense is incorporated into strategic nuclear doctrine. It puts the offense-defense relationship into a historical perspective that lends
important insight into the on-going debate over strategic defenses. Although this debate centers on the active defenses contemplated by the strategic defense initiative, the author makes the point that passive defenses are also an important component of strategic defense. He sees the inherent passive defenses of the Triad as being a key to maintaining offense-oriented deterrence, and he makes a case for survivable Peacekeeper basing and a small mobile intercontinental ballistic missile (ICBM) to enhance deterrence and pave the way for active defense.

This paper highlights arms control as a mutually shared interest in superpower relations. Chapter I addresses U.S. foreign policy vis-à-vis the USSR and vice versa, and focuses on current superpower national interests. Chapter II focuses on the specifics of the Intermediate Range Nuclear Force (INF) Treaty. A review of the background since 1977 is presented, followed by specific terms of the treaty, including types of missile systems, timetables and methods of elimination, and the mutual verification scenario. Personnel requirements to implement the treaty are also presented. Chapter III addresses the impact of the INF treaty on NATO doctrine and force employment. Current criticisms of the treaty that relate to the resulting military balance in Europe and U.S. commitment to NATO are presented. U.S./NATO and Soviet/Warsaw Pact thinking on such areas as defense sufficiency, modernization, and future arms control agreements is also covered.

This paper attempts to answer the fundamental question “Can SDI make a significant contribution to U.S. national security?” It uses as its evaluation criteria historical arms control measurements of stability, reduction in the probability of war, reduction in the consequences of war, economic benefits, and political benefits. A historical discussion of U.S. nuclear strategy development along with Soviet thinking is provided as a backdrop to set the stage for an analysis of the reasons for President Reagan's March 1983 speech. The objectives of SDI are discussed along with the major concerns expressed by the program critics. Using the evaluation criteria defined above, the author analyzes SDI potential position in a long-term integrated national strategy that includes arms control and competitive strategies.
An Assessment of Global Atmospheric Effects of a Major Nuclear Conflict.
In 1983, evidence started emerging that a major nuclear conflict could result in substantial weather changes over vast regions of the globe, including severe surface cooling over the continents. Refined projections of the density and horizontal extent of persistent layers of smoke (soot) led to revised estimates of the magnitude of the postulated surface cooling. The impact to the post-attack environment implied heretofore unrecognized consequences to the quality of life in vast regions and to effective national defense planning and execution. Subsequent studies sought to reduce the uncertainties in the calculations by clarifying some assumptions and replacing others with more complete and newer data. This report includes sections dealing with an early diagnosis of atmospheric effects; soot and its properties and production; atmospheric models; a review of published comments and meetings; and potential impact on U.S. Air Force operations.

Extended Deterrence and Arms Control: A Collection of Conference Papers.

Beyond the Illusion of Symmetry: How to Think About Arms Control.
This report examines the historical divergence in U.S. and Soviet approaches to nuclear arms control and its implications for future nuclear force reduction agreements. The study questions arms control's "illusion of symmetry" and its simplistic assumptions about each side's motivations and objectives for arms control. The study also outlines the changing context for arms control, identifies the traditional goals of arms control, measures both sides' arms control "behavior" against those goals, interprets some of the criticisms of
arms control in light of this analysis, and offers some suggested improvements for future arms control efforts. The author concludes that U.S. and Soviet arms control interests have always been asymmetrical and, consequently, U.S. arms control efforts are unnecessarily constrained by an "illusion of symmetry." As a result, U.S. arms negotiations planners and strategists are likely missing some excellent opportunities for reducing arms while improving U.S. national security. The author recommends moving beyond the "illusion of symmetry" to a broad and integrated national strategy of arms control initiatives.

0837 U.S. and Soviet Approaches to Nuclear War Termination: Strengthening the West's Hand.
U.S. and Soviet nuclear war termination doctrines are fundamentally different, and misunderstandings about them could result in rapid escalation once nuclear weapons had been used. The period just before the nuclear threshold is reached would be a key time to persuade the Soviets that further conflict would be adverse to their interests. By taking into account evolving Soviet doctrine, the U.S. could strengthen its hand in resolving a burgeoning crisis.

Remarks on some historical aspects of prohibiting chemical weapons introduce a discussion of current efforts toward a global chemical weapons ban. A review of past efforts to prohibit or control chemical weapons, the state of current negotiations, the problems in achieving a comprehensive, global, and effectively verifiable ban, and prospects for a treaty are included. An alternative approach is recommended.

0905 About the Need for the Mobile, Small ICBM in the 1990s.
A re-examination of the merits and need for the small ICBM is conducted in light of the changes since the 1983 President's Commission on Strategic Forces recommended the development. The history of U.S. declaratory nuclear policy and arms control issues are reviewed to set a foundation for force structure criteria and requirements. The role and effectiveness of the small ICBM in addressing this nuclear policy and arms control issues are discussed. The new factors of a surviving basing mode for PEACEKEEPER, declining defense budgets, START progress, and the SDI program are evaluated as they affect the original small ICBM decision. The conclusion is
reached that the rail garrison PEACEKEEPER satisfies most of the originally intended roles for the small ICBM, at significantly less cost. But continuing development, with a slower paced production and deployment schedule, is needed as a hedge on arms reductions beyond START, SDI capabilities, and future vulnerability of U.S. SLBMs.

Frame

Reel 5

1988 cont.

0001 Radiological Conditions at Bikini Atoll: Radionuclide Concentrations in Vegetation, Soil, Animals, Cistern Water, and Ground Water.  
The report is intended as a resource document for the eventual cleanup of Bikini Atoll and contains a summary of the data for the concentrations of 137Cs, 90Sr, 239+240Pu, and 241Am in vegetation through 1987 and in soil through 1985 for fourteen islands at Bikini Atoll. The data for the main residence island, Bikini, and the second most important island, Eneu, are extensive: these islands have been the subject of a continuing research and monitoring program since 1974. Data for radionuclide concentrations in ground water, cistern water, fish and other marine species, and pigs from Bikini and Eneu Islands are presented. Also included are general summaries of the resuspension and rainfall data from Bikini and Eneu Islands. The data for the other twelve islands are much more limited because samples were collected as part of a screening survey and the islands have not been part of a continuing research and monitoring program. Cesium-137 is the radionuclide that produces most of the estimated dose for returning residents, mostly through uptake by terrestrial foods and secondly by direct external gamma exposure. Remedial measures for reducing the 137Cs uptake in vegetation are discussed.

This report documents a project that implemented a key recommendation of the Nuclear Explosive Lightning Vulnerability Investigation Task Force. A prototype, lightning vulnerable, nuclear explosive test device system (LIDS) was designed, fabricated, and tested. Severe threat-level simulated lightning and rocket-triggered natural lightning were discharged into both coaxial and multiconductor cables. Subsequently a detailed data analysis was carried out by the Science and Engineering Associates, Seattle, Washington, under
subcontract number 9749605 that confirmed the observations of the experimenters, namely that the prototype LIDS protected the safety-critical components from severe threat-level lightning transient energy. Simulated electroexplosive devices (EEDs) connected to the A and F components did not “fire” under any of the test conditions. However, current measurements for the EEDs were inconclusive. Although the testing was intended to demonstrate protection against a severe lightning strike, the analysis pointed out that a relatively low-level, long-duration strike could conceivably produce partial charging of A and F components. Evaluation of this phenomenon as a potential threat was beyond the scope of this report.

0647  
**Verifying Arms Control Treaties to Deter Violations.**  
Verification has developed into a very important arms control issue. As evidenced by the recent Senate debates concerning ratification of the INF Treaty, verification can be a very controversial and emotional topic. In addition, verification’s importance will surely continue for the foreseeable future. It is a major issue in the negotiations toward large reductions in strategic weapons and will gain even greater importance should deeper cuts be considered.

0676  
**Soviet Concepts of Ballistic Missile Defense.**  
This thesis characterizes the Soviet concept of ballistic missile defense (BMD) in order to better understand and predict future Soviet BMD decision making. The Soviet concept of BMD is fundamentally different from that in the West. Soviet BMD is clearly an integral component of a much larger Soviet strategic defense effort that consists of strategic air defense as well as passive measures, such as mobility, deep underground command and control facilities, and civil defense. As the Soviet military literature demonstrates, Soviet strategic air defense encompasses defense against a continuum of threats—from aircraft to ballistic missiles to satellites to “space-strike” weapons. Soviet strategic air defense weapons therefore appear optimized to counter a wide range of airborne threats. In the Soviet view, surface-to-air missiles may be a primary tactical BMD weapon. Additionally, Soviet strategic BMD weapons may be a primary Soviet anti-satellite weapon. Furthermore, manned space platforms play a particularly significant role in Soviet thinking about the future of BMD and space warfare.
0787 **SDI: Myth or Reality?**


This report reviews previous attempts to develop strategic defenses, the technologies currently under consideration by the Strategic Defense Initiative (SDI), their main unknowns, and the likely performance of strategic defense concepts against evolving threats.

0808 **Nuclear Weapon-Free Zones.**


The literature dealing with nuclear weapon-free zones is not as prominent as is that on arms control and other security-related issues. Documentary sources are relatively scarce and widely scattered. Yet nuclear weapon-free zones have been the object of widespread, intense interest in most regions of the world. In Europe, the only region where adversary alliances maintain a high concentration of nuclear weapons, issues concerning the viability of nuclear weapon-free zones have attracted special attention. The document contains information intended to help put problems in perspective, create awareness of trends, and provide a basis for identifying factors that may bear significantly on evaluating options in the formulation of national and alliance security policies concerning nuclear weapon-free zones.

