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COLLECTION:
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National Security Council
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2016-0152-F
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b(8) Release would disclose information concerning the regulation of financial institutions [(b)(8) of the FOIA]
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RECEIVED: 29 JUL 94 16

TO: STARR, B

FROM: ITOH

DOC DATE: 25 AUG 94
SOURCE REF:

KEYWORDS: ARMS CONTROL
DEFENSE POLICY
ACDA
CONGRESSIONAL

PERSONS:

SUBJECT: ACDA RPT TO CONGRESS ON ARMS CONTROL NONPROLIFERATION & DISARMAMENT STUDIES COMPLETED IN 1993

ACTION: SENS SGD MEMO DUE DATE: 02 AUG 94 STATUS: C

STAFF OFFICER: WITKOWSKY LOGREF:

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By YL NARA, Date 1/3/2007
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002	ITOH	Z	94082617	FOR SIGNATURE
003		X	94082620	SENS SGD MEMO

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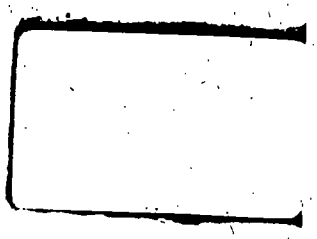

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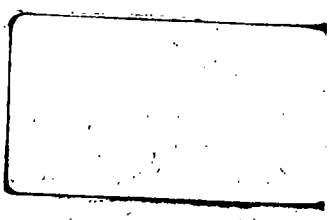

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NATIONAL SECURITY COUNCIL
WASHINGTON, D.C. 20506

6171

August 25, 1994

MEMORANDUM FOR MS. BARBARA STARR
Executive Secretary
Arms Control and Disarmament Agency

SUBJECT: ACDA Report to Congress on Arms Control, Nonproliferation and Disarmament Studies Completed in 1993

The NSC staff approves the subject report, with changes, as marked.

William H. Itoh
Executive Secretary

Attachment
ACDA Report to Congress

UNCLASSIFIED
~~with SECRET Attachment~~

~~SECRET~~

~~SECRET/NOFORN/WNINTEL~~

UNITED STATES ARMS CONTROL AND DISARMAMENT AGENCY

Washington, D.C. 20451

6171

THE DIRECTOR

DRAFT

Dear Mr. President:

I am pleased to transmit our "Report to Congress on Arms Control, Nonproliferation and Disarmament Studies Completed in 1993" and the classified addendum. I hope that this document will enhance Congressional and public understanding of the important arms control issues that the U.S. Government is addressing in a research capacity.

The enclosed report, consistent with Section 39 of the Arms Control and Disarmament Act, as recently amended, provides:

(1) a comprehensive list of studies relating to arms control, nonproliferation and disarmament issues concluded during the previous calendar year by government agencies or for government agencies by private institutions or persons;

(2) a brief description of each such study; and

(3) a classified addendum.

This report is intended as a significant improvement over previous submissions as part of the process of revitalizing ACDA. Previous reports provided a compilation of abstracts describing the arms control, nonproliferation and disarmament studies completed in the target year. This year's report continues to contain these abstracts, but also adds an assessment of the relationship of this body of work to the arms control, nonproliferation and disarmament priorities of the U.S. Government.

Sincerely,

John D. Holum

Enclosures

The Honorable
Albert Gore
President
United States Senate

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REPORT TO CONGRESS ON ARMS CONTROL, NONPROLIFERATION AND DISARMAMENT STUDIES COMPLETED IN 1993

XX JULY 1994

In response to Section 39 of the Arms Control and Disarmament Act

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UNITED STATES ARMS CONTROL AND DISARMAMENT AGENCY
Washington, D.C. 20451

THE DIRECTOR

DRAFT

Dear Mr. Speaker:

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Sincerely,

John D. Holum

Enclosures

The Honorable
Thomas S. Foley
Speaker
U.S. House of Representatives

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EXECUTIVE SUMMARY

This report is the latest in a series of reports fulfilling the requirement on the Arms Control and Disarmament Agency (ACDA) to provide a report to Congress setting forth a comprehensive list and brief description of studies relating to arms control, nonproliferation and disarmament issues concluded during the previous calendar year. This year's report, dealing with studies completed in 1993, is a significant departure from the previous submissions. Previous reports provided a compilation of abstracts describing the arms control, nonproliferation and disarmament studies completed in the target year. This report continues to contain these abstracts, but also adds an assessment of the relationship of this body of work to the arms control, nonproliferation and disarmament priorities of the US Government.

Data to produce this report was collected from U.S. Government agencies through the interagency Arms Control Research Coordinating Committee (ACRCC) chaired by ACDA. For this year's report we have added individual reviews of each study to categorize its relationship to arms control and nonproliferation issues along the dimensions of the "issues" addressed or supported *(Strategic Arms Control, Conventional Arms Control, Nuclear Testing, Nuclear Proliferation, Non-Nuclear Weapons of Mass Destruction, and Regional Issues)*, the "focus" of research *(Problem Identification, Strategies, Negotiations, Verification - Signatures, Verification - Remote sensing, and Verification - On-site sensing)*, and the "product" of research *(Basic Research, Analytical Tools, Micro Analysis, Macro Analysis, and Equipment Development)*.

A series of tables is provided listing the studies of interest in each of the "issue" areas of arms control and nonproliferation, along with the "focus" and "product" of each study. They provide a general view of the arms control research reported in the studies, and serve as a basis for observations. Specific observations are discussed along with a number of topics defined according to specific treaties, organizations or focuses within each area.

This report is the first step in a continuing process of improvement. Plans for further improvement are discussed including increased interagency participation in the planning and assessment, and means of obtaining greater uniformity and completeness of data on individual studies.

ACDA REPORT TO CONGRESS ON ARMS CONTROL, NONPROLIFERATION AND DISARMAMENT STUDIES COMPLETED IN 1993

1.0 INTRODUCTION

The Arms Control and Disarmament Act (ACDA Act; 22 U.S.C. Sec, 2571) established the Arms Control and Disarmament Agency, ACDA. Section 39 of the Act, as amended, requires ACDA to provide a report to Congress setting forth-

> "(1) a comprehensive list of studies relating to arms control, nonproliferation and disarmament issues concluded during the previous calendar year by government agencies or for government agencies by private or public institutions or persons; and
>
> (2) a brief description of each study."

This report is the latest in a series of reports fulfilling this requirement.

The arms control, nonproliferation and disarmament studies described in this report support both the pursuit of new initiatives and the implementation of existing agreements in arms control. They involve a variety of roles encompassing the definition of issues, plans for implementations and inspections, and technological developments from basic research to the acquisition of needed equipment.

The scope of this report is significantly expanded compared to previous submissions. Previous reports provided a compilation of abstracts describing the arms control, nonproliferation and disarmament studies completed in the target year. This report continues to contain these abstracts, but also provides assessments of the relationship of this body of work to the arms control, nonproliferation and disarmament priorities of the US Government. ACDA signaled its intention to improve this report in the Agency's 1993 annual report to Congress:

> "ACDA will make a significant revision in the format of the Annual Report to Congress on Arms Control Research. Past reports listed research project summaries without commentary regarding the relationship of these research efforts to arms control priorities. Future Annual Reports will include assessments of the relationship of these research projects to national arms control priorities."

The goals ACDA set out to achieve in producing this report focused on developing an improved process going well beyond simply providing details of study efforts. The current report is the first step in the process of change from the previous format. The goal is to provide an improved format directly relating US Government studies to national arms control, nonproliferation and disarmament priorities.

The main body of this report describes the approach taken this year, the observations

TABLE 1

AREAS OF INTEREST IN ARMS CONTROL, NON-PROLIFERATION, AND DISARMAMENT

A. Strategic Arms Control

0. General
1. START I
2. START II
3. INF
4. ABM
5. ATBM
6. SSD
7. Defense Conversion

B. Conventional Arms Control

0. General
1. CFE
2. FSC (or CSCE)
3. Open Skies
4. MTCR/Export controls
5. Advanced Conventional Weapons

C. Nuclear Testing

0. General
1. LTBT
2. TTBT
3. CTBT

D. Nuclear Proliferation

0. General
1. NPT
2. Fissile materials production cut-off
3. International plutonium management
4. IAEA safeguards
5. Iraq follow-on
6. Nuclear weapon free zones
7. Treaty of Tlatelolco
8. Physical security/Terrorism
9. Nuclear Suppliers Group/Export controls

E. Non-Nuclear Weapons of Mass Destruction

0. General
1. CWC
2. BWC
3. Russian Bilateral Agreements
4. BW Trilateral Agreement
5. Australia Group/Export controls

F. Regional Issues

0. General
1. Europe
2. Africa
3. Middle East
4. South Asia
5. North Asia
6. FSU
7. China
8. Latin America

This portion of the report describes the arms control issues and relates observations concerning the studies reviewed to these issues. In general it was observed across the board in all of the areas of interest, that there appeared to be little development of future options, needs or consolidated long-term planning. Plans need to be formulated to define and achieve future arms control and nonproliferation goals. Current studies reported here tend to focus on immediate needs. This near-term outlook contrasts with technology developments emphasizing items that could be available in the distant future. Planning for the use of advanced technology in future arms control needs further improvement. Put another way, technology developments will be assessed ever more effectively in the future with respect to their impact on arms control.

The relationships of studies to issues defined within a framework of topics of arms control, nonproliferation and disarmament interest are discussed below. Discussion of the issues and general comments derived by reviewing the collection of studies of interest to the issues. The specific relationship of studies to issues is contained in the series of tables referenced here and contained in Appendix A.

Some technologies have application across several topic areas. An example is tamper-detecting devices that are of use in several areas of arms control verification. A few studies on these devices were identified.

3.1 Strategic Arms Control

Table A0 refers to studies considered to be of general interest to Strategic Arms Control (all Tables A0 through F9 are contained in Appendix A). Topics treated in this report under "Strategic Arms Control" include the Strategic Arms Reduction Treaties (START I and II); the Intermediate-Range Nuclear Forces (INF) treaty; the Anti-Ballistic Missile (ABM) treaty and Anti-Tactical Ballistic Missile (ATBM) related issues; and, Safety, Security and Disarmament (SSD) and Defense Conversion. Some observations are:

-- Some studies on ways to detect nuclear warheads under examination for Strategic Arms Control Treaties (START) were carried out. Most of the methods studied involve techniques not permitted in existing agreements (START I and START II). However, the techniques may have application in the future.

-- Few studies were identified that dealt directly with issues of deep reductions beyond START II and with the increasingly difficult verification tasks.

-- Research projects on intermediate range nuclear forces were not identified.

-- A single study dealt with the ABM/ATBM distinction problem.

-- One study dealt with the allies' attitudes about ballistic missile defenses.

-- One study was identified as directed at the several "enhancements" of the BWC that are under consideration by the international community to strengthen the regime of verification.

3.6 Regional Issues

Table F0 refers to studies considered to be of general interest to Regional Issues. Tables F1 through F8 treat these issues organized along the lines of broad regions of arms control concern.

The U.S. continues to work to promote regional stability. Confidence-building measures related to arms control are being considered both within the context of the Middle East peace process, and in South Asia between India and Pakistan. Continuing U.S. efforts to press North Korea to comply with its nuclear nonproliferation commitments have been front page news.

In general, few studies were conducted that addressed the issues from a regional perspective. Africa and South America, including the Treaty of Tlatelolco appeared to be omitted all together.

4.0 PROCESS IMPROVEMENT

As discussed above, this report is intended as a significant improvement over previous submissions. The report continues to provide abstracts of arms control studies performed within or for the U.S. Government, but also adds an assessment of the relationship of this body of work to national arms control, nonproliferation and disarmament priorities. The step from providing abstracts to relating them to national priorities is involved and it was decided to concentrate on developing the forms and processes of improvement and to implement them as well as practical within reasonable time constraints. This means that the current report is a transition to a more thorough treatment. Our intention is to profit from what we learn to provide a similarly significant improvement in next year's report as we fully implement our new process.

4.1 Increased Interagency Participation in the Planning

In this initial effort to provide an enhanced ACDA Report to Congress on Arms Control, Nonproliferation and Disarmament Studies for 1993, time did not permit the involvement of other U.S. agencies in the identification of the areas of interest in arms control, nonproliferation and disarmament as shown in Table 1 of the Report, nor in the formulation of the approach used by ACDA to assess the U.S. Government's external research program (Section 2).

What is it?

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REPORT TO CONGRESS ON ARMS CONTROL, NONPROLIFERATION AND DISARMAMENT STUDIES COMPLETED IN 1993

Appendix A - Areas of Arms Control and Nonproliferation Interest

XX JULY 1994

In response to Section 39 of the Arms Control and Disarmament Act

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Table A0
Strategic Arms Control - General

Item number refers to location of the study in Appendix B. Numbers with an asterisk (*) are contained in the classified addendum.

ITEM #	STUDY	FOCUS OF RESEARCH: PROBLEM IDENTIFICATION	STRATEGIES	NEGOTIATIONS	VERIFICATION (SIGNATURE)	VERIFICATION (REMOTE SENSING)	VERIFICATION (ON-SITE SENSING)	PRODUCT
ACDA-001	Adherence to and Compliance with Arms Control Agreements	X	X	X	X	X	X	Macro Analysis
ACDA-002	Annual Report to the Congress 1992	X	X	X	X	X	X	Macro Analysis
DIA-019*	Intelligence Support to Arms Control: An Indispensable Ingredient (U)		X					Macro Analysis
DNA-010	Adjunct Monitoring Concepts and Technologies for Arms Control						X	Macro Analysis
DNA-024	VACOSS S Test Data Results						X	Equipment Development
DOE-039	DOE/LLNL Verification Symposium on Techniques for Monitoring Nuclear Tests Related to Weapons Proliferation				X	X	X	Macro Analysis
DOE-042	GRABIT: A Large Area, Broad Bandwidth, Gamma-Ray Imaging Spectrometer for Astrophysics						X	Equipment Development
DOE-047	Monte Carlo Simulations of Plutonium Gamma-Ray Spectra						X	Analytical Tools
DOE-048	Non-Intrusive Near Component Discrimination with a Micro Channel Plate Gamma-Ray Detector.						X	Analytical Tools
DOE-066	Evidence for Field Enhanced Electron Capture by EL2 Centers in Semi-Insulating GaAs and the Effect on GaAs Radiation Detectors						X	Analytical Tools
DOE-067	Fundamentals of Semiconductor Detectors for Ionizing Radiation						X	Analytical Tools
DOE-068	Present Status of Undoped Semi-Insulating Bulk LEC GaAs as a Radiation Spectrometer						X	Analytical Tools
DOE-085	Directional Measurements for Sources of Fission Neutrons						X	Analytical Tools
DOE-103	Measurement and Analysis of Neutron Energy Spectra from Fission Source						X	Analytical Tools
DOE-152	Export Control and International Safeguards Applications of Ultrasonic Intrinsic Tags				X		X	Analytical Tools
DOE-153	Fingerprinting with Bayesian and Maximum Entropy Methods				X		X	Analytical Tools
DOE-168	Minimized Ultrasonic Intrinsic Tagging (UIT) System				X		X	Analytical Tools
DOE-197	Policy & Technical Analysis Division Arms Control Reference Book: Official Summaries, Chronologies, and Other Data on U.S. Arms Control Policies, Negotiations, Agreements, and Treaties	X	X	X	X	X	X	Macro Analysis
DOE-207	Arms Control Verification: Looking Back and Looking Ahead				X	X	X	Analytical Tools

Table A2
Strategic Arms Control - START II

Item number refers to location of the study in Appendix B. Numbers with an asterisk (*) are contained in the classified addendum.

ITEM #	STUDY	FOCUS OF RESEARCH: PROBLEM IDENTIFICATION	STRATEGIES	NEGOTIATIONS	VERIFICATION (SIGNATURE)	VERIFICATION (REMOTE SENSING)	VERIFICATION (ON-SITE SENSING)	PRODUCT
ACDA-011	Alternative Russian Federation Targeting Doctrines		X					Basic Research
ACDA-018	Russian Breakout Options Under Start II	X						Basic Research
CIA-008*	<classified title>	X						Macro Analysis
CIA-023*	<classified title>	X						Macro Analysis
CIA-035*	Russia's START Implementation Costs and Capabilities (U)	X						Macro Analysis
DIA-001*	Logistic Implications of the Realignment of Russia's Strategic Bombers (U)	X						Macro Analysis
DIA-002*	"What Have Russia's Interests Got to Do With It?" : Russian Opposition to the START II Treaty (U)	X						Macro Analysis
DIA-003*	Helping Russia Destroy Its Nuclear Weapons: Status of Western Assistance Efforts (U)	X						Macro Analysis
DIA-006*	Russian Economic Crisis Portends Deep Defense Cuts (U)	X						Macro Analysis
DIA-009*	SS-18 Silo Conversion: A New Home for the SS-25 (U)		X				X	Macro Analysis
DIA-010*	START II: Implications for Russian Strategic Nuclear Forces (U)		X					Macro Analysis
DIA-011*	The START Treaties: Go, Then Stop (U)	X						Macro Analysis
DIA-012*	Progress in START and CFE, Questions on Chemical Weapons (U)	X						Macro Analysis
DIA-023*	Submarine Exclusion Zones: An Old Idea Resurfaced (U)		X					Macro Analysis
DNA-015	The Costs and Effectiveness of Treaty Verification Regimes				X			Analytical Tools
DNA-028	Portable Low Speed WIM System						X	Equipment Development
DOE-001	Associated-Particle Sealed-Tube Neutron Probe for Characterization of Materials						X	Equipment Development
DOE-020	FATS - Warhead Counting and SNM Monitoring With Radiation Detectors: the LANL and FEWAFB Tests						X	Equipment Development
DOE-103	Measurement and Analysis of Neutron Energy Spectra from Fission Source						X	Analytical Tools
DOE-177	Preliminary Detector Design, 5T862-Prototype Neutron Detector						X	Analytical Tools
DOE-179	Rapid Vulnerability Analysis Report						X	Analytical Tools
DOE-192	Unique Composites and Secure Containers						X	Equipment Development

Table A3
Strategic Arms Control - INF

Item number refers to location of the study in Appendix B. Numbers with an asterisk (*) are contained in the classified addendum.