0900 **Medical Prevention and Protection Against Chemical Weapons.**


To avoid or reduce injuries caused to our front and rear when the enemy conducts chemical attacks, not only must the military do the protection work well, but local cities, especially important ones, also must not be ignored. Doing the protection work well has important significances in preserving combat capabilities of troops, completing combat missions, ensuring safety of people's lives, and maintaining normal production and labor order. Although chemical weapons possess greater casualty-inflicting and destruction effects, they can be protected against and are curable. There are primarily three areas of work to be done well in the protection against chemical weapons: toxicant detection and examination; personal protection and group protection; and washing and sterilizing. (Translated from the Chinese.)
This paper is an overview of the conference on the Future of Nuclear Weapons: The Next Three Decades held at the Los Alamos National Laboratory, June 6–8, 1988, and sponsored by the Center for National Security Studies of the Los Alamos National Laboratory. The conference was one of the principal products of a three-year study by the Center. The future of nuclear weapons was addressed in three broad areas—policy and politics, technology, and military perspectives. Conference speakers identified and discussed the key issues and driving forces that will shape the future of nuclear weapons over the next three decades, taking both retrospective and prospective views, but not trying to predict the future.

Beating Words Into Plowshares: A Proposal for the Peaceful Uses of Retired ICBM Launchers.
Any future agreement between the superpowers regarding standing arsenals of intercontinental ballistic missiles will undoubtedly feature dramatic reductions in their numbers. Recent history suggests that the surplus missiles must be destroyed in order to provide a secure and mutually verifiable means of ensuring compliance. But demolition of the START inventories in turn denies their utility as a valuable scientific resource. In keeping with the spirit of START, this paper suggests that the demands of mutual verification and peaceful civilian needs can be reconciled by jointly and cooperatively using the idled ICBM launchers to exploit scientific and commercial promises of space.

The Effects of CW-Related Chemicals on Social Behavior and Performance.
The goal of the project was to develop a battery of tests of social behavior and performance for nonhuman primates that would be sensitive to the effects of chemical warfare (CW)-related chemicals considered for use as antidotes or prophylactics against CW agents. Different procedures for assessing social
behavior are described and evaluated, as are a number of tests for emotional reactivity, complex problem solving, and operant performance. Data are presented on changes in plasma hormone levels in response to manipulations of social and performance variables designed to induce stress in the subjects. The suitability of the test battery for use in studying CW-related chemicals was evaluated using an antidote (atropine sulphate), a therapeutic (diazepam), and control drugs (caffeine and atropine methyl nitrate). A set of tests to be included on the battery, along with some alternatives, is presented.

0160 Controlling Nuclear Weapons through a “Dynamic Freeze”: A Note on the Nuclear Materials Implications.


Failure to distinguish between numbers of nuclear weapons “deployed” and numbers “in stockpile” may, in some situations, lead to underestimates of nuclear materials requirements. Especially in an arms control environment that restricts nuclear matters, such misunderstanding, when combined with the already asymmetric nuclear materials capabilities of the United States and the USSR, might place the United States in an unexpectedly disadvantageous position. A simplified case will demonstrate that replacing warheads on a missile system, even with similar ones and even when the number of deployed delivery vehicles remains constant, temporarily increases the weapons stockpile and the commitment of nuclear materials to the system. An application is made to an arms control case involving concurrent restraints on weapons, testing, and materials production.

0179 A Strategic Planning Framework for Predicting and Evaluating Soviet Interests In Arms Control, Volume I.


This report distinguishes between Soviet interest in making arms control proposals, negotiating arms control agreements, signing arms control treaties, and actually complying with agreements once signed. It suggests that four sets of factors condition Soviet arms control interests at each of these levels: (1) Soviet threat perceptions; (2) Soviet bargaining leverage; (3) Soviet leadership stability; and (4) Soviet foreign policy orientation. Specific reference is made to strategic nuclear arms control issues. Four conditions are identified as prerequisites for Soviet interest in reaching agreement on strategic arms reductions, thus providing a basis for policy forecasting.
Frame

This report takes the framework developed in Volume I regarding levels of Soviet interest in arms control and the four factors conditioning that level of interest, and applies them to a specific case study: the Strategic Arms Reduction Talks (START) between 1982 and 1983. It concludes that none of the four variables necessary for Soviet interest in signing an agreement was present, and therefore provides a conceptual understanding for Soviet policy toward strategic arms control in the era immediately preceding the emergence of SDI and strategic defenses as a major factor in Soviet calculations.

0690 Innovative Science and Technology (IST) In Support of SDI BM/C³.
Battle management and command, control, and communications (BM/C³) issues in the SDI context were discussed at a two-day workshop at the IDA. Another workshop probed civilian systems that require handling of large amounts of data and that have fault-tolerant features that may be useful in resolving SDI BM/C³ problems. The findings are summarized in this report, with special emphasis on possible research to be supported by the Innovative Science and Technology Office of SDIO.

0751 Decision Framework for Evaluating Compliance with the Threshold Test Ban Treaty.
A decision framework for evaluating Soviet compliance with the 150-kt limit on the yield of nuclear tests, as specified by the Threshold Test Ban Treaty, has been developed. The framework is designed to help interpret available evidence of possible violations and respond appropriately to that evidence, which consists of estimates of the yield of Soviet tests. Interpreting and responding to evidence of possible violations requires a series of technical determinations and policy judgments. The decision framework, best viewed as an aid to decision making, provides a systematic method for organizing and incorporating diverse inputs, exploring the implications of alternative technical and value judgments, and understanding complex trade-offs. By exercising the framework, technical analysts and policy makers can build new insights, which ultimately can lead to better compliance evaluation decisions.


Of the more than 450 underground nuclear explosives tests conducted at the Nevada Test Site (NTS) from August 1963 (signing of the Limited Test Ban Treaty) through the end of 1986, only 23 accidentally released radioactivity that was detectable beyond the boundary of the NTS. Of these 23, four were detectable off the NTS only by aircraft while the remainder were detectable by ground monitoring instruments. Since the Baneberry venting of December 1970, only two tests released radioactivity that was detectable off the NTS, and this was a seepage of radioactive noble gases. None of these releases from underground tests designed for complete containment caused exposure of the population living in the area that exceeded standards recommended by national and international radiation protection agencies. This report summarizes the releases from each of the tests, describes the monitoring that was conducted, and lists the location of the maximum exposure.

Achieving Mutual Deterrence with Active Defenses.


A model of mutual deterrence by fixed, land-based missile forces is discussed. In the model both parties maintain boost-phase and preferential terminal defenses. Computations are given for different system configurations, and conclusions are presented about the cost-effective maintenance of mutual deterrence.

Long-Range Planning Perspectives on Nuclear War at Sea: Naval Nuclear Crisis Management.


This report presents a conceptual discussion of the implications of maritime nuclear weapons for crisis management and discusses the following themes: (1) strategic nuclear weapons have played significant crisis control and termination functions in the past; (2) current U.S. Navy maritime theater nuclear warfare capabilities, by virtue of their dispersal throughout the fleet, are very likely to be involved either directly or indirectly in future crisis responses by naval forces; (3) crisis response is a key feature of the Maritime Strategy's plan for deterring war and controlling escalation; and (4) maritime theater nuclear capabilities may both enhance and impede naval crisis management objectives.
Whither SDI: Strategic Defenses in the Next Administration.

This document examines the legacy of strategic defenses that the next president will inherit from the Reagan administration. Concentrating on SDI, it describes the programmatic, budgetary, arms control, and political contours of the strategic defense agenda that the new president is likely to confront. It then considers the options he will face and plots a course he should take. This essay is intended to stimulate and structure debate about the future of strategic defenses. An earlier version of this paper was prepared for a Council on Foreign Relations study group on the Arms Control Agenda of the Next Administration. Since it was initially drafted in spring 1988, the politics of SDI have changed with a speed that few could have predicted. Abruptly and unexpectedly, SDI all but disappeared from the political debate at precisely the time when a multitude of candidates were vying for their parties' nominations, and then the two nominees were seeking to define and distinguish their positions. Despite these changed circumstances, this document should be of interest to those who are concerned with how developments in strategic defense bear on nuclear policy, programs, and arms control.

The Environmental Effects of Nuclear War.

Substantial environmental disruption will significantly add to the disastrous consequences caused by the direct thermal, blast, and radiological effects brought on by a major nuclear war. Local fallout could cover several per cent of the Northern Hemisphere with potentially lethal doses. Smoke from post-nuclear fires could darken the skies and induce temperature decreases of tens of degrees in continental interiors. Stratospheric ozone could be significantly reduced due to nitric oxide injections and smoke-induced circulation changes. The environmental effects spread the consequences of a nuclear war to the world population, adding to the potentially large disruptive effects a further reason to avoid such a catastrophe.

Psychological and Behavioral Responses to a Chemical and Biological Warfare Environment: Final Recommendations.
*Department of Psychiatry, F. Edward Herbert School of Medicine, Uniformed Services University of the Health Sciences, Bethesda, Maryland. Robert J. Ursano, M.D., et al. September 1988. 34pp.*

In the present world climate, chemical and biological warfare (CBW) is a realistic threat to U.S. Air Force personnel. Medical care for conventional and chemical casualties in the CBW environment requires individual protection,
group protection, and decontamination as well as supply and patient transfer through contaminated areas. CBW stirs terror in individuals both because of the particular psychological fear it arouses and the tremendous difficulties presented by the need to continue to operate after an attack. Recommendations derived from CBW research cover the issues of command (e.g., maintenance of communications and morale, and command policy in the face of mass casualties), medical care (e.g., alcohol use as a risk factor in CBW environment, low dose exposure, internal SCPS-M [Survivable Collective Protection System-Medical] management, and unique stressors of the CBW environment), performance (e.g., group responses to contamination and isolation effects on performance), and training (e.g., unit reconstitution following heavy losses, "grief leadership," buddy care, development of first aid capability within squadrons, crews, and work units, maintenance of cohesion in flying and ground crews, and training for commanders in command posts). These recommendations should serve as a basis for the development of command policy, training scenarios, medical command and medical care procedures, and the direction of future research in this area.

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International Armaments Cooperation: A Case Study of the Modular Standoff Weapons.


The research examined various aspects of NATO armaments cooperation, including the ongoing Modular Standoff Weapon System (MSOW) program within the context of a broader study of overall NATO cooperation. The MSOW program currently involves five nations in an effort to build a family of long-range, air-launched ground attack missiles. In addition to determining the benefits and drawbacks of NATO armaments cooperation, the study attempted to determine whether MSOW's benefits, drawbacks, and influential factors paralleled those of overall NATO cooperation and whether the MSOW program was projected to yield a weapon system worth the additional effort required in a joint program. The research indicated that NATO armaments cooperation is worthwhile, as it is believed to reduce costs for each nation because the higher costs are shared by the partners. Cooperation also reduces inefficient duplication of research and development (R&D) within the alliance. However, armaments cooperation is complicated by political, military, and economic factors. MSOW's benefits, drawbacks, and influential
factors were found to be essentially the same as those of overall NATO armaments cooperation. Recommendations included a listing of suggested improvements from the personnel involved. The researcher's recommendations included stabilized funding for NATO cooperative programs, beginning with simpler programs, and ensuring that the knowledge and experience gained in each international program be documented and used to train personnel new to international cooperation.

0157 The Space-Based Interceptor.
The effectiveness and marginal cost-effectiveness of space-based interceptors (SBI) defenses against a variety of possible Soviet threats are calculated. Defense effectiveness is expressed in terms of participation fraction, which depends on SBI flyout distance and threat basing, and in terms of the number of interceptors needed to accomplish a given mission. Optimal interceptor sizing favors large, high velocity rockets. With such optimal design, the defense appears marginally cost effective with a 50 percent kill criterion against current or responsively modified large liquid boosters, although not against more stressing threats. Survivability of direct attack is not assessed, although survivability enhancement options are briefly discussed.

To encourage breadth in the formulation of games for official purposes, RAND responded to a request from the director of net assessment to create a number of scenarios for the early 21st century in which conflict would occur or be likely and in which due attention would be given to the political and technological conditions that might then be operational. This note presents a wide range of such scenarios in sketch form. Several of the scenarios assume varying degrees of success for elements of the current SDI program, for new applications of stealth technology, for the National Aerospace Plane, for nonnuclear strategic weapons, and for new surveillance techniques. Applications range from battlefield uses to strategic options.

0326 A Concept and Plan for Experiments to Improve Ground Shock Predictions for the EPW Program.
This document summarizes a concept and plan for providing new experimental data to be used in validating ground shock calculation. The effort was supported by the Earth Penetrator Weapons (EPW) program. The main
objective was to collect information on certain ground motion phenomena that may be observed on larger-scaled field experiments but at the same time, exercise greater control over experimental conditions. It is recommended that this work be carried out in concert with other experimental programs, such as the Defense Nuclear Agency's high explosive (HE) test program, so that results are correlative or scalable according to explosive yield. Although some differences are expected, the experimental technique proposed offers a cost-effective means of providing repeatable, reliable ground shock data for a wider variety of media and source configurations than can be obtained with field experiments. The cost of the program, however, would depend on the specific number and design of experiments and is not included in this presentation.

**The Future of Nuclear Weapon Technology.**


The next few years will bring decisions that are critical for the future of the nation's nuclear weapons program and for the role of the national weapons laboratories. To meet this challenge, the United States needs to develop both a clear, cohesive, national security strategy and a policy regarding the future role of nuclear weapons that are appropriate to rapidly evolving political and technical environments. The current weapons debate has been complicated by the controversy over the future of strategic defenses and by uncertainty over the role to be played by conventional forces and armaments. Other uncertainties have been introduced by nonmilitary security issues such as energy policy and the declining economic position of the United States with respect to other nations. Major national fiscal problems have placed severe constraints on defense spending. The nuclear weapons program itself suffers from a fragile and aging production and R and D complex, which has been further subjected to increasing demands arising from environmental, safety, and security concerns. Problems leading to shutdowns and power reductions in the DOE production reactors typify the situation, but concerns are even more widespread than those involving the reactors, both in the NWC and in the country as a whole. This paper discusses what this means to the future of nuclear weapons technology.

**Chemical Warfare Arms Control: Issues and Challenges.**


This report considers the major issues concerning chemical weapons and their prohibition. It discusses the U.S. policy on chemical warfare and analyzes the chemical weapons treaty and its verification regime currently under negotiation at the Geneva Conference on Disarmament. Also pre-
Presented are discussions of the nature of chemical warfare threat and the limitations of earlier international agreements. The report includes an explanation of chemical agents and a chronology of events relevant to chemical warfare.

0427 Strategic Defenses and International Stability.
The papers presented here grew out of a workshop held at the Los Alamos National Laboratory, October 30, 1987, on Strategic Defenses and International Stability. The workshop was sponsored by the laboratory's Center for National Security Studies.

0482 U.S. Army Training in the Tactical Employment of Chemical Weapons: A Flaw in Our Chemical Deterrence?
Chemical weapons were introduced in World War I by the Germans in 1916, during the battle of Ypres. The military's appreciation for the effectiveness of this weapon of mass destruction has continually conflicted with society's horror of its cruel effects. As a compromise, many nations agreed not to employ them in future wars, with the reservation that they would retain a retaliatory capability that would deter an adversary's impulse to introduce chemicals into the battle. While those measures served to prevent chemical use in World War II, events since then force us to reevaluate our retaliatory capability and its deterrence value. Increased use of chemical agents by the Soviet Union and its client states, and the development of chemical weapon programs in other third world nations, points to an ever-increasing future risk that the U.S. "retaliation in kind" policy will be challenged. Meanwhile the U.S. army has neglected the training of its officers and units in the tactical employment of chemical weapons to the point that it seriously undermines the credibility of the deterrence value of our chemical weapons policy. This paper concludes that the lack of training prevents the U.S. army from realizing that it is prepared to fight with an obsolete chemical doctrine, and recommends actions that will update its chemical warfighting capability and thereby enhance the deterrence effect of our chemical weapons policy.
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The purpose of this review was to continue gathering available literature applicable to the physiological and psychological effects of nuclear/biological/chemical and extended operations on crew ($P^2NBC^2$) performance. Over 1,300 abstracts were reviewed, and approximately 500 of those were found that contained applicable information. The review is presented by year, and an index of the bibliographic citations is also provided.


Los Alamos Operations (LAO) has two major areas of activity. The first includes the design fabrication, testing, and fielding of data acquisition systems used for diagnostics in underground nuclear testing. The second includes providing experimental support, engaging in data acquisition, and performing analysis of experiments involving microwave propagation in air. Analysis is also performed on weapons effects data acquired during the U.S. Nuclear Atmospheric Test Program. The current emphasis is on digital concepts and special imaging systems, including state-of-the-art fiber-optic light guide and streaking camera technology. This progress report highlights LAO's many areas of technical involvement. Projects in progress or done at LAO under other funding sources, i.e., R and D, cash orders, Economy Act Orders, etc., as well as miscellaneous programmatic tasks, are included in Sections V and VI. They are included for completeness and to illustrate the varied but complementary nature of the work done by LAO personnel.

0916 SDI Battle Management/$C^3$ Networking Technology Program Plan.


The Institute for Defense Analyses (IDA) has collected and analyzed information on network technology that is relevant to Battle Management Command, Control, and Communications (BM/$C^3$). This memorandum report represents a program plan that will provide the SDIO BM/$C^3$ directorate with administrative and technical insight into networking technology. The program plan focuses on $C^3$ network concepts and provides information and analysis to the SDIO to be used in formulating budget requirements for FY 1988 and beyond.
Based upon analysis of network requirements and ongoing programs, recommendations have been made for research areas that should be funded, including both the continuation of current work and the initiation of new tasks. While emphasis here is on the SDIO-funded tasks, other relevant government-sponsored and commercial efforts, such as packet radio networks, also have been examined.


A major assumption is that nuclear weapons will remain a principal element of the security of the United States for the foreseeable future. The NWC of the U.S. DOE provides the nuclear weapons that support the nuclear deterrent policy. This support includes production of nuclei material; design and manufacture of nuclear weapons in the stockpile; research, development, and testing of nuclear devices; and modernization of the nuclear weapons stockpile. Much of the NWC was constructed more than 30 years ago. Some facilities are experiencing operability problems due to obsolete equipment and operational systems and to stresses in complying with more stringent environmental, safety, and health standards and requirements. Many facilities throughout the NWC are approaching the end of their useful lives. Correcting these inadequacies and placing these operations in an exemplary condition will require the support of both the congress and the administration to a major, long-term modernization effort.

Interpretations: Understanding Soviet Arms Control Motivations and Verification Attitudes.

The motivation at the heart of present Soviet arms control motivations and verification attitudes is grounded within the broad historical perspective of the Russian and Soviet mobilization struggle. It is from this perspective that present Soviet behavior is rooted. Our understanding of this root motivation is essential to identifying opportunities to enhance U.S.—Soviet relations and in turn our national security.
SDI and the Soviet Defense Burden.
The Soviets' response to SDI must be understood within the context of their deteriorating economic situation and need to modernize their economy. This note evaluates the defense burden to the Soviets of both an offsetting and an emulation response to the U.S. SDI effort. The analysis is conducted within the context of General Secretary Gorbachev's modernization program, which is designed to increase the productivity of economic resources. The analysis suggests that the Soviets can partially offset a U.S. SDI effort with a ruble expenditure that is a small percentage of current defense spending. Although the Soviets may regard such a response as unsatisfactory, it is important to consider the striking contrast compared with the burden of an emulation response. The author hypothesizes, therefore, that the Soviets will choose not to directly emulate the U.S. SDI activities, at least until they have modernized their technical-economic base.