ITEM #	STUDY	FOCUS OF RESEARCH: PROBLEM IDENTIFICATION	STRATEGIES	NEGOTIATIONS	VERIFICATION (SIGNATURE)	VERIFICATION (REMOTE SENSING)	VERIFICATION (ON-SITE SENSING)	PRODUCT
DOE-022	FY-93 Preliminary Adversarial Assessment of the SNL Prototype Python Tag/Seal						X	Micro Analysis
DOE-029	SLITS Adversarial Assessment: Summary Report						X	Micro Analysis
DOE-030	STAR Tag/Seal Adversarial Assessment: Final Report						X	Micro Analysis
DOE-192	Unique Composites and Secure Containers						X	Equipment Development

Table A6
Strategic Arms Control - SSD

Item number refers to location of the study in Appendix B. Numbers with an asterisk (*) are contained in the classified addendum.

		FOCUS OF RESEARCH						
		PROBLEM IDENTIFICATION						
			STRATEGIES					
				NEGOTIATIONS				
					VERIFICATION (SIGNATURE)			
						VERIFICATION (REMOTE SENSING)		
							VERIFICATION (ON-SITE SENSING)	
ITEM #	STUDY							PRODUCT
DIA-020*	Kazakhstan and START: Taking Cues From Ukraine (U)		X					Macro Analysis
DOE-001	Associated-Particle Sealed-Tube Neutron Probe for Characterization of Materials						X	Equipment Development
DOE-005	Nuclear Disarmament Verification				X		X	Macro Analysis
DOE-010	CIVET (Controlled Intrusiveness Verification Technology) : report on the HRGS Template Tests.				X		X	Analytical Tools
DOE-014	Nuclear Materials Control and Accounting and Physical Protection : Components Review for the Urals Electrochemical Integrated Enterprise.	X						Analytical Tools
DOE-042	GRABIT: A Large Area, Broad Bandwidth, Gamma-Ray Imaging Spectrometer for Astrophysics						X	Equipment Development
DOE-047	Monte Carlo Simulations of Plutonium Gamma-Ray Spectra						X	Analytical Tools
DOE-048	Non-Intrusive Near Component Discrimination with a Micro Channel Plate Gamma-Ray Detector.						X	Analytical Tools
DOE-066	Evidence for Field Enhanced Electron Capture by EL2 Centers in Semi-Insulating GaAs and the Effect on GaAs Radiation Detectors						X	Analytical Tools
DOE-067	Fundamentals of Semiconductor Detectors for Ionizing Radiation						X	Analytical Tools
DOE-068	Present Status of Undoped Semi-Insulating Bulk LEC GaAs as a Radiation Spectrometer						X	Analytical Tools
DOE-074	An NDA System for Automated, Inline Weapons Component Dismantlement		X					Equipment Development
DOE-080	Classification Issues Related to the Use of Radiation Detection Techniques in Transparency/Safeguards						X	Analytical Tools
DOE-085	Directional Measurements for Sources of Fission Neutrons						X	Analytical Tools
DOE-093	Information Sources for Transparency Measures at Sensitive Facilities						X	Analytical Tools
DOE-103	Measurement and Analysis of Neutron Energy Spectra from Fission Source						X	Analytical Tools
DOE-167	Methods for Determining the History of HEU	X						Macro Analysis
DOE-171	Nuclear Warhead Disablement, Dismantlement, and Material Disposition for Arms Control - Initial Definition of R&D Needs and Gaps and Compilation of Work To Date		X					Macro Analysis
DOE-215	Evaluation of Means of Disposing of Fissile Material from Dismantled Former Soviet Nuclear Weapons	X						Analytical Tools
DOE-219	Nuclear Arms Control in the Post Cold War Era: From Incremental Change to Radical Solutions	X						Analytical Tools

Table B1
Conventional Arms Control - CFE

Item number refers to location of the study in Appendix B. Numbers with an asterisk (*) are contained in the classified addendum.

		FOCUS OF RESEARCH						
		PROBLEM IDENTIFICATION						
			STRATEGIES					
				NEGOTIATIONS				
					VERIFICATION (SIGNATURE)			
						VERIFICATION (REMOTE SENSING)		
							VERIFICATION (ON-SITE SENSING)	
ITEM #	STUDY							PRODUCT
CIA-012*	<classified title>		X					Macro Analysis
CIA-024*	<classified title>						X	Macro Analysis
CIA-025*	<classified title>	X						Macro Analysis
CIA-026*	CFE Flank Limits: Moscow's Strategic Plans and Options (U)	X						Macro Analysis
CIA-027*	CFE Reduction Obligations: Problems Endanger Implementation (U)	X						Macro Analysis
CIA-028*	CFE Treaty Implementation: Problems on the Southern Flank (U)	X						Macro Analysis
CIA-029*	Changing CFE Zonal Ceilings: Concerns or Canard? (U)	X						Macro Analysis
CIA-036*	Russian CFE Treaty-Limited Reduction Plans: Unsalvageable? (U)	X						Macro Analysis
CIA-038*	The Eurasian States and Conventional Arms Control Harmonization Talks (U)	X						Macro Analysis
DIA-012*	Progress in START and CFE, Questions on Chemical Weapons (U)	X						Macro Analysis
DIA-016*	CFE: Russian and Ukrainian Force Planners Are Concerned by Flank Zone Limitations (U)	X						Macro Analysis
DIA-026*	<classified title>	X						Macro Analysis
DNA-016	Treaty Cost Summary - Status Report as of September 1990				X	X		Macro Analysis
DNA-019	Adversarial Analysis of the CFE Treaty; Report on Workshops Addressing Cheating Scenarios, US Verification Vulnerabilities and Risks, US Hedges, and Programmatic Impacts of Hedges				X		X	Macro Analysis

Table B2
Conventional Arms Control - FSC (or CSCE)

Item number refers to location of the study in Appendix B. Numbers with an asterisk (*) are contained in the classified addendum.

		FOCUS OF RESEARCH						
		PROBLEM IDENTIFICATION						
			STRATEGIES					
				NEGOTIATIONS				
					VERIFICATION (SIGNATURE)			
						VERIFICATION (REMOTE SENSING)		
							VERIFICATION (ON-SITE SENSING)	
ITEM #	STUDY							PRODUCT
CIA-011*	CSCE: Europeans Still Trying to Make It Work (U)	X						Macro Analysis
CIA-012*	<classified title>		X					Macro Analysis
CIA-030*	Engaging the Smaller Successor States in the Forum for Security Cooperation (U)		X					Macro Analysis

Table C0
Nuclear Testing - General

Item number refers to location of the study in Appendix B. Numbers with an asterisk (*) are contained in the classified addendum.

ITEM #	STUDY	FOCUS OF RESEARCH: PROBLEM IDENTIFICATION	STRATEGIES	NEGOTIATIONS	VERIFICATION (SIGNATURE)	VERIFICATION (REMOTE SENSING)	VERIFICATION (ON-SITE SENSING)	PRODUCT
ACDA-001	Adherence to and Compliance with Arms Control Agreements	X	X	X	X	X	X	Macro Analysis
ACDA-002	Annual Report to the Congress 1992	X	X	X	X	X	X	Macro Analysis
DNA-023	Support of TTBT Protocol and Development of HYDRO PLUS Yield Verification Procedures						X	Macro Analysis
DOE-197	Policy & Technical Analysis Division Arms Control Reference Book: Official Summaries, Chronologies, and Other Data on U.S. Arms Control Policies, Negotiations, Agreements, and Treaties	X	X	X	X	X	X	Macro Analysis

Table C1
Nuclear Testing - LTBT

Item number refers to location of the study in Appendix B. Numbers with an asterisk (*) are contained in the classified addendum.

ITEM #	STUDY	FOCUS OF RESEARCH: PROBLEM IDENTIFICATION	STRATEGIES	NEGOTIATIONS	VERIFICATION (SIGNATURE)	VERIFICATION (REMOTE SENSING)	VERIFICATION (ON-SITE SENSING)	PRODUCT
DOE-036	Analysis of Lg Spectral Ratios from NTS Explosions: Implications for the Source Mechanisms of Spall and the Generation of Lg Waves				X			Analytical Tools
DOE-037	Array Measurements and Modeling of the Search of Shallow Volcano Tremor at Kilauea Volcano, Hawaii				X			Analytical Tools
DOE-040	Differences in Coupling Between Chemical and Nuclear Explosions				X			Analytical Tools
DOE-054	Seismic Decoupling with Chemical and Nuclear Explosions in Salt				X			Analytical Tools
DOE-060	Electron Beams at Geosynchronous Orbit					X		Analytical Tools
DOE-061	Ionospheric Photoelectrons Measured at Geosynchronous Orbit					X		Analytical Tools
DOE-073	An Examination of the Structure and Dynamics of the Outer Plasmasphere Using Multiple Geosynchronous Satellites					X		Analytical Tools
DOE-111	Plasma Observations of Magnetopause Crossings at Geosynchronous Orbit					X		Analytical Tools
DOE-122	TIPC User Manual					X		Analytical Tools
DOE-123	The Magnetospheric Lobe at Geosynchronous Orbit					X		Analytical Tools
DOE-141	All Source Database					X		Basic Research
DOE-144	Comments on Statistical Issues in Numerical Modeling for Underground Nuclear Test Monitoring					X	X	Basic Research
DOE-175	Potential for Reflected S Wave Contamination of Lg RMS Measurements, as Measured at LLNL Seismic Stations from NTS Events					X		Basic Research

Table C2 (Page 2 of 2)
Nuclear Testing - TTBT

Item number refers to location of the study in Appendix B. Numbers with an asterisk (*) are contained in the classified addendum.

ITEM #	STUDY	FOCUS OF RESEARCH: PROBLEM IDENTIFICATION	STRATEGIES	NEGOTIATIONS	VERIFICATION (SIGNATURE)	VERIFICATION (REMOTE SENSING)	VERIFICATION (ON-SITE SENSING)	PRODUCT
DOE-099	Integrated Verification Experiment Data Collected as Part of the Los Alamos National Laboratory's Source Region Program, Appendix F: Regional Data from Lawrence Livermore and Sandia Seismic Networks.				X	X		Analytical Tools
DOE-104	Measurement of Large ground Motions with the ASM Gage						X	Equipment Development
DOE-105	Modeling of Nuclear Explosions in Hard Rock Sites				X			Analytical Tools
DOE-108	New Multiphase Equation of State for Polycrystalline Quartz						X	Analytical Tools
DOE-110	Observations of Nonlinear Elastic Wave Behavior in Sandstone					X		Analytical Tools
DOE-113	Proceedings of the First Geological Materials Constitutive Modeling Workshop	X					X	Analytical Tools
DOE-114	Proceedings of the Numerical Modeling for Underground Nuclear Test Monitoring Symposium.				X	X		Analytical Tools
DOE-115	Pulse-Mode Measurement of Harmonic Generation in Rock					X		Analytical Tools
DOE-141	All Source Database					X		Basic Research
DOE-144	Comments on Statistical Issues in Numerical Modeling for Underground Nuclear Test Monitoring					X	X	Basic Research
DOE-175	Potential for Reflected S Wave Contamination of Lg RMS Measurements, as Measured at LLNL Seismic Stations from NTS Events					X		Basic Research
DOE-176	Potential for Reflected S Wave Contamination of Lg RMS Measurements, as Measured at LLNL Seismic Stations from NTS Events					X		Analytical Tools
DOE-189	The Nevada Test Site All-Sources Data Base: A First Look Assessment				X	X	X	Analytical Tools

Table C3 (Page 2 of 3)
Nuclear Testing - CTBT

Item number refers to location of the study in Appendix B. Numbers with an asterisk (*) are contained in the classified addendum.

		FOCUS OF RESEARCH						
		PROBLEM IDENTIFICATION						
			STRATEGIES					
				NEGOTIATIONS				
					VERIFICATION (SIGNATURE)			
						VERIFICATION (REMOTE SENSING)		
							VERIFICATION (ON-SITE SENSING)	
ITEM #	STUDY							PRODUCT
DOE-054	Seismic Decoupling with Chemical and Nuclear Explosions in Salt				X			Analytical Tools
DOE-055	Seismic Discrimination Studies of Little Skull Mountain Earthquakes and NTS Explosions				X		X	Analytical Tools
DOE-056	Spectral Discrimination of Earthquakes and Explosions in the Basin & Range: A Reinvestigation Using Coda Waves				X		X	Analytical Tools
DOE-057	The History and Future of the Lawrence Livermore National Laboratory NTS Network (LNN)				X			Analytical Tools
DOE-059	Analysis of Lg Spectral Ratios from NTS Explosions: Implications for the Source Mechamisms of Spall and the Generation of Lg Waves				X			Analytical Tools
DOE-060	Electron Beams at Geosynchronous Orbit					X		Analytical Tools
DOE-061	Ionospheric Photoelectrons Measured at Geosynchronous Orbit					X		Analytical Tools
DOE-062	Effects of Structural Setting and Rock Properties on Amplitudes of Surface Motions in the Vicinity of Small Explosive Tests				X			Analytical Tools
DOE-065	Explosive Shielding by Weak Layers				X	X		Analytical Tools
DOE-073	An Examination of the Structure and Dynamics of the Outer Plasmasphere Using Multiple Geosynchronous Satellites					X		Analytical Tools
DOE-078	Atmospheric Acoustic Modeling				X	X		Analytical Tools
DOE-079	Atmospheric Signals Produced by Cavity Rebound				X	X		Analytical Tools
DOE-084	Detection of Mining Explosions Using Ionospheric Techniques				X	X		Analytical Tools
DOE-087	Experimental and Theoretical Studies of Spectral Alteration in Ultrasonic Waves Resulting From Nonlinear Elastic Response in Rock					X		Analytical Tools
DOE-088	<classified title>				X			Analytical Tools
DOE-089	Ground Motions and the Infrasound Signal: A New Model and the Discovery of a Significant Cavity Rebound Signal.				X	X		Analytical Tools
DOE-095	Integrated Verification Experiment Data Collected as Part of the Los Alamos National Laboratory's Source Region Program, Appendix A: Surface Effects				X	X		Analytical Tools
DOE-096	Integrated Verification Experiment Data Collected as Part of the Los Alamos National Laboratory's Source Region Program, Appendix B: Surface Ground Motion				X	X		Analytical Tools
DOE-097	Integrated Verification Experiment Data Collected as Part of the Los Alamos National Laboratory's Source Region Program, Appendix D: Ionospheric Measurements for IVEs.				X	X		Analytical Tools
DOE-099	Integrated Verification Experiment Data Collected as Part of the Los Alamos National Laboratory's Source Region Program, Appendix F: Regional Data from Lawrence Livermore and Sandia Seismic Networks.				X	X		Analytical Tools
DOE-105	Modeling of Nuclear Explosions in Hard Rock Sites				X			Analytical Tools
DOE-109	Nighttime Sensitivity of Ionospheric Techniques for Detecting Explosions				X	X		Analytical Tools
DOE-110	Observations of Nonlinear Elastic Wave Behavior in Sandstone					X		Analytical Tools
DOE-111	Plasma Observations of Magnetopause Crossings at Geosynchronous Orbit					X		Analytical Tools
DOE-113	Proceedings of the First Geological Materials Constitutive Modeling Workshop	X					X	Analytical Tools
DOE-114	Proceedings of the Numerical Modeling for Underground Nuclear Test Monitoring Symposium.				X	X		Analytical Tools
DOE-115	Pulse-Mode Measurement of Harmonic Generation in Rock.					X		Analytical Tools
DOE-121	Sensitivity of the Close-in Seismic Source Function to Rock Properties				X	X		Analytical Tools
DOE-122	TIPC User Manual					X		Analytical Tools
DOE-123	The Magnetospheric Lobe at Geosynchronous Orbit					X		Analytical Tools

Table D1 (Page 1 of 2)
Nuclear Proliferation - NPT

Item number refers to location of the study in Appendix B. Numbers with an asterisk (*) are contained in the classified addendum.

		FOCUS OF RESEARCH						
		PROBLEM IDENTIFICATION						
			STRATEGIES					
				NEGOTIATIONS				
					VERIFICATION (SIGNATURE)			
						VERIFICATION (REMOTE SENSING)		
							VERIFICATION (ON-SITE SENSING)	
ITEM #	STUDY							PRODUCT
ACDA-009	1995 NPT Extension Conference Studies and Analyses - NPT Informational Pamphlet			X				Macro Analysis
ACDA-010	1995 NPT Extension Conference Studies and Analyses - NPT White Papers		X					Macro Analysis
ACDA-017	Quick Response on Issues Related to the Extension of NPT			X				Basic Research
ARPA-006	Application of Generalized Likelihood Ratio Tests to Seismic Event Identification				X	X		Analytical Tools
CIA-016*	<classified title>	X						Macro Analysis
CIA-021*	<classified title>	X						Macro Analysis
CIA-031*	<classified title>		X					Macro Analysis
DIA-003*	Helping Russia Destroy Its Nuclear Weapons: Status of Western Assistance Efforts (U)	X						Macro Analysis
DIA-004*	North Korea and Nuclear Weapons: The View From Moscow (U)	X						Macro Analysis
DIA-020*	Kazakhstan and START: Taking Cues From Ukraine (U)		X					Macro Analysis
DOE-001	Associated-Particle Sealed-Tube Neutron Probe for Characterization of Materials						X	Equipment Development
DOE-002	Constraining Potential Nuclear-Weapons Proliferation from Civilian Reactors							Macro Analysis
DOE-004	Isotopic Signatures for Data Validation in Arms Control						X	Basic Research
DOE-007	Application of Resonance Raman LIDAR for the Remote Detection of Effluents					X		Equipment Development
DOE-008	Application of Resonance Raman Spectroscopy as a Nuclear Proliferation Detection Technology.						X	Micro Analysis
DOE-012	Experimental Measurements of Normal Raman Spectra and Ultra Violet/Visible Absorptions for Chemicals Relevant to Nuclear Weapons Production.					X		Basic Research
DOE-016	Proliferation Detection Using a Remote Resonance Raman Chemical Sensor					X		Micro Analysis
DOE-022	FY-93 Preliminary Adversarial Assessment of the SNL Prototype Python Tag/Seal						X	Micro Analysis
DOE-023	Gamma-Neutron Threshold (GNT) Technology: Demonstration System Summary Report						X	Micro Analysis
DOE-029	SLITS Adversarial Assessment: Summary Report						X	Micro Analysis
DOE-030	STAR Tag/Seal Adversarial Assessment: Final Report						X	Micro Analysis
DOE-034	Allocating Resources for Monitoring Nuclear Testing by Potential Proliferators				X			Analytical Tools
DOE-041	French and German Foreign and Security Policies: Spring 1993		X					Macro Analysis
DOE-050	Nuclear Issues in Current French and German Security Policy		X					Macro Analysis
DOE-107	NUDET Monitoring from Satellites	X	X			X		Analytical Tools
DOE-131	Maraging Steel: Producers and Related Research Organizations	X						Basic Research
DOE-132	Microscale Chemical Instrumentation: Microchip Liquid Chromatography Interim Technical Report						X	Basic Research
DOE-134	Nuclear Fuel Reprocessing Technology: Non-Proliferation Considerations in Public Disclosures	X						Analytical Tools
DOE-143	Chemical Signatures				X		X	Analytical Tools
DOE-151	Excitation Rate and Background Measurements During LIF Studies on Krypton					X		Analytical Tools
DOE-157	Interim Report on Effluent Signatures				X		X	Analytical Tools
DOE-170	Nuclear Proliferation Signatures				X	X	X	Analytical Tools
DOE-178	Proliferation Detection Technologies Matrix				X	X	X	Analytical Tools
DOE-186	Separation of Oxide Particles by Capillary Electrophoresis				X		X	Equipment Development
DOE-192	Unique Composites and Secure Containers						X	Equipment Development
DOE-198	The Nuclear Nonproliferation Treaty: Key Organizational, Procedural, Arms Control, and Peaceful Uses Issues Relevant to the 1995 Extension Conference		X					Analytical Tools

Table D2
Nuclear Proliferation - Fissile materials production cut-off

Item number refers to location of the study in Appendix B. Numbers with an asterisk (*) are contained in the classified addendum.