FY 1988 was a significant, rewarding, and exciting period for the Lawrence Livermore National Laboratory's nuclear testing program. It was significant in that the laboratory's new director chose to focus strongly on the program's activities and to commit to a revitalized emphasis on testing and the experimental science that underlies it. It was rewarding in that revolutionary new measurement techniques were fielded on recent important and highly complicated underground nuclear tests with truly incredible results. And it was exciting in that the sophisticated and fundamental problems of weapons science that are now being addressed experimentally are yielding new challenges and understanding in ways that stimulate and reward the brightest and best of scientists. During FY88 the program was reorganized to emphasize our commitment to experimental science. The name of the program was changed to reflect this commitment, becoming the Nuclear Test-Experimental Science (NTES) Program.

This research and development program explores and develops technology to improve the nuclear survivability and effectiveness of U.S. strategic and nonstrategic weapons systems and forces, and the command, control, and communications systems needed to operate those systems and forces in a
nuclear conflict. This program is particularly responsive to the new environments of arms limitation and fiscal constraint by providing technology to create extremely reliable military systems, thereby maintaining a credible nuclear posture necessary to deter conflict. Research efforts encompass nuclear weapons effects, underground nuclear tests, nuclear hardening, radiation simulators, nuclear detonations effects, and biomedical effects survivability.

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Legal Aspects of Implementing a Global Chemical Weapons Convention under Domestic Laws.
The notion that domestic law must be considered as part of the planning to implement an arms control treaty shows how far the nations of the world have come in their negotiation of such agreements. Increasingly, arms control agreements are more than simply mutual declarations of self interest. Verification provisions have made them instruments that create enforceable law that, as such, must be integrated into the existing legal structure of each state party. Nowhere is this more obvious than in the development of international controls over chemical weapons. The Geneva Protocol of 1925 required only a single page to ban the use of chemical weapons in wartime. In contrast, the Draft Convention on the Prohibition of Chemical Weapons tabled at the Geneva Convention on Disarmament in 1984 by the United States was some thirty pages long. The most recent rolling text of this draft treaty now exceeds one hundred pages and still requires additional text. The vast majority of this material specifies the verification measures and the international agency, to be called the Organization for the Prohibition of Chemical Weapons, that have been deemed necessary to implement the agreement.

Radiation Detection in Treaty Verification.
Article VII, paragraphs 8 and 14, of the inspection protocol of the INF Treaty between the United States and the USSR provides for the use of radiation detection devices as a verification tool. That is, the treaty allows the parties to measure the radiation from the radioactive components of nuclear weapons in order to verify that the inspected party is complying with the treaty. This is the only verification provision in the treaty that addresses the nuclear components of the relevant weapons systems. Acceptance of and confidence in such
measurements is a significant development and similar measurements may be needed for verification of future treaties.

0442 Ethics and Nuclear Weapons Research.
This report discusses the ethical implications of nuclear weapons research. The roles and concerns of scientists in developing and conducting nuclear research are also discussed.

0466 The Current Debate over Soviet Defense Policy.
Gorbachev's new political thinking on national security issues poses a profound challenge to the Soviet military. He has encouraged civilian intellectuals to actively participate in the formulation of Soviet defense policy, and in so doing, has threatened the professional military's monopoly on setting the defense agenda. It is still too early to predict which of these two groups will take the lead in formulation of Soviet defense policy. Gorbachev's announcement of unilateral troop reductions reflects the views put forth by many civilian defense analysts. If, however, the rumors are true, this may signal the strengthening of the military's role in setting the defense agenda. The implications of Gorbachev's new political thinking on foreign policy and national security issues hold profound implications for the West, too. Over the last three years, the Soviet Union's actions, especially in the arms control arena, have proven that political thinking offers the West an unprecedented opportunity to address many of the most important issues facing mankind, including arms control and the arms race, human rights, and environmental issues. As Gorbachev's speech to the UN General Assembly demonstrated, the Soviet Union is ready and willing to seize the initiative on many of these issues.

0497 Thermal Measurements in the Nuclear Winter Fire Test.
In March 1987 a large open pool fire test was performed to provide test measurements to help define the thermal characteristics of large open pool fires and estimates of the smoke source term for the nuclear winter (global effects) scenario. This report will present the results of the thermal measurements as well as comparisons with previous test results. These measurements included flame temperatures, heat fluxes to a variety of calorimeters, and gas velocities in the lower flame region.
The Proliferation of Chemical Weapons: Putting the Genie Back in the Bottle.

Following the introduction of gas warfare in World War I, a set of restraints was developed that was effective in preventing the use of toxic chemical agents in World War II. The prolonged Korean and Vietnam conflicts were fought without resort to toxic chemical weapons. Recently, however, there has been a breakdown of the traditional restraints that were effective for fifty years in preventing chemical warfare. This study examines the traditional restraint systems that evolved after World War I and extrapolates that framework into the modern era to determine what has changed to render the traditional restraints ineffective today. From this analysis, a model is derived for an effective chemical weapons protocol and a strategy is proposed for worldwide chemical disarmament.

Soviet Concepts and Capabilities for Limited Nuclear War: What We Know and How We Know It.

This note analyzes the evolution of Soviet concepts of and capabilities for limited nuclear war, Western assessments of these concepts and capabilities, and the basis on which the assessments were made. It covers the period from 1954, when the Soviets first began to adapt their military strategy to the nuclear age, to the present. Soviet doctrinal commentary indicates an interest in limiting nuclear use for various military and political reasons; yet the Soviets reject the idea that nuclear war could be fought in a highly limited manner. In addition, their operational doctrine retains a strong presumptive predisposition, particularly with regard to war in Europe, where they are determined to be the first to use nuclear weapons with a potentially decisive military effect. However, given their nuclear strike capabilities and command-and-control equipment arrangements that provide tight control over initial nuclear release, the Soviets could employ their nuclear attack forces with a wide range of self-imposed constraints.


The purpose of this paper is to examine the INF Treaty in historical perspective. The thesis of the paper is that the treaty is an illusion that promotes the idea that security can be achieved exclusively through arms
control, at the expense of balanced and diverse forces across the entire spectrum of deterrence. Although the treaty has been fully ratified, and U.S. and Soviet officials have begun the process of destroying launchers, debate still rages in NATO capitals over the treaty's impact on security and cohesion. This paper begins with a discussion of the evolution of NATO's deterrent strategy. It continues with a chronology of events leading to the signing of the treaty by President Reagan and assesses the military and political impact of the treaty and ends with possible implications for NATO's future and recommendations for further arms control negotiations. The paper concludes that the treaty has not achieved what its supporters claim. In fact the treaty is an arms control agreement that: (1) is not remotely related to its original purposes; (2) has reinforced NATO military inferiority; and (3) may have laid the groundwork for the unraveling of the Atlantic Alliance.

0760 Strategic Stability Through the Strategic Defense Initiative.  

From the 1950s the U.S. policy on nuclear strategic forces has been that of massive retaliation and mutual assured destruction. Those policies are being reexamined by the leading edge of technology in spite of political direction. The advances in scientific and industrial research have caused a real and critical examination of the strategic stability issues surrounding the U.S. nuclear forces and military strategy. This paper focuses on what role the SDI research program will play in current and future nuclear stability issues. It addresses the historical policies that led to the current rationale for nuclear stability between the two superpowers and where they each stand on their strategic defense programs. The study then looks at what SDI was envisioned to be and what arms control pacts with the Soviets have done to influence our decisions to pursue this radically different deterrent strategy.


This report summarizes the SDI legacy of President Reagan, who launched the initiative with his speech March 23, 1983. It describes in detail our current assessment of the best program for the resolution of technical issues, the validation of technologies, and the demonstration of our ability to integrate them. This program of research, development, and testing would, if adequately funded, support a fully informed decision by the president and Congress in the future on whether to deploy a strategic defense of the United States. Such defenses could enhance deterrence and increase stability. In an
effort to reduce the overall costs of a first-phase strategic defense system, the Department of Defense recently completed an intensive review of the modifications made to date toward this end. The projected cost of the first phase of a strategic defense system has been reduced dramatically from the earlier estimated of $115 billion to $69 billion while maintaining the capability to contribute to deterrence. The review also confirmed that SDI is proceeding in the right direction toward development of a comprehensive space and ground-based strategic defense system.

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0001 United States National Strategy and Defense Policy Objectives after Chemical Disarmament.


Negotiations on a chemical weapons ban treaty have shown remarkable progress in recent years. The focus of this study is to define United States national security strategy and defense policy objectives after chemical disarmament is achieved. Data on the program were collected through open literature and interviews with key officials in the DOD and Department of State, including the Arms Control and Disarmament Agency. The study emphasizes the changing threat in the Third World, a phenomenon that has accelerated in the last two years. While a total verifiable ban on chemical weapons is a laudable goal, the possibility of such a treaty achieving the complete elimination of chemical threats is distinctly remote. While the United States, Soviet Union, and thirty-eight other countries participating in the 40-nation Chemical Disarmament Conference have agreed "in principle," many problems remain. The treaty in its present form does not include all chemical agents nor does it cover the agents in the mid-range between biological and chemical agents such as toxins and genetically engineered agents. Some countries not participating in the negotiations possess chemical weapons and may not sign the treaty. Lastly, there is the problem of working out a verification regime. There is a probability we may enter into an agreement for political expedience that falls short of our desires. Given that eventuality, what must the United States do to preserve its national security? A case is made for signators to maintain a limited security stockpile until a suitable confidence level is reached by all signators. Finally, in a post-treaty environment, we must continue to seek a total verifiable ban on chemical weapons, maintain our defense posture,
conduct defensive chemical research and development, and maintain a program to develop and produce nonlethal chemicals such as smoke, obscurants, and anti-plant and anti-material agents.