ITEM #	STUDY	FOCUS OF RESEARCH: PROBLEM IDENTIFICATION	STRATEGIES	NEGOTIATIONS	VERIFICATION (SIGNATURE)	VERIFICATION (REMOTE SENSING)	VERIFICATION (ON-SITE SENSING)	PRODUCT
DOE-008	Application of Resonance Raman Spectroscopy as a Nuclear Proliferation Detection Technology.						X	Micro Analysis
DOE-017	Transparency Measures for DOE SNM Production Facilities	X						Analytical Tools
DOE-018	Vulnerability Assessment of the Active Well Coincidence Counter (AWCC) for Measurement of Foreign 235U.						X	Equipment Development
DOE-047	Monte Carlo Simulations of Plutonium Gamma-Ray Spectra						X	Analytical Tools
DOE-048	Non-Intrusive Near Component Discrimination with a Micro Channel Plate Gamma-Ray Detector.						X	Analytical Tools
DOE-058	The Lawrence Livermore National Laboratory Intelligent Actinide Analysis System						X	Analytical Tools
DOE-066	Evidence for Field Enhanced Electron Capture by EL2 Centers in Semi-Insulating GaAs and the Effect on GaAs Radiation Detectors						X	Analytical Tools
DOE-067	Fundamentals of Semiconductor Detectors for Ionizing Radiation						X	Analytical Tools
DOE-068	Present Status of Undoped Semi-Insulating Bulk LEC GaAs as a Radiation Spectrometer						X	Analytical Tools
DOE-085	Directional Measurements for Sources of Fission Neutrons						X	Analytical Tools
DOE-103	Measurement and Analysis of Neutron Energy Spectra from Fission Source						X	Analytical Tools
DOE-134	Nuclear Fuel Reprocessing Technology: Non-Proliferation Considerations in Public Disclosures	X						Analytical Tools
DOE-142	Automated Nuclear Track Characterization, Advanced Concept Final Report						X	Equipment Development
DOE-143	Chemical Signatures				X		X	Analytical Tools
DOE-151	Excitation Rate and Background Measurements During LIF Studies on Krypton					X		Analytical Tools
DOE-157	Interim Report on Effluent Signatures				X		X	Analytical Tools
DOE-158	Ion Trap Mass Spectrometry Combined with Inductively Coupled Plasma/Mass Spectrometry (IT-ICP/MS)						X	Equipment Development
DOE-159	Ion-trap Mass Spectrometry with an Inductively Coupled Plasma Source						X	Analytical Tools
DOE-196	The High-Level Neutron Coincidence Counter (HLNCC): An Adversarial Analysis						X	Analytical Tools
DOE-205	The Authenticated Tracking And Monitoring System (ATMS)						X	Equipment Development
DOE-206	A Comprehensive Approach To Limiting The Production and Use of Nuclear Weapons Materials	X						Analytical Tools
DOE-217	Negotiations on Nuclear Materials Production: Choosing a Negotiating Venue	X						Analytical Tools
DOE-219	Nuclear Arms Control in the Post Cold War Era: From Incremental Change to Radical Solutions	X						Analytical Tools

Table D4 (Page 1 of 3)
Nuclear Proliferation - IAEA safeguards

Item number refers to location of the study in Appendix B. Numbers with an asterisk (*) are contained in the classified addendum.

		FOCUS OF RESEARCH						
		PROBLEM IDENTIFICATION						
			STRATEGIES					
				NEGOTIATIONS				
					VERIFICATION (SIGNATURE)			
						VERIFICATION (REMOTE SENSING)		
							VERIFICATION (ON-SITE SENSING)	
ITEM #	STUDY							PRODUCT
DIA-004*	North Korea and Nuclear Weapons: The View From Moscow (U)	X						Macro Analysis
DOE-005	Nuclear Disarmament Verification				X		X	Macro Analysis
DOE-006	A Preliminary Examination of Alternative Sampling Schemes for the Verification of a Small Gaseous Diffusion Cascade				X		X	Analytical Tools
DOE-013	Monitoring and Trace Detection of Hazardous Waste and Toxic Chemicals Using Resonance Raman Spectroscopy.						X	Basic Research
DOE-018	Vulnerability Assessment of the Active Well Coincidence Counter (AWCC) for Measurement of Foreign 235U.						X	Equipment Development
DOE-022	FY-93 Preliminary Adversarial Assessment of the SNL Prototype Python Tag/Seal						X	Micro Analysis
DOE-023	Gamma-Neutron Threshold (GNT) Technology: Demonstration System Summary Report						X	Micro Analysis
DOE-027	Nuclear Facility Transparency Signatures for the Idaho Chemical Processing Plant				X			Micro Analysis
DOE-029	SLITS Adversarial Assessment: Summary Report						X	Micro Analysis
DOE-030	STAR Tag/Seal Adversarial Assessment: Final Report						X	Micro Analysis
DOE-035	An Expert, Visual Interface Enhances the Valid Measurement of Plutonium, Gamma-Ray Data.						X	Analytical Tools
DOE-038	Assessment of Ambient-Temperature, High-Resolution Detectors for Nuclear Safeguards Applications						X	Micro Analysis
DOE-045	MGA and Passive Neutron Measurements						X	Equipment Development
DOE-049	Nonproliferation Section for Pu Storage White Paper	X						Macro Analysis
DOE-069	A Generalized Assay-Mass Sensitivity Limit for Passive Neutron Coincidence Counting.						X	Analytical Tools
DOE-070	A Neutron Counter for Small Samples						X	Analytical Tools
DOE-071	Advances in Gamma-Ray Field Instrumentation at Los Alamos						X	Equipment Development
DOE-072	Advances in Passive Neutron Instruments for Safeguards						X	Analytical Tools
DOE-075	Analysis of Initial In-Plant Active Neutron Multiplicity Measurements						X	Analytical Tools
DOE-077	Applications of Portable Gamma-Ray Technologies to Quantitative Measurements In-Situ						X	Analytical Tools
DOE-081	Comparison of Shuffler and Differential Die-away-Technique Instruments for the Assay of Fissile Materials in 55-Gallon Waste Drums						X	Analytical Tools
DOE-082	Continuous Remote/Unattended Monitoring For Safeguards Data Collection Systems						X	Equipment Development
DOE-083	Design and Performance of a New High Accuracy Combined Small Sample Neutron/Gamma Detector						X	Equipment Development
DOE-086	Evaluation of Three New Technologies for International Safeguards						X	Analytical Tools
DOE-090	Hybrid K-Edge/XRF Densitometer User Manual						X	Analytical Tools
DOE-091	Improved Implementations of Two Gamma-Ray Measurement Methods						X	Analytical Tools
DOE-094	Integrated Safeguards Systems						X	Analytical Tools
DOE-100	K-Edge Densitometer (KED)						X	Analytical Tools
DOE-106	Multiplicity Neutron Coincidence Counting User Manual						X	Analytical Tools
DOE-112	Plutonium Analysis of High-Burnup Spent Fuel Dissolver Solutions by Low-Energy Gamma-Ray Spectrometry						X	Analytical Tools
DOE-116	Recent Miniature MCA Technology Developments at Los Alamos						X	Analytical Tools
DOE-117	Research Reactor Fork Users Manual						X	Analytical Tools
DOE-118	Safeguarding the Direct Use of Spent PWR Fuel in CANDU Reactors (DUPIC)				X			Analytical Tools

Table D4 (Page 3 of 3)
Nuclear Proliferation - IAEA safeguards

Item number refers to location of the study in Appendix B. Numbers with an asterisk (*) are contained in the classified addendum.

		FOCUS OF RESEARCH						
		PROBLEM IDENTIFICATION						
			STRATEGIES					
				NEGOTIATIONS				
					VERIFICATION (SIGNATURE)			
						VERIFICATION (REMOTE SENSING)		
							VERIFICATION (ON-SITE SENSING)	
ITEM #	STUDY							PRODUCT
DOE-181	SYNTH: A Gamma-Ray Spectrum Synthesizer						X	Basic Research
DOE-182	Scintillating Glass Fiber Neutron Sensors: I. Production and Optical Characterization						X	Equipment Development
DOE-183	Scintillating Glass Fiber Neutron Sensors: II. Light Transmission in Scintillating Fibers						X	Basic Research
DOE-184	Scintillating Glass Fiber Neutron Sensors: III. Photon Economy in Scintillating Fibers						X	Basic Research
DOE-185	Scintillating Glass Fiber Neutron Sensors: IV. Applications and Performance						X	Basic Research
DOE-186	Separation of Oxide Particles by Capillary Electrophoresis				X		X	Equipment Development
DOE-187	Spectrally Resolved Fluorescence Decay Lifetimes for Scintillators						X	Equipment Development
DOE-188	The Effects of Thermal History and Structure on Light Output of Scintillating Glasses						X	Basic Research
DOE-190	The Physics and Structure-Property Relationships of Scintillator Materials: Effect of Thermal History and Chemistry on the Light Output of Scintillating Glasses						X	Basic Research
DOE-192	Unique Composites and Secure Containers						X	Equipment Development
DOE-193	Technical Design and Performance Evaluation of Rapid-Cure Adhesive Systems for the Commercial Production of Tamper Tape Seals						X	Equipment Development
DOE-195	Recommendations Regarding a Clean Laboratory Facility for Processing Environmental Samples	X			X			Micro Analysis
DOE-196	The High-Level Neutron Coincidence Counter (HLNCC): An Adversarial Analysis						X	Analytical Tools
DOE-200	Authenticated In-plant Process Monitor (AIPM)						X	Equipment Development
DOE-201	DOE Task ST557 Advance Tamper Indicating Packaging (TIP) Technologies FY93 Report						X	Equipment Development
DOE-202	Python Fiber-Optic Seal						X	Equipment Development
DOE-203	Sample Vial Secure Container (SVSC)						X	Equipment Development
DOE-204	Secure Authenticated Video Equipment						X	Equipment Development
DOE-205	The Authenticated Tracking And Monitoring System (ATMS)						X	Equipment Development

Table D9
Nuclear Proliferation - Nuclear Suppliers Group/Export controls

Item number refers to location of the study in Appendix B. Numbers with an asterisk (*) are contained in the classified addendum.

ITEM #	STUDY	FOCUS OF RESEARCH: PROBLEM IDENTIFICATION	STRATEGIES	NEGOTIATIONS	VERIFICATION (SIGNATURE)	VERIFICATION (REMOTE SENSING)	VERIFICATION (ON-SITE SENSING)	PRODUCT
CIA-006*	<classified title>	X						Macro Analysis
CIA-034*	<classified title>		X					Macro Analysis
DOE-025	Material Identification Technology (MIT): Concept Technical Feasibility Study				X		X	Micro Analysis
DOE-178	Proliferation Detection Technologies Matrix				X	X	X	Analytical Tools
DOE-213	Effect of Export Nonproliferation Export Controls	X						Analytical Tools
DOE-214	Enhancing The Effectiveness Of Nonproliferation Export Controls	X						Analytical Tools

Table E0
Non-Nuclear Weapons of Mass Destruction - General

Item number refers to location of the study in Appendix B. Numbers with an asterisk (*) are contained in the classified addendum.

ITEM #	STUDY	FOCUS OF RESEARCH: PROBLEM IDENTIFICATION	STRATEGIES	NEGOTIATIONS	VERIFICATION (SIGNATURE)	VERIFICATION (REMOTE SENSING)	VERIFICATION (ON-SITE SENSING)	PRODUCT
ACDA-001	Adherence to and Compliance with Arms Control Agreements	X	X	X	X	X	X	Macro Analysis
ACDA-002	Annual Report to the Congress 1992	X	X	X	X	X	X	Macro Analysis
ACDA-012	Assertive Nonproliferation: Political, Legal and Military Issues		X					Basic Research
ACDA-015	Program on Stability and the Offense/Defense relationship - Seminar Series on Nonproliferation and Counterproliferation.	X						Basic Research
DOE-197	Policy & Technical Analysis Division Arms Control Reference Book: Official Summaries, Chronologies, and Other Data on U.S. Arms Control Policies, Negotiations, Agreements, and Treaties	X	X	X	X	X	X	Macro Analysis
DOE-207	Arms Control Verification: Looking Back and Looking Ahead				X	X	X	Analytical Tools

Table E1 (Page 2 of 2)
Non-Nuclear Weapons of Mass Destruction - CWC

Item number refers to location of the study in Appendix B. Numbers with an asterisk (*) are contained in the classified addendum.

ITEM #	STUDY	FOCUS OF RESEARCH: PROBLEM IDENTIFICATION	STRATEGIES	NEGOTIATIONS	VERIFICATION (SIGNATURE)	VERIFICATION (REMOTE SENSING)	VERIFICATION (ON-SITE SENSING)	PRODUCT
DOE-132	Microscale Chemical Instrumentation: Microchip Liquid Chromatography Interim Technical Report						X	Basic Research
DOE-137	Potential Enrichment Plant Chemical Signatures				X			Analytical Tools
DOE-139	Surface-Enhanced Raman Monitors for Detection of CW Agents						X	Equipment Development
DOE-146	Design Specifications for Man-Portable Supercritical Fluid Extraction Systems						X	Equipment Development
DOE-147	Detailed Conceptual Design of the Air Concentrator-Ion Spectrometer (AC-ITMS) for the Amps Effluent Pod Trap Mass					X		Equipment Development
DOE-161	Laboratory Performance of The ATR/FTIR Chemical Process Monitoring System Using Chemical Simulants and Corrosive Chemical Process Streams						X	Equipment Development
DOE-221	Strategic Planning Workshop on Chemical Weapons Convention Support						X	Analytical Tools

Table E2
Non-Nuclear Weapons of Mass Destruction - BWC

Item number refers to location of the study in Appendix B. Numbers with an asterisk (*) are contained in the classified addendum.

ITEM #	STUDY	FOCUS OF RESEARCH: PROBLEM IDENTIFICATION	STRATEGIES	NEGOTIATIONS	VERIFICATION (SIGNATURE)	VERIFICATION (REMOTE SENSING)	VERIFICATION (ON-SITE SENSING)	PRODUCT
DNA-003	Evaluation of the Concept of a List for the BWC				X		X	Macro Analysis
DOE-194	Vitrification Destruction of Nerve Agents						X	Analytical Tools
DOE-222	Strengthening Biological Weapons Nonproliferation: An Inventory of Proposals	X						Analytical Tools

Table E3
Non-Nuclear Weapons of Mass Destruction - Russian Bilateral Agreements

Item number refers to location of the study in Appendix B. Numbers with an asterisk (*) are contained in the classified addendum.

ITEM #	STUDY	FOCUS OF RESEARCH: PROBLEM IDENTIFICATION	STRATEGIES	NEGOTIATIONS	VERIFICATION (SIGNATURE)	VERIFICATION (REMOTE SENSING)	VERIFICATION (ON-SITE SENSING)	PRODUCT
ACDA-006	Support for US-Russian Transparency Measures		X					Micro Analysis
CIA-032*	Prospects for Future Progress on US-Russian Chemical Weapons Arms Control (U)	X						Macro Analysis
DIA-007*	Chemical Weapon Negotiations End, but Will Bilateral Agreements Be Signed? (U)	X						Macro Analysis
DNA-008	Tagging Applications for the Wyoming Memorandum of Understanding						X	Equipment Development

Table F3
Regional Issues - Middle East

Item number refers to location of the study in Appendix B. Numbers with an asterisk (*) are contained in the classified addendum.

ITEM #	STUDY	FOCUS OF RESEARCH: PROBLEM IDENTIFICATION	STRATEGIES	NEGOTIATIONS	VERIFICATION (SIGNATURE)	VERIFICATION (REMOTE SENSING)	VERIFICATION (ON-SITE SENSING)	PRODUCT
ACDA-013	Long-term Monitoring of Iraq: Final Report of an Interactive Planning Game	X	X		X	X	X	Basic Research
ACDA-016	Protecting Peaceful Nuclear facilities in a World of Clandestine Nuclear Programs		X					Basic Research
CIA-018*	<classified title>		X					Macro Analysis

Table F4
Regional Issues - South Asia

Item number refers to location of the study in Appendix B. Numbers with an asterisk (*) are contained in the classified addendum.

ITEM #	STUDY	FOCUS OF RESEARCH: PROBLEM IDENTIFICATION	STRATEGIES	NEGOTIATIONS	VERIFICATION (SIGNATURE)	VERIFICATION (REMOTE SENSING)	VERIFICATION (ON-SITE SENSING)	PRODUCT
DOE-220	Regional Solutions in Nuclear Non-Proliferation: A South Asian Nuclear Test Ban	X			X	X	X	Analytical Tools

Table F5
Regional Issues - North Asia

Item number refers to location of the study in Appendix B. Numbers with an asterisk (*) are contained in the classified addendum.

ITEM #	STUDY	FOCUS OF RESEARCH: PROBLEM IDENTIFICATION	STRATEGIES	NEGOTIATIONS	VERIFICATION (SIGNATURE)	VERIFICATION (REMOTE SENSING)	VERIFICATION (ON-SITE SENSING)	PRODUCT
DOE-126	Training for Special Safeguards Inspections						X	Analytical Tools

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Appendix B - Comprehensive Listing

XX JULY 1994

In response to Section 39 of the Arms Control and Disarmament Act

27-JUL-94

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SPONSORING ORGANIZATIONS:
- ACDA - Arms Control and Disarmament Agency
- ARPA - Advanced Research Projects Agency
- CIA - Central Intelligence Agency
- DIA - Defense Intelligence Agency
- DNA - Defense Nuclear Agency
- DOE - Department of Energy

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ACDA-005	Chemical Weapons Nonproliferation Strategies -- MERIDIAN CORPORATION	3
ACDA-006	Support for US-Russian Transparency Measures -- MERIDIAN CORPORATION	3
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ACDA-001
TITLE: (U) Adherence to and Compliance with Arms Control Agreements

SPONSOR: ACDA
PERFORMING ORGANIZATION: ACDA/IVI
RELATED TABLES: AO,BO,CO,DO,EO,FO

(U) These reports are required annually beginning in 1986 by the Arms Control and Disarmament Act, Section 52, and are often referred to as the Pell Reports. They focus on assessments of compliance with arms control agreements including US compliance, as well as noncompliance by other nations. The Pell Reports are prepared by the ACDA Director in coordination with the Secretaries of State, Defense, and Energy, the Chairman of the Joint Chiefs of Staff, and the Director of Central Intelligence, and submitted to Congress by the President.

ACDA-002
TITLE: (U) Annual Report to the Congress 1992

SPONSOR: ACDA JAN-93
PERFORMING ORGANIZATION: ACDA/D/M
RELATED TABLES: AO,BO,CO,DO,EO,FO

(U) The Annual Report provides information about the nature and significance of treaties signed during the year, the conduct of arms control negotiations and treaty implementation procedures, and other activities conducted by the Arms Control and Disarmament Agency.

ACDA-003
TITLE: (U) Implications of the Chemical Weapons Convention on the US Chemical Industry

SPONSOR: ACDA 18-JUN-93
PERFORMING ORGANIZATION: EAI Corporation
RELATED TABLES: E1

(U) A key aspect of successful domestic implementation of the Chemical Weapons Convention, which will come into force as early as January 1995, will be the universal, timely and cooperative fulfillment by the chemical and related industries of new obligations under the convention. Part of this project was to conduct five regional, one-day seminars which both informed industrial representatives on all aspects of their involvement with the convention and also collected their comments and concerns. This report describes how the seminars were arranged; compiles, summarizes and categorizes, and analyzes the industry comments; and recommends (a) elements of the implementation legislation, (b) topics requiring clarifications from the Preparatory Commission in the Hague, and (c) activities that the interagency working group and the National Authority (which is required by the treaty) should carry out prior to entry-into-force.

ACDA-004
TITLE: (U) Study of US Regulatory Requirements Related to the Chemicals Covered by the Chemical Weapons Convention

SPONSOR: ACDA 9-FEB-93
PERFORMING ORGANIZATION: EAI Corporation
RELATED TABLES: E1

(U) The Chemical Weapons Convention (CWC) will require declarations and annual reports from signatory nations and their chemical and related industries. This report compares CWC reporting requirements against existing US federal and state regulations requiring reports from the chemical industry with the aim of using all or part of the domestic data to meet CWC requirements. US regulations, reported information, resources and needs are described in detail. The report concludes that the information provided under existing regulations will not meet CWC requirements for reasons documented in the report, and offers several recommendations for government action.

ACDA-010
TITLE: (U) 1995 NPT Extension Conference Studies and Analyses - NPT White Papers

SPONSOR: ACDA JAN-93
PERFORMING ORGANIZATION: Science Applications International Corp.
RELATED TABLES: D1

(U) To support ACDA's preparations for the 1995 NPT Extension Conference, SAIC prepared a series of White papers which provides background information and sets forth US policies and views on NPT-related issues including NPT extension and duration, IAEA safeguards under the NPT, peaceful nuclear cooperation as a result of the NPT, and arms control efforts pursued in fulfillment of NPT objectives. These papers are intended for US officials in Washington and overseas who are supporting US NPT diplomacy.

ACDA-011
TITLE: (U) Alternative Russian Federation Targeting Doctrines

SPONSOR: ACDA 27-APR-93
PERFORMING ORGANIZATION: Science Applications International Corp.
RELATED TABLES: A2

(U) This report develops a set of alternative targeting doctrines for the strategic and sub-strategic nuclear forces of the Russian Federation, corresponding to different sets of reduced force structures. The military implications of each of the alternative targeting doctrines are developed and the implications for arms control are assessed.

ACDA-012
TITLE: (U) Assertive Nonproliferation: Political, Legal and Military Issues

SPONSOR: ACDA 5-MAY-93
PERFORMING ORGANIZATION: Science Applications International Corp.
RELATED TABLES: D0,E0

(U) This report is an options paper drafted for ACDA on "Assertive Nonproliferation." In the course of its analysis, the authors address the following questions: - What is the most effective military structure for carrying out assertive nonproliferation? How should it be organized, equipped and trained? - How can such a force be enabled to operate with the approval of the world community? What structure can meet both the requirement for United Nations approval and the requirement for militarily effective surprise action?

ACDA-013
TITLE: (U) Long-term Monitoring of Iraq: Final Report of an Interactive Planning Game

SPONSOR: ACDA 7-JUL-93
PERFORMING ORGANIZATION: Science Applications International Corp.
RELATED TABLES: F3

(U) ACDA sponsored a six-hour crisis game designed to explore the issue of long term monitoring of Iraq's nuclear weapons potential. Specific objectives of the game included understanding: Iraq's nuclear goals; the sustainability of UN sanctions; the cost of long term monitoring; possible Iraqi strategies for developing nuclear weapons despite sanctions and/or monitoring; and, the role that the US should/will play.

ACDA-014
TITLE: (U) National Security Intellectual Resource Assessment

SPONSOR: ACDA 18-JUN-93
PERFORMING ORGANIZATION: Science Applications International Corp.
RELATED TABLES: F6

(U) This study describes the quality and allocation of intellectual resources that have contributed to defense and national security in the republics of the FSU as well as in the United States; compares those resources to resources available in other areas of endeavor; and assesses the feasibility of redirecting those resources into issue areas of increasing priority to net security and stability.

ACDA-018
TITLE: (U) Russian Breakout Options Under Start II

SPONSOR: ACDA DEC-93
PERFORMING ORGANIZATION: Science Applications International Corp.
RELATED TABLES: A2

(U) The purpose of this study was to explore potential Russian breakout options under the START II Treaty. It first describes the most likely Russian force structure under START II based on recent intelligence projections. However, the study also identifies a Russian force that is optimized to breakout should the Russians decide -- for whatever reason -- to no longer adhere to START II Treaty limits. This second force differs from the first force in that while it would remain at least nominally in compliance with Treaty limits, it best facilitates relatively rapid expansion in the numbers of warheads, once the decision to go beyond START II limits is reached, in order to deal with a rapid and radical change in the international security situation. Although this second force is optimized for breakout, it relies on the easiest and most "Treaty friendly" methods of preparation for breakout to include evasion.

ACDA-019
TITLE: (U) Special Study on the Sea Disposal of Chemical Munitions

SPONSOR: ACDA 19-JAN-93
PERFORMING ORGANIZATION: Science Applications International Corp.
RELATED TABLES: E1

(U) The purpose of this study was to document, insofar as existing records allowed, the dumping of chemical weapons. ACDA tasked SAIC to do the following: (I) Conduct an exhaustive literature search of US official records to identify instances of dumping of captured German chemical munitions or any other CW stocks into the oceans, particularly by the former Soviet Union and the United States; II) Conduct an exhaustive literature search to determine the quantities, type(s) of agent, and dumped configuration of any munitions involved; III) Identify if dumping was performed under the auspices of any agreement; and IV) Conduct a literature search to identify possible chemical reactions with seawaters at the ambient temperatures and turbidity of the oceans involved.

ARPA-001
TITLE: (U) Bayesean Belief Networks for Inexact Reasoning in Expert Systems for Seismic Discrimination.
Document # SAS-TR-94-90

SPONSOR: ARPA DEC-93
PERFORMING ORGANIZATION: ENSCO, Inc.
RELATED TABLES: C3

(U) This report describes the results of the first phase in our study of the application of Bayesean belief networks to seismic discrimination. We have begun the development of a graphically-based interface for constructing and analyzing causal belief networks for seismic discrimination. Belief networks provide a method for inexact reasoning in seismic discrimination and give consistent probability estimates for the identification of seismic events. Discrimination rules are linked together causally such that decisions about event identifications are conditioned on source physics assumptions (e.g., earthquakes should have high shear, explosion should not; earthquakes are deep, explosions are not) which, in turn, condition expected values of seismic parameter or waveform feature measurements (e.g., P/S rations, depth estimates). These conditioning relations are derived from Bayes theorem using conditional probabilities. By instantiating the conditional probability relations with the actual feature measurements, we propagate the probabilities through the network to the final identification probability estimate. This method has been developed to correct deficiencies in the Intelligent Seismic Event Identification System (ISEIS), an expert system based approach to seismic discrimination. These deficiencies include the opaqueness and lack of modularity of the knowledge base and a non-rigorous, ad hoc method for uncertainty calculation. We have found the causal belief diagram display to be extremely useful for forcing the development of clearly structured knowledge bases, where the justification of discrimination rules are clearly defined. Because belief network evaluation of uncertainties is based on well understood probability theory, the method provides a powerful method for estimating internally consistent discrimination uncertainties. This report discusses the design and development of a graphically-based development tool, called XBELIEF, to support the development of belief networks for discrimination. We demonstrate the utility of the method on a simple depth discrimination problem and discuss plans for incorporating the system into ISEIS.

ARPA-004
TITLE: (U) Regional Characterization of Mine Blasts, Earthquakes, Mine Tremors, and Nuclear Explosions Using the Intelligent Seismic Event Identification System. Document # SAS-TR-94-12

SPONSOR: ARPA JUL-93
PERFORMING ORGANIZATION: ENSCO, Inc.
RELATED TABLES: C3

(U) This report describes the results of a study of the Intelligent Seismic Event Identification System (ISEIS) which was installed at the Center for Seismic Studies and applied to regional events in the Intelligent Monitoring System (IMS) database. A subset of IMS data has been collected for known events in a database called the Ground Truth Database (GTD) and these events were processed by ISEIS. This has shown that the regional high-frequency P/S ratio discriminates between explosions and earthquakes in the Vogtland region recorded at the GERESS array. Mine tremors in the Lubin and Upper Silesia resemble earthquakes. Lg spectral ratio was found to separate explosions and earthquakes in the Vogtland region, but the Lubin and Upper Silesia region mine tremors had large scatter. An evaluation was made of the discrimination rules in the ISEIS expert system on the events in four regions (Vogtland, Lubin, Upper Silesia, and Steigen) in the GTD. This report also describes the results of the analysis of the December 31, 1992 event which occurred near the Russian test site on Novaya Zemlya. Analysis of Pn/Sn ratios at NORESS indicated that these ratios were comparable to those measured for Kola Peninsula mine blasts, although the propagation paths were different. The ratios were only slightly greater than those observed for earthquakes in the Greenland Sea. The August 1, 1986 event recorded was re-analyzed and also found to resemble mine blasts. However, other discriminants indicate that the event was probably an earthquake. A statistical analysis of the relative log Pn/Sn ratios, compared to nuclear explosions at Novaya Zemlya, of the December 31, 1992 event, recorded at ARCESS, and the August 1, 1986 event, recorded at NORESS, indicated that the two events were very similar. Since the August 1, 1986 event was apparently an earthquake, its similarity to the December 31, 1992 event suggests that the latter was also an earthquake.

ARPA-005
TITLE: (U) Research on Monitoring at Regional Distances

SPONSOR: ARPA SEP-93
PERFORMING ORGANIZATION: Massachusetts Institute of Technology
RELATED TABLES: C3

(U) This contract was for a program of research on regional propagation and scattering, and has focused on scattering by small-scale heterogeneities near a seismic array. For this research they have determined the coherency of Lg signals recorded by the Scandinavian arrays as a function of inter-element spacing, and used a 2-D finite-element program to synthesize scattering effects on signals due to a random distribution of scatterers. Results indicate that volume heterogeneity in the earth s crust is a viable explanation of ground motion variability observed at seismic arrays on bedrock. They have also studied the problem of source radiation patterns in anisotropic and heterogeneous media. This work, based on theoretical calculations, indicates that explosions in anisotropic media (media containing micro- or macro-fractures with preferred orientation) generate a significant amount of shear energy, including SH components, as well as a nonisotropic radiation pattern. Heterogeneous media (with random velocity variations) are less effective in generating shear. They studied the P.S energy ratio as a function of anisotropy and heterogeneity, and compared the theoretical results with recordings of explosions.

ARPA-008
TITLE: (U) Development of a Comprehensive Yield Estimation System for Explosions at the Shagan River Test Site

SPONSOR: ARPA JUN-93
PERFORMING ORGANIZATION: S-Cubed, a Division of Maxwell Labs
RELATED TABLES: C2

(U) The objectives of this project are to develop a new and improved seismic yield estimation system for application to underground nuclear explosions by integrating all available pieces of the seismic yield estimation process into a prototype operational system which takes full advantage of new capabilities and data which are not currently being utilized for routine monitoring purposes. More specifically, the goal is to develop a research system in which yield estimates based on a wide variety of different seismic measurements can be determined, merged with all available information regarding the specific test location under consideration and statistically combined to obtain an optimum estimate of explosion yield and a quantitative measure of the uncertainty in that estimate.

ARPA-009
TITLE: (U) Numerical Simulations of Quarry Blasts

SPONSOR: ARPA SEP-93
PERFORMING ORGANIZATION: S-Cubed, a Division of Maxwell Labs
RELATED TABLES: C3

(U) The objective of this project was to provide a theoretical basis for the discrimination of quarry blasts from earthquakes and nuclear tests, and to evaluate an evasion scenario of simultaneously exploding a nuclear test beneath a quarry. The quarry blast source models incorporated the effects of ripple fired sources, the finite size and duration of the source, the horizontal and vertical movement of spalled material, the relative excitation of the explosive charges and the spall process, and the bench topography. From the calculations, we made the following conclusions: Conclusions 1 through 7 are the result of the relative excitation of the explosive and spall components of the source and the relatively long duration of the quarry blast. Conclusions 8 through 11 are the result of the quarry geometry. (1) The quarry blast source is a band-limited signal compared to the overburied bomb. (2) Pg spectral values rise in the band from 0.5 to 3.5 Hz for a bomb, but decay in that band for the quarry blast. (3) Spall strongly affects the quarry blast source. Peak Pg and Lg amplitudes from spall and from the explosive charges are comparable. (4) Quarry blast spectral scallops are primarily due to the finite size of the source and are insensitive to the details of ripple firing. (5) In simultaneous explosion and quarry blast, the explosion will dominate if the explosion yield (tamped or equivalent decoupled) exceeds approximately 10% of the quarry blast yield. (6) Seismic amplitudes are insensitive to the direction of spall as long as there is minimal elevation change. (7) An elevation change (the spalled face falling to a lower level) can significantly increase seismic amplitudes from quarry blasts. An elevation change of 10 meters can increase the signal by as much as a factor of 5 in the 2-5 Hz band. (8) Two-dimensional simulations show that seismic signals from point explosion (dilatational) sources located behind the quarry face can be reduced substantially in amplitude, while seismic waves from sources on the quarry floor may be amplified. Seismic signals from point forces are affected very little by proximity to the quarry face. The source amplitude variations occur for sources within about one bench height of the quarry face. (9) An extended source in the standard configuration averages these variations leading to a source that is reduced slightly in amplitude relative to a source in a half space. (10) Results (8) and (9) are nearly independent of the takeoff angle of the seismic signal. (11) Three-dimensional simulations show that the quarry creates a shadow for signals exiting the quarry on the side opposite the bench.

ARPA-012
TITLE: (U) Initial Wave-Type Identification with Neural Networks and its Contribution to Automated Processing in IMS Version 3.0. Document # SAIC-93/1219

SPONSOR: ARPA DEC-93
PERFORMING ORGANIZATION: Science Applications International Corp.
RELATED TABLES: C3

(U) This report describes a new 4-class neural network for automated identification of initial wave type (Teleseism, Regional P. Regional S, or Noise) for data recorded by 3-component stations or arrays. This is an extension of the 2-class (P or S) neural network that we developed for 3-component stations (Patnaik and Sereno, 1991). The input data are dominant period, polarization attributes, contextual information (e.g., measurements related to a group of arrivals), a spectral representation of the horizontal-to-vertical power ratio, and the slowness determined by f-k analysis for array stations. We used a three-staged approach, and each stage consists of a 2-class neural network. The first state separates signal from noise. The signals are passed to the second stage which separates regional S phases from regional P phases and teleseisms. The regional P phases and teleseisms are passed to the final stage which separates them into two distinct classes. A three-layer backpropagation neural network is used at each stage. Neural networks were trained for six 3-component IRIS/IDA stations in the CIS, and a 4-element micro-array in Kislovodsk. The identification accuracy of the neural networks is >90% for most of the stations that we tested. The neural network module was integrated into the Intelligent Monitoring System (IMS), and it was applied to the 3-component IRIS/IDA data under simulated operational conditions. The result was a reduction in the number false-alarms produced by the automated processing and interpretation system by about 60%.