**Low-Intensity Conflict: A Chemical Corps Role?**


The increased focus on the lower end of the spectrum of conflict, particularly low-intensity conflict (LIC) itself, highlights the critical balance that must be obtained between rapid development and mission capability. Combat support and combat service support activities must be able to demonstrate a direct application to mission accomplishment or be relegated to follow-on forces that can only be brought into theater when time and lift assets allow. The role played by the Chemical Corps in chemical-biological (CB) defense is acknowledged and recognized throughout the Army, but what if an immediate CB threat is lacking? If Chemical Corps units and personnel can not perform any other roles that will contribute directly to mission accomplishment, then they are not needed on the battlefield. On the other hand, if there are unique missions that these forces can accomplish that effectively serve to multiply the overall effectiveness of the force, then they should be deployed into theater early. This study looks at lessons learned from previous combat operations performed by Chemical Corps personnel and units in an attempt to assess the validity of a present role in LIC. Experience shows that smoke and flame operations, used properly, can be effective combat multipliers, particularly in LIC. Riot control agents may have a significant tactical role even subject to current presidential restrictions. Herbicides, on the other hand, may no longer be a viable tactical consideration given the regulatory constraints. The study also attempts to highlight the need for continuing training, material development, and ammunition procurement as well as necessary force structure stabilizations that can ensure a future capability when needed.

**Force Structure Implications of START.**


The emerging START treaty will reduce strategic nuclear weapons from 30-50 percent. The treaty will modify Soviet and American capabilities, but it will not eliminate the nuclear potential for either of the superpowers. START and arms control in general are not panaceas to remedy East-West relations; rather, arms control is one element supporting a nation's strategy and helps to define its strategic position. The primary purpose of arms control is to
reduce risks and to maintain strategic stability. Strategy and arms control must be coordinated and we often link arms control proposals to force modernization plans. At the same time, the realities of political compromise may force adjustments to those plans. This paper reviews the proposed START Treaty and discusses the political setting that created the opportunity for the reductions. In addition, the study reviews the factors beyond the treaty that will make force structure decisions difficult.

0195 Ensuring Effective Monitoring Technology for Arms Control Verification.  
The demand for monitoring technologies with applications in arms control verification has increased dramatically in recent years. Parallel to this development, however, is growing uneasiness in some quarters, particularly Congress, about whether the U.S. government is organized in the best manner to ensure effective verification R&D for U.S. arms control policy. Future arms control verification requirements and the associated demand for monitoring technologies will be determined by (1) broad national security goals; (2) the arms control agenda; (3) treaty-specific monitoring requirements; (4) verification standards; (5) intelligence capabilities; (6) resource allocation choices; and (7) the availability of safeguards. The principle driver for future verification technology demand will be treaty-specific monitoring requirements in light of U.S. national security goals and related arms control objectives. But the other considerations will influence the specific demand for monitoring technologies—increasing, tempering, or containing what is thought to be required.

0234 U.S. and Soviet Strategic Command and Control: Implications for a Protracted Nuclear War.  
This thesis addresses the relative ability of the command and control systems of the United States and Soviet Union to support a protracted nuclear war. It covers the development and structure of the command and control organizations used to support the respective National Command Authorities. In discussing these organizations, the various systems supporting the command and control apparatus are also covered. This includes the threat warning and attack assessment equipment used to determine strategic and tactical warning and the communication equipment used to alert forces of increased readiness and the conduct of nuclear strikes if required. The technical factor
associated with the performance of C3 in a nuclear environment is also covered. The result is a net assessment of the two command and control systems that highlights the strengths and weaknesses inherent in each. Recommendations to help enhance the United States' position regarding this national security issue are also developed.

0391 Political and Technical Verification Issues of Limitations on Sea-Launched Cruise Missiles.


This paper examines the political and technical verification issues associated with proposals to place quantitative and/or qualitative limits on the deployment of nuclear armed sea-launched cruise missiles (SLCMs). Overviews of the arms control relationship between the United States and the Soviet Union, the development of the SLCM, and Soviet and American concepts of verification are presented. The views of the American arms control defense communities regarding the SLCM are discussed in depth, accompanied by a detailed examination of the various methods that have been proposed to verify a SLCM limitation agreement. The conclusion is that there are no technological barriers, per se, to SLCM verification, but as the decision on an agreement's verifiability is a political one, the U.S. Navy should concentrate its arguments against SLCM limitations on the weapon's operational utility rather than argue that such an agreement is unverifiable.

0496 DOE Nuclear Weapon RD&T: Objectives, Roles, and Responsibilities.


An overview of the DOE nuclear weapons research, development, and testing (RD&T) program is given along with a description of the program objectives and the roles and responsibilities of the various involved organizations. The relationship between the DOD and DOE is described, and the division of responsibilities for weapon development as well as the coordinated planning and acquisition activities are reviewed. Execution of the RD&T program at the nuclear weapons laboratories is outlined.

0533 Strategic Defenses and Crisis Stability.


The effect that defenses have on crisis stability is one of the central issues in the current debate over the SDI. Crisis stability would be threatened in a situation in which either the United States or the Soviet Union feels pressure to strike first in the hope of producing a more favorable outcome to what
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appears to be inevitable nuclear war. This Note examines various issues surrounding the question of crisis stability. In particular, it considers options for ameliorating any potential instabilities that might arise during a transition to higher levels of strategic defense. The authors suggest that a crisis-state transition is possible, that the mutual survivability of strategic offensive forces is crucial to maintaining crisis stability, that space-based defenses of strategic offensive forces (SOF) are potentially crisis destabilizing unless they are backed up by terminal defenses of SOF, and that the mutual survivability of strategic defenses and defense suppression forces is also critical to crisis stability.

0589 SDI: Shield or Sword?
The paper attempts to answer the fundamental question, "Is SDI an adjunct to a first strike strategy?" As its criteria, it discusses Soviet and U.S. opposing views on SDI, an historical application of Mutual Assured Destruction strategy, and a discussion of Soviet and U.S. thinking on first strike capability. President Reagan's March 1983 address on SDI is used as the backdrop to set the stage for the discussion. It is the objective of the authors to evaluate and analyze the potential impact of SDI on first strike.

0625 U.S. ASAT: Do We Need It.
Remarks on some historical aspects in the development of antisatellite (ASAT) weapons within the United States and the Soviet Union introduce a brief discussion of the current status of ASAT development within the United States. The vital importance of space systems for U.S. strategic and tactical interests is described, followed by a treatment of the Soviet military space threat to those interests—setting the stage for an indepth review of U.S. ASAT policy issues. The author addresses several of the outstanding issues, questions, and concerns about ASAT, including its appropriateness, military essentiality, impact on arms control, and its close relationship with Ballistic Missile Defense initiatives. The purpose is to highlight the diversity and significance of the issues concerning ASAT development and to demonstrate the importance these issues have on current and future U.S. military space policy.
Challenges to the Nonproliferation Regime into the 21st Century.
This paper is an overview of the conference on "Challenges to the Nonproliferation Regime into the 21st Century" held at Los Alamos, July 20-21, 1988, and sponsored by the Center for National Security Studies of the Los Alamos National Laboratory in cooperation with the Center for Science and International Affairs of Harvard University and the International Assessments Section of Lawrence Livermore National Laboratory. The discussions were centered around six topics: defining the problem; nuclear supply issues; bilateral and multilateral issues; crafting policy; and implementing policy.

A Decision-Analysis Process to Support Verification Technology Research and Development.
This report describes the systematic decision-analysis process developed by Pacific-Sierra Research Corporation (PSR) to evaluate all pertinent factors in the verification technology R&D programmatic decision-making process. This decision-analysis process is aided by a commercial software program that allows quantitative evaluation of alternatives based on qualitative judgments of evaluators.

START and Bomber Survivability.
The survivability of the strategic bombers, while important today, is likely to be viewed as being of even greater importance in the 1990s if the United States makes drastic cuts in its strategic forces as proposed in START and possible follow-on treaties. The analysis in this paper indicates that the Soviets, with only a few SSBNs, could pose a serious threat to the survivability of the strategic bombers (as presently based) if they moved these SSBNs close to the coasts or developed short-time-of-flight trajectories for their SLBMs. In searching for ways to improve bomber survivability, the use of the proposed LPS (Limited Protection System) ABM to defend bomber bases was examined, but found to offer marginal improvement, at best. However, a significant improvement in survivability against even severe threats could be achieved if the alert bomber forces were rebased at a large number (preferably 40 or more) of separate bases distributed in a region in the interior of the country with the closest base being at least 500 nautical miles from the coasts.
Optimizing the Post-START U.S. Strategic Nuclear Force Mix.
This thesis examines the impact a START agreement might have on the United States and Soviet strategic nuclear forces. It then proposes an "optimum" past-START force mix for the U.S. and Soviet Union. The current, as well as projected, post-START targeting policies are discussed. It is concluded that the impact of a START agreement on the current U.S. strategic targeting policy will be minimal. Although the target database will not shrink as much as the forces tasked to cover it, a prioritization of targets is all that should be necessary with a post-START force. A START agreement will mean major reductions in U.S. and Soviet strategic nuclear forces. As proposed in this thesis, only the ICBM leg of the Triad will require any major restructuring. This would include the addition of mobile ICBM systems. The SLBM and bomber legs will feel minimal charges (i.e., retiring POSEIDON SSBNs and retiring or converting some older B-52s). It is recommended that the B-2 program be cancelled and funding be redirected into the mobile ICBM systems. By doing so the United States could utilize technology available today to strengthen its forces and not gamble on the low observable technology that a "stealth" bomber might have.