ARPA-013
TITLE: (U) Knowledge-Based Interpretation of Seismic Data in the Intelligent Monitoring System

SPONSOR: ARPA OCT-93
PERFORMING ORGANIZATION: Science Applications International Corp.
RELATED TABLES: C3

(U) The Intelligent Monitoring System (IMS) provides a new capability for automated and interactive analysis of data to detect and locate seismic events recorded by a network of seismic stations. IMS integrates emerging technologies in artificial intelligence, database management, computer graphics, and distributed processing into an operational system used for routine bulletin production and associated research tasks. The first version of IMS (Bache et al., 1990a,b; Bratt et al., 1990) was designed for detection and location of regional events recorded by the two high-frequency arrays in Norway (NORESS and ARCESS). This has been extensively revised and expanded to become IMS Version 2 which is designed to detect and locate all seismic events recorded by an arbitrary seismic network. Since March 1991, it has been operated continuously to process the data from four high-frequency arrays (adding FINESA in Finland and GERESS in Germany). For some periods data from as many as seven 3-component stations in Eurasia have also been included in the processing. The most important new element is ESAL (Expert System for Association and Location) which interprets signal detections to form and locate seismic events. It is programmed in the ART expert system shell which provides the knowledge representation framework and inference mechanisms for complex and knowledge-rich rule-based reasoning. The current version of ESAL represents knowledge through approximately 200 ART rules that are configured through about 300 use-specified parameters and tables. The IMS architecture and operational procedures are designed to facilitate acquisition of new knowledge for ESAL. Knowledge acquisition methods being used include: Bayesian analysis, training neural-nets, statistical analysis to estimate parameters configuring rules, computing fuzzy-logic membership functions, and formulating new rules. Only the Bayesian probabilities are discussed in detail here. They provide a compact representation of complex knowledge about station-specific differences in phase characteristics. As an example, we describe the rules used for automated identification of detected regional Sn, Lg, and Rg phases. Using a Bayesian analysis technique, we quantify the differences in S-phase characteristics. The data shows that they fall into two classes with GERESS distinct from the three Fennoscandia arrays.

ARPA-017
TITLE: (U) Simultaneous Inversion of Explosion Size and path Attenuation Parameter with Crustal Phases.
Document # TGAL-92-11

SPONSOR: ARPA JAN-93
PERFORMING ORGANIZATION: Teledyne
RELATED TABLES: C2

(U) This is our second semi-annual technical report prepared under DARPA contract F29601-91-C-DB23. It summarizes the research conducted during April-October 1992. An iterative procedure is developed to invert for the path g and the event mb (Lg) values simultaneously without using any a priori path g information. This joint inversion scheme can be applied to data from multiple test sites as well. With this iterative method, it is rather easy to incorporate the appropriate boundary condition into the inversion. The iterative scheme is less sensitive to rounding errors, and hence it is numerically more accurate than those direct methods based on matrix factorization or Gaussian elimination. When the number of equations becomes large, the iterative method is often the only practical means to tackle the problem. The necessity of incorporating an extra boundary condition is also reviewed in this report. This joint inversion scheme is a natural extension to crustal phases of the one we used in the mb analyses. We have tested this joint inversion scheme with Nuttli s Semipalatinsk mb(Lg) data set recovered by ARPA/NMRO. The result indicates that the majority of Qo values Nuttli used in his pioneering Lg study are very good except for the path from Eastern Kazakh to COP (Copenhagen, Denmark). An 8% increase in Nuttli s postulated coefficient of anelastic attenuation, Qo, for this particular path is necessary. Overall, Nuttli s (1986b, 1987) mb(Lg) data set for Semipalatinsk explosions appears to have very good quality with a standard deviation (of single observation) of only 0.1 magnitude unit.

ARPA-018
TITLE: (U) Statistical Chracterization of Rugged Propagation Paths with Application to Rg Scattering Study.
Document # TGAL-93-07

SPONSOR: ARPA NOV-93
PERFORMING ORGANIZATION: Teledyne
RELATED TABLES: C3

(U) An accurate prediction of the regional phases due to explosion sources in areas of high proliferation concern requires a decent understanding of the attenuation/scattering mechanisms along the propagation paths. Motivated by many observations of correlation between the free-surface topography and the coda generation at teleseismic and regional distances, seven simple statistics have been presented and analyzed in this study to test whether they can fully characterize the roughness of an arbitrary rugged freesurface topography. The definitions of these parameters are very natural, and some of parameters might be suitable to quantify the roughness of realistic profiles. The normalized arc length and Durbin-Watson number (von Neumann ratio) are identified as the best and the poorest, respectively, roughness measures, in terms of correlating with the propagation behavior of Rg. 2-dimensional finite-difference simulations are then conducted to investigate short-period Rayleigh wave scattering by these 27 topographic profiles The numerical experiments show that rougher topography causes stronger attenuation (as expected), that reflection is an efficient process, and that the bulk of the energy which is not transmitted across the topography is either converted to body waves or reflected back. The scattered P and S waves are radiated as coda to teleseismic distances and some P-SV energy is trapped in the crustal waveguide as Pg, Sg, and Lg. The body waves appear to radiate from the changes in slope and to first order can be visualized as from point diffractors along the rugged free-surface. For most models tested in this study, the Rg-to-S conversion is more efficient than that of Rg-to-P. particle motion plots of the scattered body waves can help to illustrate this point too. The displacement synthetics of the scattered body waves, which makes the synthetics can be compared easily. This approach is more convenient than another one which presents the scattered wavefield in strain units. The spatial Q values associated with rough topographic profiles, inferred from the logarithm of the transmitted power spectrum, range from 15 to 80, which are in excellent agreement with the Qb of the uppermost crust in many places of the world. Regression results also suggest that both the attenuation coefficient, g, and the scattering loss can be represented as linear functions of the roughness parameters. This work offers a promising approach to quantify effects of scattering by topography and heterogeneity upon other regional phases.

ARPA-022
TITLE: (U) Seismic Propagation in South Central Siberia; Baikal 1991 Seismic Array Project Data Report

SPONSOR: ARPA JAN-93
PERFORMING ORGANIZATION: Univ of California in Los Angeles
RELATED TABLES: C3

(U) During July 7 to October 5, 1991 UCLA, U. of Wisconsin (UW), the Institute of the Earth s Crust of the Russian Academy of Sciences, Irkutsk and the Institute of Physics of the Earth, Moscow, conducted a joint seismic array study in the territory of the Baikal rift zone, 26 seismic stations (10 PASSCAL Reftek and 16 UW recorders) were installed about lake Baikal. The UCLA filed trip team installed and operated the 10 Reftek stations. All of the stations were equipped with 1 Hz 3-D sensors and five of the stations were co-sited with broadband (4 Guralp and 1 STS2) seismometers. All seismographs synchronize internal clocks to signals from the Omega navigation system (locked to either Norway or Japan) which ensured that the timing error for most of the data was less than 2 ms. This report provides information needed for others to use this unique data set recorded by the 10 UCLA Reftek stations during July to October 5, 1991.

ARPA-023
TITLE: (U) Characterization of Regional Phase Propagation in Eurasia Using Data from Historic Nuclear Explosions in the U.S.S. R

SPONSOR: ARPA DEC-93
PERFORMING ORGANIZATION: University of California in Santa Cruz
RELATED TABLES: C3

(U) P/Lg amplitude ratios are the most promising regional distance seismic discriminants. However, strong path effects on the ratios have so far restricted their use to nearly common propagation paths. Reduction in P/Lg variance by correcting this ratio for empirically derived propagation effects may remove the restriction of common paths for explosion and earthquake data. This would greatly enhance the possibility of discrimination in the context of non-proliferation monitoring, where no prior explosion population may be available. We use four different data sets characterizing gross crustal properties in Eurasia: surface topography, crustal thickness, sediment thickness, and attenuation, to examine path influences on P/Lg ratios from historic explosions and recent earthquakes in Eurasia. After a statistical treatment of the data, we obtain a model which involves two independent variables, path attenuation and sediment thickness. Using this model to correct observed p/Lg measurements reduces the variances for separate earthquake and explosion data by 40% and 27% respectively. This slightly enhances the performance of the discriminant for periods near 1 second.

ARPA-024
TITLE: (U) Lg Propagation in Eurasia

SPONSOR: ARPA JUN-93
PERFORMING ORGANIZATION: University of California in Santa Cruz
RELATED TABLES: C3

(U) The objective of this research effort was to conduct theoretical and observational investigations of the Lg phase at regional distances in Eurasia. The primary focus of the work was on explaining the variations observed in RMS Lg signals for different paths. The principal data-base used was the JVE exchange data of digitized regional phases of underground explosions in the Semipalatinsk and Novaya Zemlya test sites recorded by Soviet stations in Eurasia. Broadband digital recordings of recent events were also utilized. Three basic problems have been addressed. The first involves the variability of yield scaling of RMS-Lg measurements on different paths in Eurasia. Theoretical and observational analysis establishes that this results from a combination of frequency-dependent yield-scaling of the Lg source function and the bandlimiting properties of propagation on different paths. The second problem involves the fundamental excitation of Lg from underground explosions, with numerical modeling being used to demonstrate the relative importance of S*, scattering, spall and wave conversions in the crustal waveguide. The third effort was to empirically explore the effects of along-path surface topography on regional distance signals, with the underlying idea being that waveguide properties that control the regional phases may be manifested in along-path topography. In fact, strong correlations are found between the Sn/Lg ratio and statistical measures of the roughness of topography on each path. This raises the possibility of reducing scatter in seismic discriminants by accounting for path effects.

DNA-001
TITLE: (U) A Study of Detector Utility in the Chemical Weapons Convention. Document # DNA-TR-92-125

SPONSOR: DNA 1-JUN-93
PERFORMING ORGANIZATION: Battelle Memorial Institute
RELATED TABLES: E1

(U) The study used expert opinion to assess the capability of remote and point chemical detectors which might be available by CWC treaty entry into force to practically detect vapor or aerosol emissions and provide reliable evidence of a violation of that treaty. The study concluded that vapor and aerosol emission concentrations of interest were lower than near-term available real-time remote and point detection and analysis capabilities. Further, practical detection of such emissions from a batch process was determined to be fortuitous. As a result of the analysis it was recommended that investments be directed towards discrete sampling techniques.

DNA-006
TITLE: (U) CWC Inspector Functions, Qualifications and Certification. Document # DNA-TR-93-17

SPONSOR: DNA 1-JUL-93
PERFORMING ORGANIZATION: BDM Federal, Inc.
RELATED TABLES: E1

(U) This report examines issues related to the functions, hiring qualifications, and training of inspection personnel under the final draft Chemical Weapons Convention (CWC) (dated September 1992, CD/1173). It updates a 1991 BDM analysis based on the August 1991 CWC Rolling Text (CD/1108) and published as DNA TR-92-21, Examination of the Functions, Qualifications, and Training of Inspectors for the CWC. This report includes a comparison of CD/1173, and the Bilateral Destruction Agreement.

Based on the examination of these issues, the report recommends the OPCW: (1) establish relatively high selection standards for basic techical competence and select personnel based on job experience and education; (2) divide inspection functions into a limited number of broad specialties: Team Chief, Chemical Weapons Stockpile, Chemical Process and Biotoxin Inspectors; and Sample Analysis, Medical, Monitoring and General Support Inspection Assistants; (3) hire a contractor to develop courses and instruct the initial cadre of inspection personnel; and (4) adopt and manage a formal, multilevel certification program.

DNA-007
TITLE: (U) Chemical Weapons Convention Inspections of Private Facilities Application of United States Environmental and Safety Laws. Document # DNA-TR-93-70

SPONSOR: DNA 1-NOV-93
PERFORMING ORGANIZATION: BDM Federal, Inc.
RELATED TABLES: E1

(U) The on-site inspection provisions of the Chemical Weapons Convention (CWC) must be executed in compliance with legal obligations to protect the environment and public safety. Federal implementing legislation can expedite fulfillment of these obligations in accord with domestic statutory requirements. CWC sampling activities will likely invoke the application of the primary environmental and safety statutes in the United States. These include: the Clean Air Act, the Clean Water Act, the Resource Conservation and Recovery Act, the Emergency Planning and Community Right to Know Act, the Comprehensive Environmental Response, Compensation and Liability Act, the Occupational Safety and Health Act, and the Hazardous Materials Transportation Act.

Perhaps the most complex environmental and safety issue to be faced in the CWC "implementing legislation" is the role that state and local regulations and regulators should play in the inspection process. Congress can ensure that verification activities are conducted in accord with national environmental and safety standards by selecting from a broad range of options, and pursuing three integrated policies: (1) maximizing CWC compliance; (2) minimizing burdens on facility owners; and (3) clarifying the role of state and local interests.

DNA-008
TITLE: (U) Tagging Applications for the Wyoming Memorandum of Understanding. Document # DNA-TR-93-19

SPONSOR: DNA 1-JUL-93
PERFORMING ORGANIZATION: BDM Federal, Inc.
RELATED TABLES: E3

(U) This report describes the testing and evaluation results of tags and seals suggested for support to the Wyoming MOU/Bilateral Destruction Agreement. Tag/Seal evaluated were: Reflective Particle Tag (RPT-2), Secure Loop Inspectable Tag/Seal (SLITS), Cobra II, and Tamper Tape.

DNA-009
TITLE: (U) Acoustic Resonance Spectroscopy in CW Verification Tooele Field Trial (August 1992). Document # DNA-TR-93-84

SPONSOR: DNA 1-NOV-93
PERFORMING ORGANIZATION: Electronic Mat'ls & Device Research
RELATED TABLES: E1

(U) This report describes the Acoustic Resonance Spectroscopy (ARS) technique and details the various aspects of the NDE field trials carried out during August 1992 at the Tooele Army Depot in Utah. Test results for approximately 750 items including both conventional and chemical munitions are presented. The report also identifies various software and hardware modifications necessary to enhance the capabilities of the ARS system.

DNA-012
TITLE: (U) Task 1 Report; Target Vapor Identification and Database Development. Document # DNA-TR-92-128

SPONSOR: DNA
PERFORMING ORGANIZATION: General Research Corporation
RELATED TABLES: E1

1-JUL-93

(U) This report covers "Task 1: Target Vapor Identification and Database Development" for the program "Development of a Handheld Chemical Detector Using Microchip GC." The study described in this report addresses the performance requirements for the concept handheld instrument for vapor detection of CW-related material using microchip GC. Included in this study is a survey of the volatiles and semivolatiles included in Schedules 1, 2 and 3 from the draft convention for CW treaty verification. The concept approach and estimated operational requirements are discussed with respect to these materials. Experimental measurements are presented using representative schedule materials and simulants for volatile and semivolatile CW agents in Schedule 1. These measurements demonstrate the desired chemical selectivity required for the concept instrument and "bracket" the chromatographic performance requirements. Instrument operation in two regimes is likely to be required in the concept instrument based upon these results. A likely instrument configuration would contain two small, fast GC modules operated at different temperatures, and each module performing highly selective chemical identification through correlated gas chromatography.

DNA-013
TITLE: (U) Task 2 Report; Algorithm Development and Performance Analysis. Document # DNA-TR-92-196

SPONSOR: DNA
PERFORMING ORGANIZATION: General Research Corporation
RELATED TABLES: E1

1-JUL-93

(U) This report covers "Task 2: Algorithm Development and Performance Analysis," for the program "Development of a Handheld Chemical Detector Using Microchip GC." The study described in this report addresses the algorithmic performance requirements for the concept handheld instrument for vapor detection of CW-related materials using microchip GC. Included in this report are example signal processing and algorithmic analyses using actual microchip GC data. An overall algorithmic approach for the concept handheld CW detection instrument is developed and presented. Approaches investigated in this study include: pre-processing of chromatograms by different smoothing methods; the application of various peak detection methods; chromatographic correlations using CW data reference tables; and algorithms for merged peak analysis. To best illustrate the robustness of the recommended approach, our signal processing approach is successfully applied to several microchip GC data sets which confound existing methods.

DNA-014
TITLE: (U) The Cost Processor System Treaty Verification Program User's Guide. Document # DNA-TR-92-70

SPONSOR: DNA
PERFORMING ORGANIZATION: Institute for Defense Analyses
RELATED TABLES: B0,D0,E1

1-FEB-93

(U) The planning and implementation of arms control agreements requires management and budgeting oversight not unlike that for any other defense program. The projected advent of nuclear, conventional, and chemical prevention treaties heightens the utility of computerized tools structured to facilitate arms control management. The prototype system documented in this report has evolved from discussions with various DOD organizations responsible for various aspects of the arms control process: cost processor engine, cost processor system, database management system, budgeting, arms control, and management.

DNA-015
TITLE: (U) The Costs and Effectiveness of Treaty Verification Regimes. Document # DNA-TR-92-69

SPONSOR: DNA
PERFORMING ORGANIZATION: Institute for Defense Analyses
RELATED TABLES: A1,A2

1-JAN-93

(U) Methodologies for examining the cost/effectiveness of verification regimes for arms control agreements are presented with an example application for the Strategic Arms Reduction Treaty. Factors considered include estimates of noncompliance for the inspected party, the capabilities of national technical means, aerial inspections, and on-site inspections. The possibilities of erroneous inspection results are included in the analysis. Three different measures of effectiveness are discussed that characterize different aspects of what can be known about sites subject to inspection based on what is observed during inspection.

DNA-020
TITLE: (U) Compliance Monitoring for the Chemical Weapons Convention Preliminary Operational Concepts--An Adversarial Analysis. Document # DNA-TR-92-173

SPONSOR: DNA 1-JUL-93
PERFORMING ORGANIZATION: JAYCOR
RELATED TABLES: E1

(U) The objective of this report is to assess preliminary operational concepts developed by the U.S. Army Chemical Research, Development and Engineering Center (CRDEC). The "Adversarial Analysis Methodology for the Chemical Weapons Convention," developed by the JAYCOR Team, provides a conceptual framework and criteria for this assessment. Adversarial analysis (AA) complements the CRDEC methodology by accounting for noncompliance activities and includes risk and vulnerability analyses as well as a politico-strategic assessment of potentially noncompliant nations.
CRDEC highlights many difficulties, flaws, and discrepancies in the formal CWC verification regime. AA helps overcome these shortcomings. First, it identifies how an adversary might accomplish cheating, spoofing, and circumvention (CSC), including underlying motivations and objectives. Second, it highlights potential verification system vulnerabilities that would permit CSC. Finally, it assesses the impact of such activities qualitatively and quantitatively. The end product of this approach is a vulnerability assessment report describing the potential effectiveness of various deceptive practices and recommendations for improving the verification regime's resistance to deception.

DNA-021
TITLE: (U) Iraq Inspections-Lessons Learned. Document # DNA-TR-92-115

SPONSOR: DNA 1-JAN-93
PERFORMING ORGANIZATION: JAYCOR
RELATED TABLES: D5

(U) United Nations (UN) Resolution 687 established the basis for inspections of Iraq's nuclear, chemical, biological and ballistic weapons programs. This study, conducted under DNA's ongoing adversarial analysis program, assesses lessons learned from the UN Special Commission (UNCOM) inspections for the implementation of future and ongoing arms control treaties. Lessons learned are divided into two categories: (1) camouflage, concealment and deception, and other means of obstruction that might undermine the effectiveness of on-site inspections (OSI) and (2) general lessons on the implementation of OSI, including organization, logistics, etc.