The Political Utility of Nuclear Weapons in Nuclear War Termination.
This thesis begins with a discussion of the theoretical aspects of nuclear war termination, specifically, the objective of war termination, the requirements necessary to meet that objective, and the unclassified guidance available on war termination. As a more practical matter, the Soviet view of war termination is then covered. This is followed by a discussion of the goals of the United States in the event of a nuclear war and how those goals may change depending on the scenario. Finally, the surrender of Japan at the end of World War II is analyzed as a case study to determine the significant historical lessons that may be of value in the future. Particular attention is given to the political actions that were taken as a result of the use of nuclear weapons.
Shield Optimization Program, Part I: Executive Summary.
Detailed studies have been completed to estimate the radiation-induced damage in sensitive electronic components carried on a space-based interceptor weapons platform. The architecture of the interceptor was devised to be as realistic as the electrons at an orbital altitude of 500 kilometers and man-made (nuclear weapons: neutrons, gamma-rays, X-rays, and pumped electron belts) radiation expected to be encountered by a SDI platform. Studies have also been completed to determine the hydrodynamic responses of beryllium mirror surfaces to mono-energetic X-rays (1 and 2 keV). This work included the effects of impurities that are introduced into the surface during machining. Finally a comparison of the HULL and PUFF-TFT codes are presented, which includes the thermo-mechanical response of an Al slab to 5 keV black body radiation.

Shield Optimization Program, Part II: Effects of Van Allen Belt Radiation on SDI Weapon Platforms.
The effect of both natural and man-made Van Allen Belt (VAB) radiation at an altitude of 500 kilometers are presented for various components of a prototypic SBI weapon platform. The weapon platform is described in detail and represents the authors' concept of such a system. The calculated results show that the SBI platform will survive long-term (10 years) exposure to natural VAB protons and electrons. However, when the electron belts are enhanced by the detonation of a nuclear weapon, high levels of radiation can be expected in components mounted on or near the surface of the spacecraft. These dose levels are sufficient enough to produce damage in the most sensitive components.

Initial studies have been completed to estimate the radiation-induced damage to the silicon-based electronic components and other sensitive areas (fuel tanks) carried on a representative SBI weapon platform, which represents the author's concept of such a system. The analysis was completed for the blackbody X-ray radiation environment emanating from a nuclear weapon detonation in space and considered blackbody temperatures in the range of 1 to 25 keV and exterior wall loadings in the range of 1 to 10 cal/cm². The
results indicate the dose to the sensitive components within the exterior hull of the platform was insufficient to cause any damage at a 1 to 3 cal/cm$^2$ exterior wall loading. At higher (5 to 10 cal/cm$^2$) exterior wall loadings, some of the Kinetic Kill Vehicle (KKV) computers and sensors begin to receive doses sufficient enough to cause damage. The effects of shielding from within the platform architecture are seen by the different dose levels received in the KKV's and fuel tanks. Because of the low dose levels to the components within the exterior hull of the platform, no additional shielding is required for these components and for low exterior wall loadings. However, sensors and electronic components on the surface or outside of the exterior hull will require some form of X-ray shielding to survive the effects of a nuclear weapon detonation yielding a wall loading of 1 cal/cm$^2$ or greater. All of the calculations were carried out for an unshielded SBI weapon platform to determine the radiation levels for which shielding must be designed to ensure survivability of the electronic systems.

**Shield Optimization Program, Part IV: Effects of Neutron and Gamma-Ray Radiations from Nuclear Weapons on SDI Weapon Platforms.**

Initial studies have been completed to estimate the radiation-induced damage in silicon based electronic components onboard a representative SBI weapon platform that represents the author's concept of such a system. The analysis was completed for neutrons and gamma rays emanating from a nuclear weapon detonation in space. Results indicate dose levels to the sensitive components within the SBI weapon platform may exceed design limits if the weapon is detonated within a critical radius. For example, a 1962 Starfish detonation at a distance of 91.4 kilometers from the SBI weapon platform generates a total dose in the central instrument bay of 964 rads(Si). The dose rate, assuming a 40 nanosecond deposition time, is $1 \times 10^{10}$ rads(Si)/sec. All of the calculations were carried out for an unshielded SBI weapon platform to determine the radiation levels for which shielding must be designed to ensure survivability of the electronic systems.

**On-Site Inspection as an Enhancement to Verification.**

This paper rejects the notion that on-site inspection provisions, such as the "historic" terms of the INF Treaty, necessarily ensure verification. The principles and processes of verification are examined, as are two failed post–World War I arms control measures that featured intrusive inspection. The
Treaty of Versailles was ignored by the Germans, while its replacement, the Anglo-American Naval Treaty, fared no better; both were marked by Allied wishful thinking. A review of post–World War II agreements relative to charges of Soviet noncompliance reveal more ambiguities than actual violations, although the infamous radar near Krasnovarsk fails to be explained away. Discussion of the INF Treaty centers on on-site inspection provisions, provisions that are described as being too costly and too complex to properly implement, as well as offering the Soviet Union unreasonable opportunities for collateral intelligence collection. The author suggests that the United States rebuild its counterintelligence assets, attempt to resolve compliance issues through such forums as the Standing Consulting Committee, and form arms control policy in the context of a comprehensive international security policy—one driven only peripherally by the political requirements of the moment.


Analysis of three major areas for naval arms control proposals: (1) restrictions on strategic antisubmarine warfare, (2) naval operations, and (3) strategic antisubmarine warfare technology. Author reviews the goals of arms control and finds none of these three areas in need of regulation. Author concludes with a number of innovative areas for naval arms control in areas of doctrine, strategy, operations, and exercises with concrete recommendations and acceptable (to U.S. Navy) fallback positions.


The B-2 brings new challenges for electromagnetic pulse (EMP) testing. This paper discusses the unique characteristics of the B-2 and develops a time line of activities that need to be completed by the Air Force Weapons Laboratory before EMP testing of the B-2 begins.


This report presents a logical and transparent methodology for evaluating strategic offensive forces on the basis of first-strike stability, which the authors define as a condition that exists when neither superpower perceives the other as motivated by the strategic force posture to launch the first nuclear strike in
Frame

a crisis. The methodology underlines that (1) first-strike stability under current conditions is relatively robust, (2) postures of U.S. and Soviet strategic nuclear forces become increasingly important under an arms reduction regime if the current level of first-strike stability is desired, (3) enlarging U.S. and Soviet strategic nuclear weapons inventories does not necessarily erode first-strike stability, (4) the superpowers should realize the importance of both sides generating forces early in a crisis to render these forces nontargetable, and (5) whatever the index of first-strike stability, the index applies equally to both the United States and the Soviet Union, and thus suggests a dimension of U.S.—Soviet cooperation.


This report makes a preliminary examination of the nuclear-mine threat to the multiple aimpoint, carry-hard ICBM system. By attacking the ICBMs in flight as they leave their shelters, the number of weapons required to attack the system could, in principle, be reduced from several thousand to several hundred or less. However, the Soviets would face serious technical problems in implementing the concept. Moreover, there appear to be a number of effective U.S. countermeasures available thus, in practice, the nuclear mine approach is likely to be a very high risk, uneconomical method of attack.


The large reduction in strategic forces that may take place over the next several years, coupled with the potential deployment of some type of strategic defense, raises many questions with regard to the desirability of various elements of these forces. This report considers the relative role played by manned bombers in such a reduced force structure. It is shown that a key element in understanding this issue is the ratio of the number of critical targets to weapons for each side. Relative crisis stability is examined for different levels of this ratio. Depending on the ratio and the size of any defense buildup, bombers can have either a stabilizing or destabilizing effect. In particular, relative crisis stability can be maintained in the early stages of a buildup in strategic defense by allowing for changes in the effectiveness of an existing bomber force. That is, interceptors and bombers could be added simultaneously in some ratio to be determined based on the calculated effectiveness of each.
The Contamination Control System Analysis continued into Phase IV, which examines the flow of contamination information to determine the most mission effective solution. Toxicology testing is continuing on the primary uptake simulant, leading to approval for human use. The Multiman Intermittent Cooling System successfully completed qualitative operational tests. The system provides filtered cooled air to personnel during rest periods from heavy work in chemical protective clothing. A study was performed to determine the effectiveness of various communication devices for personnel in chemical clothing working in a flight line noise environment. Advanced development test started on a detection device that uses the surface acoustic wave principle. The detector will be used in aircraft cockpits and collective shelters. A study was performed to determine the effectiveness of a mask fit test device in improving personal protection.

This report was prepared at the request of the U.S. DOE's Office of Arms Control to determine the implications of future treaties for the activities of the department. It provides background on the negotiations on reduction of conventional forces in Europe (CFE) and, using the initial negotiating positions of the NATO alliance, develops a framework for verifying a postulated treaty. This framework identifies the main elements of one approach to verification as a way to generate discussion of the problem as a whole. Stemming from this verification scheme is a discussion of the technologies needed to verify the postulated treaty provisions. Finally, a section is devoted to possible implications that the reduction of CFE could have for the DOE and, more specifically, for the Office of Arms Control. This report was developed separately from NATO and U.S. government efforts and neither draws on their efforts nor represents the policy or views of NATO, the U.S. government, or DOE. This report does draw on the author's 30 years of experience in the U.S. Army, working with the NATO organization and with the conventional forces of the United States, its allies, and the Warsaw Treaty Organization.
The basic phenomenology of radioactive fallout from nuclear detonations is described nonmathematically for military commanders who may become engaged in nuclear battle. Subjects include a description of fallout debris, the process of formation and deposition, and hazards to personnel. Comparisons are made between initial nuclear radiation and radiation from fallout. A radiation rate and exposure forecasting method is presented for situations where the source of fallout and rate of decay are unknown. Additional research is recommended for (1) development of improved methods for estimating casualties resulting from combined exposure to initial nuclear radiation and fallout radiation; and (2) improving the estimate of the K-factor (how much of the radioactive material comes to the ground as early fallout).

The recent use and proliferation of chemical weapons provide impetus to the ongoing negotiations in Geneva to ban the production, possession, and use of all chemical weapons. The provisions of the Chemical Weapons Convention are not all agreed upon yet, with challenge inspections and sanctions against violators being two particularly difficult areas. Verification of declared stocks and activities poses no major technical problems, but care in technology development and selection will be required to provide effective verification with minimum intrusion. A carefully designed system will be needed to interpret the extensive data from routine inspections, monitoring, and reporting and to protect company proprietary information. Identification of appropriate sites for challenge poses very difficult technical problems, on which R&D could be fruitful. On-site inspection in the United States poses potential problems ranging from the loss of classified or proprietary information to high financial costs for site preparation and lost operating time. Site access for inspection could also violate U.S. companies' freedom from illegal search and seizure; several remedies are considered.
Domestic Implementation of a Chemical Weapons Treaty.
To determine the effects on and the role of industry in the event of implementation of a chemical weapons treaty, this report analyzes the way in which the proposed treaty can mesh with the U.S. regulatory system, examines whether and how existing reporting and inspection requirements or regulations can be used to facilitate domestic implementation, studies the domestic implementation procedures and experience gained from the U.S.-International Atomic Energy Agency Safeguards Agreement, and develops some general observations and recommendations pertaining to legislative and regulatory approaches to U.S. treaty implementation.

The Containment of Underground Nuclear Explosions.
The report reviews the safety of the nuclear testing program and assesses the technical procedures used to test nuclear weapons and ensure that radioactive material produced by test explosions remains contained underground.

Carry Hard ICBM Basing: A Technical Assessment.
Carry Hard is a deceptive, multiple-aimpoint ICBM basing concept in which hardened, encapsulated missiles are shuttled among several thousand, low-cost, water-filled vertical shelters. Since most of the essential launch and operational support equipment is carried with the missile (not provided with each shelter), the overall system costs are reduced. High system hardness permits relatively close shelter spacing, which in turn allows Carry Hard to be deployed on a comparatively small piece of land (a few hundred square miles) that would be removed from public access. Controlled access to the deployment area helps in maintaining concealment of the missiles among the shelters. If concealment is successfully maintained, the system is believed to be survivable against plausible Soviet threats, regardless of whether attack-warning information is received or acted upon. Thus, Carry Hard holds high promise as a feasible, affordable, and survivable means of ICBM deployment, and a high priority should be given to developing the concept to the point that an informed decision on full-scale engineering development can be made.
A Potential Soviet Compromise on Ballistic Missile Defense.
The body of this research memorandum was written before the Baker-Shevardnadze meeting in Wyoming. It presented evidence suggesting that the Soviet Union might agree to a compromise at the Wyoming meeting that defers the issue of ballistic missile defense (BMD) negotiations to a later stage in arms reductions, thus facilitating a first-stage cut in offensive arms without an explicit Soviet endorsement of the SDI. Through this compromise, offensive arms reductions should first be delinked from an agreement on BMD, and then be relinked during the second stage of deeper cuts. Therefore, negotiations on limiting BMD systems, though deterred, are deemed “inevitable” if the United States persists in deploying a strategic defense system (SDS). Moreover, some Soviet arms controllers already look beyond the first stage to the prospect of negotiated transition into a strategic defense environment (i.e., a reliance on defensive deterrence). In this approach, Wyoming, then, was expected to be only a first move in the Soviet negotiating strategy for a grand compromise on strategy defense. As explained in the afterword added to the paper, the actual events at Wyoming seem consistent with that interpretation.

Analyzing Trigger Levels for Future Test Ban Treaties.
Future test ban treaties may include the idea of triggers, test yields above which the country conducting a test must give the other side prior notice. The treaty would then allow the other side to inspect the test site or install additional yield measurement devices (e.g., CORRTEX). Triggers should help both sides verify treaty compliance when they conduct tests near the treaty threshold, a yield above which both sides are prohibited from testing. By using more accurate measurement systems at yields near the threshold, the country verifying compliance can decrease its uncertainty about the test yield. We can model the effect of triggers at various levels similar to the levels of analysis considered in the compliance evaluation report. At lower levels, the analysis is simple but does not include all the issues relevant to choosing a trigger level. Higher levels of the analysis incorporate these issues, at the cost of additional complexity and required data. This memorandum considers several models of trigger levels to show what we can learn by incorporating additional issues into the analysis.
Defending against a Space Blockade.

Although great attention has been paid to space weapons in relation to the SDI, there seems to be little recognition that platforms performing an SDI role could establish a space blockade. The United States must recognize the feasibility of such a blockade and take steps to offset it. Possible steps include depending on arms control pacts to keep weapons out of space, developing terrestrial systems for use in breaking a blockade, or putting weapons in space before an adversary can establish a blockade. Problems in verifying the nature of orbiting vehicles reduce the reliability of arms controls. Advantages space weapons will have over surface-based systems argue against dependence on restorative measures undertaken from the ground. Thus, putting weapons in space is an option that should be explored. There are, of course, arguments against this option. Perhaps the most cogent is that using space for military ends may be destabilizing. Merely placing U.S. weapons in low orbit, even if they were deployed solely for SDI, would threaten rivals because of the possibility of a U.S. blockade. Moreover, such platforms would be vulnerable if another power put weapons in orbit. However, a mix of low-orbit SDI forces and high-orbit reserve forces should be less vulnerable and less threatening. Such a defense could be improved by creating a high-orbit keep-out zone for each space power.

Alternative Futures in U.S. Nuclear Strategy.

This thesis examines the future of U.S. nuclear strategy from the alternative futures/scenarios methodological approach. It begins by tracing the evolution of U.S. declaratory strategic policy from the end of World War II to the present. Specifically, it focuses on those particular environmental threats, constraints, and resources that were fundamental to the development of a nuclear strategy for each time period. The same kind of analysis is used to examine four alternative future security environments. Specific nuclear strategies are then developed for each alternative world scenario. The U.S. Navy's Maritime Strategy, especially the nuclear component, is presented as an example of the strategy development process. Finally, the process of strategic planning in the military and long-range planning in general are discussed.
This document lists chronologically and alphabetically by event name all nuclear tests conducted and announced by the United States from July 1945 through December 1989, with the exception of the GMX experiments. The 24 GMX experiments, conducted at the Nevada Test Site (NTS) between December 1954 and February 1956, were "equation-of-state" physics studies that used small chemical explosives and small quantities of plutonium. Several tests conducted during Operation Dominic involved missile launches from Johnston Atoll. Several of these missile launches were aborted, resulting in the destruction of the missile and nuclear device either on the pad or in the air. On August 5, 1963, the United States and the Soviet Union signed the Limited Test Ban Treaty, which effectively banned testing of nuclear weapons in the atmosphere. All United States nuclear tests conducted prior to that date have been announced and are listed in this document. Some tests conducted underground since the signing of the Treaty and designed to be contained completely have not been announced. Information concerning these events is classified. Occasionally the name and detonation date of an unannounced test is declassified, which permits its listing in subsequent revisions to this document.

0626 Risk Associated with the Demilitarization of the United States Chemical Weapons Stockpile.
In accordance with Public Law 99–145 (Title 14, Part B, Section 1412), a programmatic Environmental Impact Statement was prepared to assess the environmental impact of destruction of the continental U.S. (CONUS) stockpile of unitary lethal chemical agent and munitions. The CONUS supply of chemical munitions and agents accounted for 94.4% by weight of the entire U.S. stockpile. The CONUS stockpile is currently stored at the eight sites. The hazards associated with the disposal process included those associated with (1) plant operations, (2) transportation, (3) handling, and (4) external events (pervasive among the other three hazard areas).
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This paper addresses third generation nuclear weapons, and the advance workshop literature describes them as including earth penetrating warheads (EPWs) and maneuvering reentry vehicles (MARVs), as well as nuclear directed energy weapons (NDEWs). A historical context for the evolution of advanced nuclear weapon concepts is presented, discussing the types of advanced concepts and how they differ from conventional nuclear weapons currently in the stockpile. The policy context for doing R&D on nuclear directed energy weapons and how this R&D relates to the SDI is discussed. Some military requirements for the various advanced concepts and potential missions are provided, indicating the potential advantages and disadvantages of the various applications. Arms control and stability considerations as they relate to the development of advanced concepts and the implications of the rapidly changing political relationships between the United States and the Soviets, and between their respective allies are also discussed.

Strategic Defense Initiative, Three Reasons to Stay the Course.
President Reagan’s SDI announced 23 March 1983 has had a profound effect on the shape the world has taken since that time. While there has been much talk that the system as envisioned by the president is impossible, this study examines three compelling reasons why we should continue forward with the research and development effort. The SDI has brought the Soviets to the bargaining table and made CFE a reality. The threat of nuclear and chemical proliferation makes the deployment of defensive system a logical strategy. The cost of developing and deploying the SDI may not be as high as the critics propose if we can use SDI as the third leg of our strategic deterrent. The American people and the people of the rest of the world deserve better than living with the threat of extinction.

This report summarizes the findings of a three-year study by the Center for National Security Studies (CNSS) that evaluated the long-term (thirty-year) future of nuclear weapons. The Future of Nuclear Weapons (FNW) study
sought (a) to identify and analyze the key long-term political, military, and technical trends that will influence the future of nuclear weapons in order (b) to provide a basis for analyzing the impact of these trends on future DOE/Los Alamos programs and activities. The FNW study was not intended to predict which specific nuclear weapons systems that the United States will deploy in the year 2020 but was instead designed to develop insights rather than specific and detailed conclusions about the future of nuclear weapons. These insights are offered to challenge the reader and identify the appropriate issues for further consideration, and not to predict that a particular future nuclear course is preordained.

This effort supports the analysis of optical concepts that are being proposed or developed for application to Theater Missile Defense (TMD). The effort consists of responding to specific requests for analysis of systems involving optical sensors. These analyses may include the identification performance requirements, definition of relevant issues and/or recommended procedures for resolving the issues. The first part will present an overview of the major tasks undertaken, and the second part will consist of appendices containing the narrative response or the presentation material developed in support of each of these tasks.