DNA-022
TITLE: (U) Minimal Military Significant Quantity of CW Agent. Appendix A--Scenario 1 (Document # DNA TR-91-193-Ap-A); Appendix B--Scenario 2 (Document # DNA TR-91-193-Ap-B). Document # DNA TR-91-193-Ap-A

SPONSOR: DNA 1-SEP-93
PERFORMING ORGANIZATION: JAYCOR
RELATED TABLES: E1

(U) Verification of the CWC requires the knowledge of the quantity of CW agent that would constitute a military significant hazard. The objective of this report is to use a scenario to assess the minimal chemical agent requirement for a military conflict, thus enabling a more effective verification regime. Based on the assessment of realistic scenarios, the use of chemical agents might have a decisive influence on the outcome of a battle. Quantitities of agent required are on the order of 100 tons in an offensive or less than 30 tons in a defensive scenario.

DNA-023
TITLE: (U) Support of TTBT Protocol and Development of HYDRO PLUS Yield Verification Procedures. Document # DNA-TR-91-117

SPONSOR: DNA 1-FEB-93
PERFORMING ORGANIZATION: JAYCOR
RELATED TABLES: C0

(U) This report contains the specific contributions made by JAYCOR in support of DNA's activities associated with the verification of horizontal standard and non-standard underground nuclear tests.

DNA-024
TITLE: (U) VACOSS S Test Data Results. Document # DNA-TR-92-172

SPONSOR: DNA 1-SEP-93
PERFORMING ORGANIZATION: JAYCOR
RELATED TABLES: A0

(U) The JAYCOR Team implemented the VAriable COde Seal System Series (VACOSS S) Test Plan from July 27 to August 6. The testing was conducted at the JAYCOR laboratory facility located in Albuquerque, New Mexico. Using the Adversarial Analysis (AA) methodology, test areas were designed to examine VACOSS S for "high reliability, long duration surveillance in those applications requiring periodic access." The test areas are based on generic adversarial capabilities to conduct Cheating, Spoofing and Circumvention (CSC) and "human-induced" environmental defeat efforts.
This report presents the data compiled during test implementation. The specific procedures associated with the test areas are located in Task 3.

DNA-029
TITLE: (U) Technical Ramifications of Inclusion of Toxins in the Chemical Weapons Convention (CWC). Document # DNA-TR-92-116

SPONSOR: DNA 1-FEB-93
PERFORMING ORGANIZATION: US Army Medical Research Institute
RELATED TABLES: E1

(U) The purpose of this report is to provide a discussion of the technical aspects of toxins and the implications of their inclusion in the Chemical Weapons Convention. Toxins are addressed in terms of their physical and biological characteristics, their historic use as weapons, and their widespread use in science and medicine for legitimate purposes.

A supplement (Aug 93, Document # DNA-TR-92-116-SUP) provides a discussion of the technical aspects of biological mediators (bioregulators) and the implications of their inclusion in the Chemical Weapons Convention. Mediators are addressed in terms of their physical and biological characteristics and their widespread use in research and medicine for legitimate purposes. The report contains 78 pages and 193 references.

DOE-001
TITLE: (U) Associated-Particle Sealed-Tube Neutron Probe for Characterization of Materials. Document # ANL-81431

SPONSOR: DOE OCT-93
PERFORMING ORGANIZATION: Argonne National Laboratory
RELATED TABLES: A2,A6,D1

(U) A relatively small and inexpensive neutron diagnostic probe system has been developed that can identify and image most elements having a larger atomic number than boron. It has the potential to satisfy van-mobile and fixed-portal requirements for nondestructive detection of contraband drugs, explosives, and nuclear and chemical warfare weapon materials, and for treaty verification of sealed munitions and remediation of radioactive waste. The probe is based on a unique non-pulsed associated-particle sealed-tube neutron generator (APSTNG) that interrogates the object of interest with a low-intensity beam of 14-MeV neutrons generated from the deuterium-tritium reaction and detects the alpha-particle associated with each neutron. Gamma-ray spectra of resulting neutron reactions (primarily inelastic scattering) identify nuclides associated with drugs. explosives, and other contraband. Flight times determined from detection times of the gamma-rays and alpha-particles yield a separate coarse tomographic image of each identified nuclide. Chemical substances are identified and imaged by comparing relative spectral line intensities with ratios of elements in reference compounds. The high-energy neutrons and gamma-rays will penetrate large objects and dense materials. The source and emission detection system can be located on the same side of the interrogated volume, allowing measurements with access to one side only. A relatively high signal-to-background ratio is obtained and maximum information is extracted from each detected gamma-ray, yet high-bandwidth data acquisition is not required. The APSTNG also forms the basis for a compact fast-neutron transmission imaging system. No collimators for the source or detectors are required, and only minimal personnel radiation shielding is needed. The small and relatively inexpensive neutron generator tube exhibits high reliability and can be quickly replaced. The detector arrays and associated electronics can be made reliable with low maintenance cost. Surveillance systems based on APSTNG technology can avoid the large physical size, high capital and operating expenses, and reliability of complex accelerators.

DOE-006
TITLE: (U) A Preliminary Examination of Alternative Sampling Schemes for the Verification of a Small Gaseous Diffusion Cascade. Document # SSN-93-25

SPONSOR: DOE SEP-93
PERFORMING ORGANIZATION: Brookhaven National Laboratory
RELATED TABLES: D4

(U) The statistical characteristics of two types of inspector sampling schemes for material accountancy verification of a small gaseous diffusion cascaded are examined. The cascade is made up of C cells with S stages per cell. In the first scheme, a fixed number of stages are randomly chosen from the population of S stages in each cell; in the second scheme, a fixed number of cells are chosen randomly from the population of C cells, and all stages within this cell are selected; the selected stages are measured by the inspector. The sources of uncertainty are measurement error and the estimation of the distribution of solid holdup by the operator. Appropriate statistics for the two cases are analyzed, and their expected values and variances calculated.

DOE-007
TITLE: (U) Application of Resonance Raman LIDAR for the Remote Detection of Effluents. Document # BNL-48189; SSN-92-21

SPONSOR: DOE MAR-93
PERFORMING ORGANIZATION: Brookhaven National Laboratory
RELATED TABLES: D1

(U) The technology of Resonance Raman spectroscopy as applied to the remote detection of effluents are addressed. Resonance Raman (RR) spectroscopy potentially possesses many of the characteristics of an ideal verification technology. These ideas are (1) very high selectivity and specificity to allow the deconvolution of a mixture of the chemicals of interest, (2) high sensitivity in order to measure a species at trace levels, (3) high reliability and long-term durability, (4) applicability to a wide range of chemicals (closely associated with i), (5) capability for sensing in a variety of environmental conditions, (6) independence of the physical state of the chemical, (7) capability for quantitative analysis, and (8) capability for full signal development within seconds (response speed). The RR spectroscopic results which can be applied to the remote detection/identification of CW-relevant chemicals are discussed. The basic principles behind this technique, both theoretical and experimental, are reviewed along with some recent results obtained in the laboratory. In addition, the potential of a RR based LIDAR system are examined. Finally, the application of this technology to other detection activities are also discussed.

DOE-008
TITLE: (U) Application of Resonance Raman Spectroscopy as a Nuclear Proliferation Detection Technology. Document # BNL-48453; SSN-92-22

SPONSOR: DOE JUN-93
PERFORMING ORGANIZATION: Brookhaven National Laboratory
RELATED TABLES: D1,D2

(U) Resonance Raman spectroscopy (RRS) potentially possesses many of the characteristics of an ideal verification technology. Some of these ideal traits are: (1) very high selectivity and specificity to allow the deconvolution of a mixture of the chemicals of interest, (2) high sensitivity in order to measure a species at trace levels, (3) high reliability and long-term durability, (4) applicability to a wide range of chemicals (closely associated with 1), (5) capability for sensing in a variety of environmental conditions, (6) independence of the physical state of the chemical, (7) capability for quantitative analysis, and (8) capability for full signal development within seconds (response speed). The potential of RRS as a detection/identification technology for chemicals pertinent to nuclear materials production and processing are assessed. A review of the basic principles behind this technique, both theoretical and experimental, are discussed along with some recent results obtained in the laboratory.

DOE-009
TITLE: (U) Basic Nuclear Material Control and Accountability Concepts as Might be Applied to Uranium from the U.S.-Russian HEU Purchase. Document # SSN-93-27

SPONSOR: DOE SEP-93
PERFORMING ORGANIZATION: Brookhaven National Laboratory
RELATED TABLES: D8

(U) Nuclear material control and accounting and physical protection systems are designed to deter, prevent, detect, or respond to unauthorized possession, use, or sabotage of nuclear materials. This article presents a brief summary of material control and material accounting fundamentals, followed by a synopsis of appropriate materials accounting and materials control system components that might be involved in the U.S.-Russian HEU to LEU (highly enriched uranium to low-enriched uranium) process.

DOE-014
TITLE: (U) Nuclear Materials Control and Accounting and Physical Protection : Components Review for the Urals Electrochemical Integrated Enterprise. Document # SSN-93-31

SPONSOR: DOE OCT-93
PERFORMING ORGANIZATION: Brookhaven National Laboratory
RELATED TABLES: A6,D8

(U) The U.S. has entered into a long-term agreement to purchase from the Russian Federation at least 500 metric tonnes of highly enriched uranium (HEU) extracted from nuclear weapons. The HEU will be converted from metal to oxide to hexafluoride at the Russian facility at Sverdlovsk (formerly known as Sverdlovsk-44), now called the Urals Electrochemical Integrated Enterprise (UEIE). The HEU will be blended as hexafluoride with low-enriched uranium (LEU) hexafluoride blend-stock to 4.4% U-235 LEU. The LEU will be transported by rail to St. Petersburg, Russia, where the U.S. will take possession. The purchase agreement stipulates that nonproliferation, physical protection/security (PP), nuclear material control and accounting (MC&A), and environmental requirements of the parties be fulfilled via "appropriate measures", and that the parties shall establish "...transparency measures to ensure that the objectives of this Agreement are met, including provisions for material accounting and control and access, from the time that HEU is made available for conversion until it is converted into LEU". This report has been prepared as a foundation document on which U.S. assistance to Russians on MC&A and physical protection at UEIE would be based. It provides a detailed description of nuclear materials accounting, control, and physical protection components which would be needed for an effective safeguards system at UEIE.

DOE-015
TITLE: (U) Open Skies : Facilitating the many dimensions of transparency. Document # SSN-93-13; BNL-48581

SPONSOR: DOE 28-JUN-93
PERFORMING ORGANIZATION: Brookhaven National Laboratory
RELATED TABLES: B3

(U) The Treaty on Open Skies was signed on 24 March 1992 by 23 European nations in addition to the United States and Canada. Unlike other arms control treaties which prohibit specific weapons or weapon systems, Open Skies is intended to provide, in the words of its preamble, means "to facilitate the monitoring of compliance with existing or future arms control agreements". In addition, its objectives include the "improvement of openness and transparency for conflict prevention and crises management in the framework of the Conference on Security and Cooperation in Europe and in other relevant international institutions". The preamble also alludes to the possible extension of the Open Skies regime into additional (non-arms control) fields, such as environmental protection. Not mentioned is an objective which the treaty would appear to strive to attain: to equalize to some degree the ability of nations to obtain intelligence deemed essential to their national security. This is in fact the case since it provides such means to signatories which otherwise do not have direct access to advanced information gathering technology. "Open Skies" also contributes to monitoring or treaty verification by providing an instrument for cuing further investigation of information which might indicate impending treaty violation. Thus, while appearing unfocussed from a monitoring or treaty verification point of view, Open Skies represents substantial progress toward facilitating transparency.

DOE-016
TITLE: (U) Proliferation Detection Using a Remote Resonance Raman Chemical Sensor. Document # BNL-49247; SSN-93-10

SPONSOR: DOE JUL-93
PERFORMING ORGANIZATION: Brookhaven National Laboratory
RELATED TABLES: D1,E1

(U) This report introduces the optical technique of resonance Raman spectroscopy for the remote detection, monitoring, identification and verification of proliferant effluents relevant to the production of weapons of mass destruction. A resonance Raman chemical sensor is an improvement on many technologies in that optical fingerprints are at the heart of Raman spectroscopy. Fingerprinting has the advantage that no prior knowledge is required to which chemicals are to be interrogated, and because the optical signature is species-specific. Resonance Raman spectroscopy can offer the fingerprinting advantage coupled with high sensitivity for trace analysis, providing a very powerful technique for detecting, identifying, monitoring, and, in the case of destruction, verifying many classes of chemicals.

DOE-021
TITLE: (U) FY-92 Noncontacting Acoustic Ultrasonic Signature Analysis (NAUSA) Development and Equipment Field Trials. Document # EGG-MS-10665

SPONSOR: DOE FEB-93
PERFORMING ORGANIZATION: Idaho National Engineering Laboratory
RELATED TABLES: E1

(U) The identity of fill material in munitions and other types of containers is important for operations in which either appropriate disposal or treaty compliance is an issue. A noncontacting, long-standoff inspection system with proven capabilities in container fill identification has been under development at the Idaho National Engineering Laboratory. The system detects subtle changes in container vibration characteristics due to variations in the physical properties of different fill materials. The response of containers to acoustic excitation is measured with a laser vibrometer. A standoff distance of several meters is feasible. Infield trials at the Tooele Army Depot, the inspection system proved to be a practical and reliable means of distinguishing between munitions with a variety of chemical fills. Research was conducted in excitation methods that would permit longer standoff distances, approaches for concentrating acoustic energy in air, and exciting structural resonances using a high-powered pulsed laser.

DOE-022
TITLE: (U) FY-93 Preliminary Adversarial Assessment of the SNL Prototype Python Tag/Seal. Document # INEL-SP-340

SPONSOR: DOE NOV-93
PERFORMING ORGANIZATION: Idaho National Engineering Laboratory
RELATED TABLES: D1,D4,D8,A3

(U) This report describes the results of a preliminary vulnerability assessment of the Sandia National Laboratory designed, high-security Python tag/seal prototype technology.

DOE-023
TITLE: (U) Gamma-Neutron Threshold (GNT) Technology: Demonstration System Summary Report. Document # INEL-SP-343

SPONSOR: DOE DEC-93
PERFORMING ORGANIZATION: Idaho National Engineering Laboratory
RELATED TABLES: D1,D4

(U) This report describes an active, electron accelerator-based, interrogation system, referred to as the Gamma-Neutron Threshold (GNT) technology. The system consists of a variable-energy (2-10 MeV), pulsed, electron accelerator which produces energetic X-rays. The energetic X-rays have high penetrability in most most materials and result in neutron production via the photoneutron and photofission interactions. The time-dependent neutron emissions (or signature), as a function of the electron beam energy and time after each accelerator pulse, is measured with a tripod-mounted detector and portable data acquisition system. The report describes each component of the system, identifies the operational requirements of the system, presents signature results from various experimental applications, and identifies the minimum detectible limits.

DOE-024
TITLE: (U) Imaging System (INEL) T805 Prototype Status Report. Document # EGG-EE-10723

SPONSOR: DOE MAR-93
PERFORMING ORGANIZATION: Idaho National Engineering Laboratory
RELATED TABLES: B3

(U) This is a description of the hardware, software, and algorithms used in an Automatic Target Recognition system. The ATR system is designed to rapidly scan large amounts of multi-sensor image data and identify those scenes with "targets". The report gives two simple examples of the use of the system, and it quotes speeds for typical image analysis operations. Also, Evaluation Plan (Sep 93, Document # EGG-EE-10899).

DOE-030
TITLE: (U) STAR Tag/Seal Adversarial Assessment: Final Report. Document # INEL-SP-332

SPONSOR: DOE JUN-93
PERFORMING ORGANIZATION: Idaho National Engineering Laboratory
RELATED TABLES: D1,D4,D8,A3

(U) This report describes the results of a final vulnerability assessment of the Lawrence Livermore National Laboratory-designed, high-security STAR tag/seal technology.

DOE-031
TITLE: (U) Volume 1: Technical Specifications Manual for the Mark-1 Pulsed Ionizing Radiation Detection System. Document # WINCO-1121

SPONSOR: DOE MAR-93
PERFORMING ORGANIZATION: Idaho National Engineering Laboratory
RELATED TABLES: A5,A4

(U) The technical report describes a portable system (MARK-1) for the detection and analysis of intense photon emissions from pulsed ionizing radiation systems. The report presents the technical design specifications for the MARK-1 detection system and is written primarily to assist the support or service technician in the service, calibration, and repair of the system.

DOE-032
TITLE: (U) Volume 3: Experimental Applications for the MARK-1 and MARK-1A Pulsed Ionizing Radiation Detection Systems. Document # WINCO-1166

SPONSOR: DOE DEC-93
PERFORMING ORGANIZATION: Idaho National Engineering Laboratory
RELATED TABLES: A5,A4

(U) The technical report decribes the experimental applications of the developed, portable system (MARK Series) for the detection and analysis of intense photon emissions from pulsed ionizing radiation systems. The report describes the MARK-1A detection system, compares it to the previous design - the MARK-1 system, and describes the experimental testings of the detection system.

DOE-033
TITLE: (U) A Role for On-Site Chemical Analysis to Support CWC Inspections. Document # UCRL-JC-113871

SPONSOR: DOE 19-MAY-93
PERFORMING ORGANIZATION: Lawrence Livermore National Laboratory
RELATED TABLES: E1

(U) With the signing of the Chemical Weapons Convention (CWC in January 1993, a major portion of the world s nations entered into a joint endeavor to rid mankind of the threat of attack by these weapons of mass destruction. The CWC, when it enters into force, will be unique among arms control treaties in the detail of its verification provisions. Each of the treaty provisions will, at least in principle, be monitored by on-site inspections managed by the Director General (DG) and staffed by the Technical Secretariat (TS) of the International Organization for the Prohibition of Chemical Weapons (OPCW). Inspections can be viewed as falling into two general categories: ROUTINE and CHALLENGE. The goal of these inspections is to verify compliance with the provisions of the CWC.