0837 U.S. Chemical Defense and the Third-World Threat.
This monograph discusses the U.S. Army's chemical defense posture in relation to the chemical warfare threat in the third world. It seeks to determine if current U.S. chemical defense tactical doctrine is adequate to counter the expected threat, and practiced enough to develop proficient execution in the field. Following an overview of chemical warfare, the study reviews the current chemical threat focusing on the third world. It explores availability, proliferation, acquisition and development, means of employment, and factors limiting employment. After a discussion of U.S. chemical defense doctrine, the paper posits three scenarios of chemical use against Army forces in three environments: the jungles of Honduras, the desert plains of Lebanon, and mountain passes of Korea. The study finds that the chemical threat in a jungle environment will be low, that in the midwest low to medium, and that in Korea high. Yet, in each of these third world locations, regardless of the threat of use, the probability of use is not great. It argues that throughout military history chemical warfare has never lived up to its promise and has never been
tactically decisive. The paper concludes that the combination of the viable U.S. chemical defense doctrine with the nondecisive nature of tactical chemical weapons reduces the impact of battlefield chemicals, and that improved training will ensure this result.

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This study focuses on one aspect of potential arms control agreements involving conventional military forces: the use of constraints, defined as measures directly limiting or prohibiting current or future operations by military forces. The authors focus on constraints involving the conventional forces of the Warsaw Pact and NATO. Constraints may save money for all parties involved in a conventional arms control agreement. In addition, constraints have the potential to reduce the incentives for attack by increasing the amount and quality of warning time available to the defending side or by forcing an attacker to launch a constrained offensive. The authors develop and apply, with hypothetical examples, three criteria (defense asymmetry, clarity, and economy) for determining whether a particular constraint is a good idea. Because of the difficulties of determining when constraint measures actually constrain an attacker’s operations more extensively than a defender’s operations, the nations of NATO and the Warsaw Pact should approach constraint measures cautiously lest they reach an agreement that reduces the prospects of a successful defense against large-scale offensives.


This paper analyzes the current NATO and Warsaw Organization proposals for arms control of tactical air forces in the Atlantic to the Urals (ATTU) region and then devises a more comprehensive approach. This approach is based on an attempt to meet all objectives of the CFE mandate and is specifically focused on an effort to limit the capability for surprise, offensive attacks. The paper proposes to limit these capabilities by inhibiting the single role, deep attack aircraft on both sides.
Key Considerations In the Selection of an Appropriate Response to Evidence of a Treaty Violation.
A formal decision analytic framework for assisting in determining how to respond to evidence of treaty violations is described. The nature of violations and the effectiveness of responses are first discussed qualitatively. A mathematical model is then used to suggest potential advantages of responding to evidence of a violation with less than full vigor. When evidence for a violation is not unequivocal, a milder response may serve as a hedge or as the best response to a less serious violation. The analysis legitimates such an intermediate response as a compromise position among policy makers who disagree as to the significance of a transgression. In conclusion, we suggest how the framework can provide proactive guidance to negotiators of arms control treaties by allowing for the design of verification systems consistent with the limits of the negotiated detection systems and the monitoring nation's response options.

SDI: Is Its Future Past?
This paper reviews likely threats and the ability of known defenses to address them, concluding that initial deployments should be affordable and development could improve the effectiveness of each of several layers. Current research and development appears to be a prudent hedge against an uncertain future. Effective defenses would provide a positive incentive for the reduction of offensive forces and hence a direct, stabilizing influence that could shift the threat in directions in which they could be more effective and mutually useful.

National Policy, Goals and Objectives After Chemical Disarmament.
Since World War I, the United States has been in the forefront of peacekeeping nations in trying to ban the use of lethal weapons. Today, negotiations for a bilateral and multilateral Chemical Weapons Convention banning the development, production, and use of chemical weapons and eliminating all stocks globally are closer to success than at any time in the past. In light of the ongoing negotiations on chemical disarmament, this paper reexamines current U.S. policy statements, elaborates on the full spectrum of possible threats, and enumerates U.S. vulnerabilities in light of the foregoing threat.
analysis. From this analysis, suggested changes to the U.S. national security objectives are proposed and recommendations relating to chemical weapons training, intelligence gathering, and required advancements in research and development are provided.

**Country Statements on the Nuclear Non-Proliferation Treaty Article VI.**


The Fourth NPT Review Conference was held from August 20 to September 14, 1990. Recent statements by key NPT member and nonmember states suggest certain themes that are likely to dominate discussion of Article 6 at the conference. These common themes may be divided into two categories: the nonproliferation of nuclear weapons and nuclear and general disarmament. For the most part, they reflect the basic lines of debate at earlier NPT Review Conferences. However, two differences are evident: (1) more discussion of a step-by-step process of limiting nuclear testing; (2) considerably greater emphasis on negative security assurances. In addition, while recent U.S.–Soviet progress on bilateral nuclear arms reductions is sometimes acknowledged, that progress appears to have done little to dampen rhetorical enthusiasm for a comprehensive nuclear test ban. This paper covers the current status and upgrade strategies for negative security assurances (NSA).

**Intelligence Support to Arms Control.**


This paper argues that intelligence support is critical to the success of arms control. The paper identifies and describes the existing intelligence organizational structure for arms control support, and identifies and analyzes issues. The roles include support to policy formulation, support to treaty negotiation, support to ratification, and finally, during verification, support for the implementation of the treaty through monitoring. The director of Central Intelligence is responsible for monitoring, while the Arms Control and Disarmament Agency has responsibility for verification. Adjudication of conflicting interpretations occur within the National Security Council committee structure. For several reasons, intelligence cannot be expected to do the actual verification of an arms control treaty. Most importantly, determination of an acceptable degree of confidence is always a political issue, although based on military judgment. Assigning intelligence responsibility for monitoring, rather than verification, helps to limit the politization of intelligence. Issues identified during the research for this paper were analyzed within three subgroups: those inherent in the intelligence discipline (these must be managed successfully to limit
adverse impact on intelligence products), issues and challenges inherent in arms control bureaucratic relationships (these are best managed by keeping separate the actual monitoring analysis and verification structures), and the historical nature of Soviet behavior (this gives the West justification for caution and reinforces the need for continued emphasis on verification).

0319  **Trident SSBNs In START.**
This report advocates not agreeing to ballistic missile warhead sublimits in START in order to place maximum reliance on the Trident/D-5 strategic weapon system. With reduced numbers in our post-START inventory, it is mandatory to emphasize our most survivable, capable, flexible, and affordable systems for deterrence and defense.

0339  **1990 Report to the Congress on the Strategic Defense Initiative.**
This report recounts the progress the SDI program has made over the last several years and describes our plans for the future. One of the biggest breakthroughs occurred recently—the introduction of the Brilliant Pebbles concept into the space-based portion of the defense architecture. Preliminary cost estimates and effectiveness analyses indicate that deployment of Brilliant Pebbles as the space-based layer of a Phase One Strategic Defense System could allow savings of $14 billion from previous estimates, reducing the cost of an initial system from $69 billion to approximately $55 billion. In 1989, we launched the Beam Experiment Aboard a Rocket (BEAR), which demonstrated propagation of a particle beam in space. Also in 1989, we witnessed the first firing of the Alpha chemical laser. In 1990, we plan to achieve even more significant testing milestones. In January, we launched the first High Endo-Atmospheric Defense Interceptor (HEDI) test and demonstrated the ability to cool the interceptor's forebody and sensor window. We are demonstrating defensive technologies that we believe offer the potential for moving toward a more stable relationship with the Soviet Union while reducing offensive forces. In sum, our efforts to demonstrate defensive technologies, to modernize our offensive forces, and to work toward beneficial arms control agreements are fully integrated and mutually reinforcing.

0517  **Strategic Weapons. Long-Term Costs Are Not Reported to the Congress.**
During the 1980s, concerns over the threat posed by the Soviet Union led the United States to acquire modernized strategic nuclear weapon systems as its defense budget increased. Recent events indicate that perceptions of a
lessened Soviet threat will lead to greater efforts in the 1990s to control the federal deficit by reducing defense spending. The Congress is considering the first defense budget of the 1990s in light of these events and is reviewing the affordability of major weapon systems. This report uses 12 strategic weapon systems to illustrate the importance and difficulty of obtaining the long-term cost estimates that the Congress needs to assess weapon system affordability.

An Analysis of the Morality of Intention in Nuclear Deterrence, with Special Reference to Final Retaliation.

[Merlon College, Oxford; doctoral dissertation.] Jeffrey A. Zink. 1990. 216pp. Quite apart from its apparent political obsolescence, the policy of nuclear deterrence is vulnerable to attack for its seemingly obvious immortality. Nuclear war is blatantly immoral, and nuclear deterrence requires a genuine intention to resort to the nuclear retaliation that would precipitate such a war. Therefore, since it is wrong to intend that which is wrong to do, deterrence is immoral. This thesis seeks to examine the nature of the deterrent intention as a means of verifying the soundness of the above deontological argument. This examination is carried out by first suggesting an acceptable notion of intention in general and then, after analyzing the views of deterrent intention by other writers, proceeding to demonstrate the uniqueness of that intention. Having done this, and having explored the possibility that deterrence need not contain a genuine intention to retaliate, the thesis moves on to suggest and defend a moral principle that states that endeavors requiring the formation of an immoral intention may nevertheless be moral. Called the Principle of Double Intention (and based on the Principle of Double Effect), it offers a method for the moral assessment of agents who form immoral intentions within larger contexts. By applying this principle to nuclear deterrence, it is demonstrated that agents who undertake such a policy may be morally justified in doing so, provided certain conditions are met. The thesis closes with a refutation of the objection that an agent cannot rationally form an intention (such as that required in deterrence) which he has no reason to carry out. By highlighting the objection's reliance on a claimed isomorphism between intention and belief, it is shown that the objection, while generally sound, does not apply to the special case of nuclear deterrence. The conclusion suggests a framework for disarmament that results in a deterrent force structure that is both strategically effective and morally acceptable.
SUBJECT INDEX

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: 0625 directs the researcher to the document that begins at Frame 0625 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.

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