DOE-034
TITLE: (U) Allocating Resources for Monitoring Nuclear Testing by Potential Proliferators. Document # UCRL-ID-113966

SPONSOR: DOE JUN-93
PERFORMING ORGANIZATION: Lawrence Livermore National Laboratory
RELATED TABLES: C3,D1

(U) In order to address the detection and attribution of a clandestine nuclear test and to resolve false indications of a test, this paper provides a framework for optimizing the allocation of nuclear monitoring resources among potential proliferations and physical environments and for setting priorities for R & D aimed at enforcing the capabilities.

DOE-039
TITLE: (U) DOE/LLNL Verification Symposium on Techniques for Monitoring Nuclear Tests Related to Weapons Proliferation. Document # UCRL-MI-111683

SPONSOR: DOE MAY-93
PERFORMING ORGANIZATION: Lawrence Livermore National Laboratory
RELATED TABLES: A0,D0

(U) Several experts in monitoring technology presented invited talks assessing the status of monitoring technology with emphasis on the deficient areas requiring more attention in the future. In addition, several speakers discussed proliferation monitoring technologies being developed by the DOE's weapons laboratories.

DOE-040
TITLE: (U) Differences in Coupling Between Chemical and Nuclear Explosions. Document # UCRL-JC-109448

SPONSOR: DOE FEB-93
PERFORMING ORGANIZATION: Lawrence Livermore National Laboratory
RELATED TABLES: C1,C2,C3

(U) The teleseismic amplitude resulting from an underground explosion is proportional to the asymptotic value of the reduced displacement potential (f?) or, in physical terms, to the permanent change in volume measured anywhere beyond the range at which the outgoing wave has become elastic. f? decreases with increasing initial cavity size (r0) until the cavity is large enough to preclude inelastic behavior in the surrounding rock, at which point no further decrease occurs. With nuclear explosions, f? can also be reduced by decreasing the initial cavity size over a certain range. This occurs because, in this range of r0W-1/3 (where W is the yield) the thermal pressure in the surrounding medium increases much more slowly than does the thermal energy. With chemical explosions, by contrast, r0W-1/3 cannot be decreased below the fully tamped limit because the energy density is bounded above. Moreover, for most of the cavity expansion period the ratio of specific heats of the chemical explosion products is substantially higher than the equivalent ratio in a nuclear explosion, so that the cavity pressure in the former case is higher as well and this further amplifies the differences between the two. Calculations show that the teleseismic amplitude could be as much as 50% higher for an equivalent tamped chemical explosion in salt than was observed in the SALMON nuclear event.

DOE-041
TITLE: (U) French and German Foreign and Security Policies: Spring 1993. Document # UCRL-ID-114417

SPONSOR: DOE 19-MAY-93
PERFORMING ORGANIZATION: Lawrence Livermore National Laboratory
RELATED TABLES: C3,D1,F1

(U) This report is a consequence of field research conducted in France and Germany during April 1993 and ongoing monitoring of pertinent documentary materials (newspapers, periodicals, public speeches by political leaders, official government statements, communiqu s, international agreements, and treaties). This study assessed public as well as official attitudes and government policies toward current nuclear issues in France and Germany in the immediate aftermath of French parliamentary elections in March 1993. These elections reflected a massive turnabout in voter preferences and resulted in extensive change in the composition of the French parliament and government. Under the new conditions, a situation has arisen akin to that between 1986-1988, in that parliament and government are in the hands of a center-right coalition while the presidency remains occupied by Fran ois Mitterand, a Socialist. Major topical areas addressed are: priority concerns and goals of the French and German governments; the relative importance of domestic versus foreign and security policies; and questions of change or continuity specifically about issues of nuclear weapons development, proliferation (NPT), and testing (CTB). A range of other foreign and security policy issues were also explored and are noted in the report according to their relevance.

DOE-042
TITLE: (U) GRABIT: A Large Area, Broad Bandwidth, Gamma-Ray Imaging Spectrometer for Astrophysics

SPONSOR: DOE 1-DEC-93
PERFORMING ORGANIZATION: Lawrence Livermore National Laboratory
RELATED TABLES: A0,A6

(U) GRABIT is the Gamma-Ray Bar Imaging Telescope, a low-energy gamma-ray (60-600 keV) imaging spetrometer that can be extended to a large area at low cost. GRABIT has a gamma-ray position resolution of 2 mm with an energy resolution typical of alkali-halide detectors (18% at 60 keV). The complete coded-aperture telescope will have arc-minute resolution over a large field of view. In addition, the good energy and angular resolutions are obtained over the full bandwidth of the instrument.

DOE-047
TITLE: (U) Monte Carlo Simulations of Plutonium Gamma-Ray Spectra.
Document # UCRL-JC-112823

SPONSOR: DOE 16-JUL-93
PERFORMING ORGANIZATION: Lawrence Livermore National Laboratory
RELATED TABLES: A0,A6,D2

(U) Monte Carlo calculations were investigated as a means of simulating the gamma-ray spectra of PU. These simulated spectra will be used to develop and evaluate gamma-ray analysis techniques for various nondestructive measurements. Simulated spectra of calculational standards can be used for a code inter-comparisons, to understand systematic biases and to estimate minimum detection levels of existing and proposed nondestructive analyses instruments. The capability to simulate gamma-ray spectra from HPGe detectors could significantly reduce the costs of preparing large numbers of real reference materials. MCNP was used for the Monte Carlo transport of the photons. Results from the MCNP calculations were folded in with a detector response function for a realistic spectrum. Plutonium spectrum peaks were produced with Lorentzian shapes, for x ryas, and Gaussian distributions. The MGA1 code determined the PU isotopes and specific power of this calculated spectrum and compared it to a similar analysis on a measured spectrum.

DOE-048
TITLE: (U) Non-Intrusive Near Component Discrimination with a Micro Channel Plate Gamma-Ray Detector

SPONSOR: DOE
PERFORMING ORGANIZATION: Lawrence Livermore National Laboratory
RELATED TABLES: A0,A6,D2

(U) Lawrence Livermore National Laboratory (LLNL) has designed and tested a prototype Micro-channel plate gamma-ray instrument that discriminates special nuclear material or nuclear weapons from non-nuclear items. The instrument is based on a leaded-glass micro-channel plate (MCP) electron multiplier that senses gamma rays by counting Compton-scattered electrons formed in the micro-channel plate. Applications include chain-of-custody weapon verification and weapon-component diversion monitoring. This instrument counts gamma rays non-intrusively, computes their statistical significance, and logs results in real time on a printout. It is hand-held, battery-powered, and designed to service temperature extremes from about-20 degrees C to 50 degrees C.

DOE-049
TITLE: (U) Nonproliferation Section for Pu Storage White Paper.
Document # TVP-93-032

SPONSOR: DOE NOV-93
PERFORMING ORGANIZATION: Lawrence Livermore National Laboratory
RELATED TABLES: D3,D4,D8

(U) The paper provided input on nonproliferation and international inspection issues in long-term storage of plutonium. The white paper compares long-term storage in existing DOE facilities, in upgraded facilities, or in a new dedicated storage facility.

DOE-050
TITLE: (U) Nuclear Issues in Current French and German Security Policy. Document # UCRL-ID-113318

SPONSOR: DOE MAR-93
PERFORMING ORGANIZATION: Lawrence Livermore National Laboratory
RELATED TABLES: C3,D1,F1

(U) This study summarized and analyzed three interim reports that contained information acquired in the course of extensive field research conducted in France and Germany during summer and early fall 1992, updated relevant information whenever feasible on the basis of written documentary sources available in the United States, and drew pertinent conclusions about evolving French and German attitudes and policies toward nuclear issues that impact on U.S. national security interests and planning.

DOE-054
TITLE: (U) Seismic Decoupling with Chemical and Nuclear Explosions in Salt. Document # UCRL-JC-114711

SPONSOR: DOE AUG-93
PERFORMING ORGANIZATION: Lawrence Livermore National Laboratory
RELATED TABLES: C1,C2,C3

(U) An extensive series of simulations was performed of underground explosions in salt, using both chemical and nuclear explosives. In both cases, the radius of the initial emplacement cavity was varied from the fully tamped configuration to as large as 80m/kt1/3 when not fully tamped, the cavity was assumed initially to contain air at ambient temperature and pressure. In the nuclear source case, the simulations are shown to be in good agreement with the SALMON/STERLING events conducted by the U. S., and with recently released Russian data on a similar pair of explosions in an Azgir salt dome. Simulation of the U. S. COWBOY series of chemical explosions in a Louisiana salt mine are also shown to be in very good agreement with the experimental data, however the constitutive model for the salt that best explains these data is different from that derived for SALMON; both salt models are amply supported by laboratory and field data. The main result of these simulations is that cavity decoupling with chemical explosives is much less efficient than with nuclear explosives. Although maximum decoupling factors, fmax, near 200 may be attainable with either of the two sources, the cavity size required to achieve this value appears to be >40m/kt1/3. For cavity radii half as large, fmax, is roughly 4 times lower with nuclear explosives, and lower by another factor of 4 with chemical sources. Moreover, if the initial cavity radius is a more modest 10m/kt1/3, fmax,<3 even with a nuclear source.

DOE-055
TITLE: (U) Seismic Discrimination Studies of Little Skull Mountain Earthquakes and NTS Explosions. Document # UCRL-JC-114700

SPONSOR: DOE JUL-93
PERFORMING ORGANIZATION: Lawrence Livermore National Laboratory
RELATED TABLES: C2,C3

(U) This study evaluates four potential discrimination methodologies using earthquakes and explosions that have occurred on the Nevada Test Site (NTS). The Little Skull Mountain earthquake sequence was initiated by a 5.5 mb mainshock on June 29, 1992, and occurred between areas 25 and 28 near the southwestern perimeter of NTS. These earthquakes were recorded at regional distances on the broadband seismometers of the Livermore NTS Network (LNN). In addition, LLNL, in cooperation with the University of Nevada, Reno (UNR), and the United States Geological Survey (USGS), fielded instruments a few days after the start of the sequence, and local recordings are available for many events in the sequence. Excellent hypocentral control was afforded by the local Southern Great Basin Network, a short-period network operated by the USGS and UNR. Because of the proximity to the nuclear testing areas, the Little Skull Mountain sequence allows the opportunity to study small magnitude discrimination over paths which are virtually in common with NTS explosions.

DOE-059
TITLE: (U) Analysis of Lg Spectral Ratios from NTS Explosions: Implications for the Source Mechamisms of Spall and the Generation of Lg Waves. Document # LA-UR-93-4151

SPONSOR: DOE OCT-93
PERFORMING ORGANIZATION: Los Alamos National Laboratory /Lawrence Livermore National Lab.
RELATED TABLES: C2,C3

(U) In this paper, we use a spectral ratio method involving two closely located explosions, one of which is over-buried, as a means to detect the effects of sapll on far-field signals for a normal-depth explosion. We demonstrate that it is effective for detecting the signatures of spall in the amplitude spectrum of regional phases. We have applied this method to NTS explosions; the results show the presence of spall-related signatures in the spectra of Lg wave for these explosions. The implications of these results for seismic discrimination and explosion source theory are discussed.

DOE-060
TITLE: (U) Electron Beams at Geosynchronous Orbit

SPONSOR: DOE SEP-93
PERFORMING ORGANIZATION: Los Alamos National Laboratory /Naval Postgraduate School
RELATED TABLES: C1,C3

(U) This thesis surveys electron and ion measurements collected by the geosynchronous satellite 1989-046. In particular, this survey focuses on a phenomenon known as "electron beams," which are attributed to the sudden acceleration of electrons along the earth's magnetic field lines. Observations over a twelve day period reveal electron beam occurrences during the first few minutes of hot plasma injection associated with a magnetospheric substorm. Analysis of distribution functions shows these beams have a characteristic peak. The distributions can be approximately fitted as Maxwellians, providing a means of characterizing the temperature, density, and potential drop associated with the beam. Plots of the differential flux also show a general diffusion of the beam into neighboring pitch angles. Theories on the source of the acceleration and diffusion are presented.

DOE-061
TITLE: (U) Ionospheric Photoelectrons Measured at Geosynchronous Orbit

SPONSOR: DOE JUN-93
PERFORMING ORGANIZATION: Los Alamos National Laboratory /Naval Postgraduate School
RELATED TABLES: C1,C3

(U) Measurements of ions and electrons were made by the Los Alamos National Laboratory instrument, the Magnetospheric Plasma Analyzer, onboard spacecraft 1989-046. Observations from five days indicated the presence of both field aligned electrons and equatorially trapped electrons. Correlation existed between occurrences and location in the magnetosphere. Field aligned electrons were measured in the plasmasphere during daylight. On two days, field aligned electrons were also noted in the midnight region of the magnetosphere. Field aligned electrons at energies between 1 and 50 eV were characterized. These electrons' spectrum was shown to be similar in shape to the ionospheric photoelectron distribution. Conic distributions of photoelectrons were observed between 0800 and 1000 local time on days when both photoelectrons and equatorially trapped electrons were present. Vparallel versus Vperpendicular spectrograms clearly indicated that photoelectrons undergo perpendicular acceleration.

DOE-062
TITLE: (U) Effects of Structural Setting and Rock Properties on Amplitudes of Surface Motions in the Vicinity of Small Explosive Tests. Document # LA-UR-93-4072

SPONSOR: DOE NOV-93
PERFORMING ORGANIZATION: Los Alamos National Laboratory /New Mexico Inst. of Mining & Tech.
RELATED TABLES: C2,C3

(U) A series of small-scale explosive experiments was conducted in a perlite mine near Socorro, NM. The purpose of these tests was to measure the changes in the shock wave and seismic coupling as a function of depth of burial and structural setting. Preliminary results indicate that significant differences in the amplitudes of signals can occur when the location of the explosive charges are changed by only meters.

DOE-067
TITLE: (U) Fundamentals of Semiconductor Detectors for Ionizing Radiation

SPONSOR: DOE
PERFORMING ORGANIZATION: Los Alamos National Laboratory /University of Michigan
RELATED TABLES: A0,A6,D2

(U) The modes of operation of semiconductor detectors are reviewed, together with the influence of charge carrier collection in developing a signal pulse for spectroscopic applications. Because of the importance of charge trapping in many semiconductors of interest in the fabrication of room temperature radiation detectors, the effects of incomplete charge collection are quantified. Calculated results are presented for the expected pulse height and energy resolution under a variety of charge collection conditions.

DOE-068
TITLE: (U) Present Status of Undoped Semi-Insulating Bulk LEC GaAs as a Radiation Spectrometer

SPONSOR: DOE
PERFORMING ORGANIZATION: Los Alamos National Laboratory /University of Michigan
RELATED TABLES: A0,A6,D2

(U) Bulk GaAs has undergone extensive research by several groups in order to ascertain its usefulness as a room temperature radiation spectrometer. The results of an experimental program studying the properties of detectors fabricated from bulk GaAs are summarized in this paper. Electric field models of the active region are compared with measured results. Limitations of bulk LEC GaAs as a material for radiation spectrometers are discussed.

DOE-069
TITLE: (U) A Generalized Assay-Mass Sensitivity Limit for Passive Neutron Coincidence Counting. Document # LA-UR-93-1454

SPONSOR: DOE
PERFORMING ORGANIZATION: Los Alamos National Laboratory
RELATED TABLES: D4

(U) A generalized, practical model for prediction of the minimum detectable limit of 240Pu-effective mass (sensitivity) that may be obtained with passive neutron coincidence counters is described. Shift-register electronics is assumed. The model is applicable to the case where the background-corrected real coincidence count rate (reals or doubles) is used as the assay signature for 240Pu-effective mass. The model can also be used to predict the precision of low-level assays.

DOE-070
TITLE: (U) A Neutron Counter for Small Samples. Document # LA-UR-93-1640

SPONSOR: DOE
PERFORMING ORGANIZATION: Los Alamos National Laboratory
RELATED TABLES: D4

(U) The Inventory Sample Counter Model IV is the most recent neutron coincidence counter specifically designed to measure small samples. We used a combination of measurement experience and Monte Carlo modeling to design a neutron counter that can provide measurement results with an accuracy of 0.5% or better. Some applications incorporate a high-resolution detector into the neutron counter. This allows the simultaneous measurement of the plutonium isotopics using the passive gamma-ray emission and the measurement of the 240Pu effective mass using the passive neutron emission. The two results are then combined to yield the plutonium mass.

DOE-071
TITLE: (U) Advances in Gamma-Ray Field Instrumentation at Los Alamos. Document # LA-UR-93-2784

SPONSOR: DOE
PERFORMING ORGANIZATION: Los Alamos National Laboratory
RELATED TABLES: D4

(U) We have developed a prototype miniature and modular multi-channel analyzer (M3CA). The prototype brings together hardware and software technologies in an instrument that can be effectively used in many safeguards, arms control, nuclear industry, and environmental applications. The design uses modular building blocks for both hardware and software. It is hardware bus independent and, because of its interface philosophy, it is very versatile and is much easier to interface to external controllers than previous instruments. The prototype instrument demonstrates that low-power instruments now have the capabilities and performance required in many applications where, previously, only mains-powered instruments have been used.

DOE-076
TITLE: (U) Analyzing Lagrange Gauge Measurements of Spherical, Cylindrical, or Plane Waves. Document # LA-UR-93-3839

SPONSOR: DOE JUL-93
PERFORMING ORGANIZATION: Los Alamos National Laboratory
RELATED TABLES: C2

(U) In-material (Lagrangian) gauge measurements of radial stress and/or particle velocity histories provide a basis for developing constitutive models of geologic media. The requisite measurements and the analysis are feasible for both laboratory and field experiments. Three classes of waves are considered in this report: planar, cylindrical, and spherical. The equations for strain components and tangential stress are given in terms of the measured quantities, radial stress and particle velocity, and their derivatives. The procedures are described for integrating these equations to obtain values for the strains and tangential stresses. Example of results of the analysis are given for plane wave measurements in marble.

DOE-077
TITLE: (U) Applications of Portable Gamma-Ray Technologies to Quantitative Measurements In-Situ. Document # LA-UR-93-2861

SPONSOR: DOE
PERFORMING ORGANIZATION: Los Alamos National Laboratory
RELATED TABLES: D4

(U) Technologies and methods in portable gamma-ray spectroscopy for quantitative nondestructive assay (NDA) of nuclear materials are being planned, developed, and tested in field applications for determination of holdup in process equipment, determination of in-process inventory, quantification of nuclear materials during decontamination and decommissioning (D&D) of process equipment and facilities, waste measurements, environmental measurements, and measurements for special inspections. Low- and high-resolution gamma-ray detectors and portable, self-contained gamma-ray spectroscopy instruments are used. Automation of the portable spectroscopy instruments and the real-time quantitative analysis of data has been demonstrated in the field. Generalized geometric models for calibration and assay of holdup have been developed in the laboratory, proven in the field, implemented in automated systems, and extended to measurement needs other than holdup determinations. Generic gamma-ray measurement-control/quality-assurance (MC/QA) procedures and data-reduction/data-analysis tools (including, for example, correcting for gamma-ray attenuation and finite sample dimensions) have been used effectively in the numerous applications listed, including automated applications under computer control. This commonality (compact, self-contained spectroscopic capability, generalized calibration/assay models, and generic QA/QC and analysis tools) in the various portable field applications, coupled with the common need to manage (identify, acquire, analyze, store, and track) data that typically represents hundreds to thousands of individual measurements per campaign, increases the significance of the new methods and technologies that are developed and tested for a single application.

DOE-078
TITLE: (U) Atmospheric Acoustic Modeling. Document # LA-12566-MS

SPONSOR: DOE JUN-93
PERFORMING ORGANIZATION: Los Alamos National Laboratory
RELATED TABLES: C3

(U) We study the propagation of acoustic pulses in the atmosphere from the ground to the ionosphere, and to the time where part of the wave is headed back down to the ground. The study is accomplished via two computer codes, FLOTUBE and AADCAT. We include the effects of viscous dissipation and heat conduction and investigate the influence of the initial strength of the acoustic pulse. Wave flow through caustic regions is illustrated.

DOE-083
TITLE: (U) Design and Performance of a New High Accuracy Combined Small Sample Neutron/Gamma Detector. Document # LA-UR-93-2670

SPONSOR: DOE
PERFORMING ORGANIZATION: Los Alamos National Laboratory
RELATED TABLES: D4

(U) This paper describes the design of an optimised combined neutron and gamma detector installed around a measurement well protruding from the floor of a glove box. The objective of this design was to achieve an overall accuracy in the determination of plutonium element concentration in gramme-sized samples of plutonium oxide powder approaching that routinely achieved by inspectors' chemical analysis (~0.1-0.2%). The efficiency of the clam shell neutron detector was increased and the flat response zone extended in axial and radial direction. The sample holder introduced from within the glovebox was designed to form the upper reflector, while two graphite half shells fitted around the thin neck of the high-resolution LEGe detector replace the lower plug. IRMM Geel prepared special plutonium oxide test samples whose plutonium concentration was determined to better than 0.05%. During a three week initial performance test campaign in July 1992 at ITU Karlsruhe, and in long term tests since it has been established that the target accuracy can be achieved provided sufficient care is taken to assure reproducibility of sample bottling and sample positioning. The paper presents and discusses the results of all test measurements.

DOE-084
TITLE: (U) Detection of Mining Explosions Using Ionospheric Techniques. Document # LA-UR-93-3557

SPONSOR: DOE SEP-93
PERFORMING ORGANIZATION: Los Alamos National Laboratory
RELATED TABLES: C3

(U) A possible means of discrimination between mining explosions and underground nuclear tests would be to detect the acoustic waves produced by airblast; for a given seismic magnitude the airblast produced by a surface mining explosion has about ten times the energy content of that produced by a contained underground explosion. These acoustic waves propagate vertically into the upper atmosphere where they interact with the ambient plasma of the ionosphere to produce effects that are detectable using radio remote-sensing technicues. This report reviews the phenomenology of airblast from mining explosions and describes recent detections of mining explosions using radio techniques to remotely sense the ionsophere directly above the mine.

DOE-085
TITLE: (U) Directional Measurements for Sources of Fission Neutrons. Document # LA-12633-MS

SPONSOR: DOE NOV-93
PERFORMING ORGANIZATION: Los Alamos National Laboratory
RELATED TABLES: A0,A6,D2

(U) Although penetrating neutron and gamma-ray emissions arguably provide the most effective signals for locating sources of nuclear radiation, their relatively low fluxes make searching for radioactive materials a tedious process. We describe an alternative approach for locating radiation sources that is based on the concept of a polarized radiation field, which provides an estimated source angle and distance. The search detector uses segmentation and requires little or no collimating material and additional weight. Attenuation across the detector creates differences in the count rates for opposite segments, whose ratios can be used to calculate the orthogonal components of the polarization vector. Although this approach is applicable to different types of radiation and detectors, in this report we demonstrate its use for sources of fission neutrons by using a prototype fast-neutron detector, which also provides background-corrected energy spectra for the incident neutrons. Computer simulations of possible search procedures indicate that the directional capability should significantly improve the performance of searches for nuclear sources.

DOE-086
TITLE: (U) Evaluation of Three New Technologies for International Safeguards. Document # LA-UR-93-1669

SPONSOR: DOE 19-MAY-93
PERFORMING ORGANIZATION: Los Alamos National Laboratory
RELATED TABLES: D4

(U) Los Alamos National Laboratory is examining a number of promising technologies that could increase the effectiveness and efficiency of international nuclear safeguards. The techniques described in this paper include video image processing, infrared imaging, and acoustic resonance spectroscopy. Each of these techniques offers unique advantages in the implementation of an inspection regime.

DOE-092
TITLE: (U) Influence of Equation of State (EOS) and constitutive Behavior on Seismic Coupling. Document # LA-UR-93-3839

SPONSOR: DOE JUL-93
PERFORMING ORGANIZATION: Los Alamos National Laboratory
RELATED TABLES: C2

(U) A series of calculations using a granite equation-of-state illustrate the dependence on initial cavity size and on shear strength of parameters commonly used to describe the reduced velocity potential and reduced displacement potential (RDP). Calculations for explosions in granite support both the results of Terhune, et al. (1979) and of King, et al. (1989) which indicate no enhanced coupling in the hydrodynamic regime for the same initial cavity sizes. Calculations of seismic coupling for tamped explosions with the same granite model except for variations in shear strength show the transition from a strength dominated regime to an overburden dominated regime. When the rock strength is insufficient to prevent a large cavity rebound driven by the overburden stresses, the coupling as measured by the asymptotic RDP value becomes independent of strength. The RDP overshoot parameter appears to be a good indicator of whether this is occurring. It may be a useful parameter to filter the database of seismic records from nuclear explosions when looking for correlations with rock properties.

DOE-093
TITLE: (U) Information Sources for Transparency Measures at Sensitive Facilities. Document # LA-UR-93-2586

SPONSOR: DOE JUL-93
PERFORMING ORGANIZATION: Los Alamos National Laboratory
RELATED TABLES: A6

(U) The concept of transparency stems from a desire to assure other parties that some action such as the dismantlement of a weapons system is taking place while avoiding the intrusiveness, complexity, and lengthy negotiations associated with formal verification measures. By their nature, transparency measures may fall short of providing the degree of confidence associated with arms control treaties, such as INF or START, but can be more quickly and easily implemented. This paper discusses information sources that could form the basis of transparency measures at sensitive facilities.

DOE-094
TITLE: (U) Integrated Safeguards Systems. Document # LA-UR-93-2859

SPONSOR: DOE
PERFORMING ORGANIZATION: Los Alamos National Laboratory
RELATED TABLES: D4

(U) In this paper, we describe integrated nondestructive assay (NDA) and measurement systems that have been developed and installed. These systems reduce inspection manpower requirements and lessen the impact of inspections on the operator.

Systems that have been developed for safeguards measurements and monitoring include the following:

- integrated nondestructive assay system for the plutonium scrap recovery facility,
- continuous/unattended radiation monitoring/measuring systems,
- automated retirement and integrated extraction system (ARIES), and
- Hanford integrated waste-tank monitor.

DOE-095
TITLE: (U) Integrated Verification Experiment Data Collected as Part of the Los Alamos National Laboratory's Source Region Program, Appendix A: Surface Effects. Document # LA-UR-93-3370

SPONSOR: DOE SEP-93
PERFORMING ORGANIZATION: Los Alamos National Laboratory
RELATED TABLES: C2,C3

(U) Presented in this paper are observations of surface fracturing associated with the Integrated Verification Experiments involving mapping that extended from about one-half to one-and-a-half times the predicted spasll radius. Observations from Lawrence Livermore National Laboratory and from the Los Alamos-sponsored Raytheon geologists have been incorporated into the maps in this document, as appropriate.

DOE-101
TITLE: (U) Magnetospheric Plasma Analyzer (MPA): Initial Three-Spacecraft Observations from Geosynchronous Orbit. Document # LA-UR-93-845

SPONSOR: DOE AUG-93
PERFORMING ORGANIZATION: Los Alamos National Laboratory
RELATED TABLES: D0

(U) The first three magnetospheric plasma analyzer (MPA) instruments have been returning data from geosynchronous orbit nearly continuously since late 1989, 1990, and 1991. These identical instruments provide for the first time simultaneous plasma observations from three widely spaced geosynchronous locations. The MPA instruments measure the three-dimensional velocity space distributions of both electrons and ions with energies between ~1 eV/q and ~40 keV/q. MPA capabilities and observations are summarized in this paper. We use the simultaneous observations from three longitudinally separated spacecraft to synthesize a synoptic view of the morphology of the magnetosphere at geosynchronous orbit over a 6-week interval in early 1992.

DOE-102
TITLE: (U) Magnetospheric Plasma Analyzer for Spacecraft with Constrained Resources. Document # LA-UR-92-3419

SPONSOR: DOE APR-93
PERFORMING ORGANIZATION: Los Alamos National Laboratory
RELATED TABLES: D0

(U) A light-weight, low-power, plasma analyzer is described that can be used for measuring the plasma environments of spacecraft with constrained resources. A unique system using a single electrostatic analyzer coupled to a single array of channel electron multipliers allows measurement of the three-dimensional energy per charge distributions of both ions and electrons over E/q ranges from ~1 eV/q to >40 keV/q. Particles selected by the analyzer are post-accelerated into the multipliers to maintain sensitivity for the lowest energy particles. An instrument using this concept called the magnetospheric plasma analyzer (MPA) is described. Presently, three MPAs are in geosynchronous orbits (GEO). The MPA and its response characteristics are described, and examples of on-orbit data showing some of the MPA capabilities are presented.

DOE-103
TITLE: (U) Measurement and Analysis of Neutron Energy Spectra from Fission Source. Document # LA-12627-MS

SPONSOR: DOE NOV-93
PERFORMING ORGANIZATION: Los Alamos National Laboratory
RELATED TABLES: A0,A1,A2,A6,D2

(U) Measurements of neutron energy spectra are usually much more difficult than spectral measurements for other types of radiation. Because neutrons are uncharged, they can be detected only by nuclear interactions, either neutron capture or neutron scattering, neither of which provides an efficient method for spectroscopy at fission energies. A new scintillator technology combines the scattering and capture approaches to provide an electronically "black" detector, one that registers energy deposition only for neutrons that are totally absorbed. Using a prototype of such an instrument, we obtained spectral measurements for several fission sources at distances up to 11 m. Examples from these measurements serve to explain the detection principle, the instrument calibration, and the techniques for data analysis. A companion paper describes techniques for obtaining directional measurements, and subsequent papers will focus on particular features of the individual spectra and discuss comparisons with calculations.

DOE-104
TITLE: (U) Measurement of Large ground Motions with the ASM Gage. Document # LA-UR-93-2378

SPONSOR: DOE JUL-93
PERFORMING ORGANIZATION: Los Alamos National Laboratory
RELATED TABLES: C2

(U) Conversion of the energy from underground explosions to distant seismic signals involves hydrodynamic flows sampling a wide range of pressures. For lower pressures a large portion of the initial wave motion must be measured to obtain definitive results. The intermediate pressure range, where the initial wave is strong enough to destroy most instrumentation but does not contain definitive information in its initial amplitude, presents special difficulties. We present design considerations for an experiment implementing the ASM gage principle (induction of eddy currents in a moving conducting plate) that can sample wave motion for many milliseconds. In essence we hang a large metal plate (large in area) on a wall and watch the free-surface release. This is not an in-situ measurement of the wave profile because the incoming wave is modified by the release propagating backwards from the wall. However, this is a relatively clean modification of the incoming wave and is a situation commonly handled in many shock-wave experiments.

DOE-110
TITLE: (U) Observations of Nonlinear Elastic Wave Behavior in Sandstone. Document # LA-UR-92-3938

SPONSOR: DOE DEC-93
PERFORMING ORGANIZATION: Los Alamos National Laboratory
RELATED TABLES: C2,C3

(U) An experimental investigation of nonlinear elastic wave behavior was conducted using a 2 meter long cylindrical rod of Berea sandstone in order to study the strong elastic nonlinearity that is characteristic of microcracked materials. Measurements of the displacement field at distance x from the source show rich harmonic content with harmonic amplitudes depending on x, source frequency, and source amplitude. The amplitude of the 2w harmonic is found to grow linearly with x and as the square of both the source frequency w and the source amplitude U. This behavior is in agreement with the predictions of nonlinear elasticity theory for a system with cubic anharmonicity. From the measured amplitude of the 2w harmonic the parameter

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DOE-111
TITLE: (U) Plasma Observations of Magnetopause Crossings at Geosynchronous Orbit. Document # LA-UR-93-4238

SPONSOR: DOE NOV-93
PERFORMING ORGANIZATION: Los Alamos National Laboratory
RELATED TABLES: C1,C3

(U) The entire three-spacecraft Magnetospheric Plasma Analyzer (MPA) data set has been examined for intervals of magnetosheath plasma at geosynchronous orbit. Over 6 1/2 spacecraft-years of data reviewed, 916 5-minute intervals of magnetosheath plasma observations were identified and cataloged. Unlike previous studies which suggested that magnetopause encounters were far more likely on the pre-noon than post-noon side at geosynchronous orbit, this study examines three independent lines of evidence and finds that only a small asymmetry (in this same sense) exists.

DOE-112
TITLE: (U) Plutonium Analysis of High-Burnup Spent Fuel Dissolver Solutions by Low-Energy Gamma-Ray Spectrometry. Document # LA-UR-93-1726

SPONSOR: DOE ...
PERFORMING ORGANIZATION: Los Alamos National Laboratory
RELATED TABLES: D4

(U) High-resolution gamma-ray analysis of the isotopic abundances of plutonium in highly radioactive dissolver solutions from reprocessing plants requires separating the plutonium from the fission products. It is difficult to sufficiently purify a few milligrams (usually more) of plutonium to allow isotopic analysis in the commonly used gamma-ray energy ranges of 59-208 keV (MGA2) or 120-414 keV (FRAM). Recently, by taking advantage of the higher intensities of lower-energy gamma rays (*52 keV), low-energy gamma-ray spectrometry (LEGS) has measured plutonium isotopic abundances and elemental concentrations of spent-fuel dissolver solutions with burnups up to 28 000 MWD/T. To test the LEGS technique with higher-burnup spent fuels, we performed an exercise at the European Institute for Transuranium Elements at Karlsruhe, Germany. Three spent-fuel dissolver solutions with burnups ranging from 30 000 to 44 400 MWD/T were prepared and measured. Comparison of results from mass spectrometry indicates that LEGS-based methods are promising because of timeliness, simplicity, and economy.

DOE-113
TITLE: (U) Proceedings of the First Geological Materials Constitutive Modeling Workshop. Document # LA-12534-C

SPONSOR: DOE NOV-93
PERFORMING ORGANIZATION: Los Alamos National Laboratory
RELATED TABLES: C2,C3

(U) A workshop on constitutive modeling of geologic materials was held at Los Alamos National laboratory on 9-10 December 1992. The workshop was hosted by the Earth and Environmental Sciences Division and the Physics Divisions at the Laboratory. Its purpose was to provide an overview of our current understanding of the dynamic response of geologic materials under stress wave loading, to identify the most important gaps in this understanding, and to define promising experimental approaches for filling the gaps. Particular emphasis was placed on material behavior in the hydrodynamic and strength-dominated regimes for buried explosions, with application to verification and nonproliferation. These proceedings are a compilation of the brief summary papers and associated viewgraphs presented at the workshop, along with commentary on modeling and experimental issues addressed in the roundtable discussion session. The papers are printed as submitted by the authors, but have been retyped for uniform format. In cases where legibility allowed, the viewgraphs were reduced to half-page size for a more compact document.

DOE-118
TITLE: (U) Safeguarding the Direct Use of Spent PWR Fuel in CANDU Reactors (DUPIC). Document # LA-UR-94-2218

SPONSOR: DOE JUN-93
PERFORMING ORGANIZATION: Los Alamos National Laboratory
RELATED TABLES: D4

(U) The fuel cycle options under consideration for the Direct Use of PWR Spent Fuel in CANDU Reactors (DUPIC) satisfy the need to maximize the energy output of nuclear fuel while minimizing the potential for proliferation of separated plutonium. Several options have been considered including repackaging options and thermal processing. Los Alamos has completed preliminary investigations of the safeguards aspects of the different processing options and the need for measurement development. Future safeguards activities will focus on the thermal-mechanical process selected for further development.

DOE-119
TITLE: (U) Safeguards Instrumentation for Continuous Unattended Monitoring in Plutonium Fuel Fabrication Plants. Document # LA-UR-93-1860

SPONSOR: DOE
PERFORMING ORGANIZATION: Los Alamos National Laboratory
RELATED TABLES: D4

(U) Nondestructive assay (NDA) systems have been developed for use in an automated mixed-oxide fabrication facility. Unique features have been developed for the NDA systems to accommodate robotic sample handling and remote operation. In addition, the systems have been designed to obtain International Atomic Energy Agency inspection data without the need for an inspector at the facility at the time of the measurements. The equipment is being designed to operate continuously in an unattended mode with data stor-age for periods of up to one month. The design, performance characteristics, and authentication of the NDA systems are described. The data related to reliability, precision, and accuracy are presented.

DOE-120
TITLE: (U) Safeguards Techniques and Technologies for Large-Scale Reprocessing Plants. Document # LA-UR-93-1843

SPONSOR: DOE 19-MAY-93
PERFORMING ORGANIZATION: Los Alamos National Laboratory
RELATED TABLES: D4

(U) Between 1987 and 1992 a multi-national forum known as LASCAR (Large Scale Reprocessing Plant Safeguards) met to assist the IAEA in development of effective and efficient safeguards for large-scale reprocessing plants. The US provided support throughout this forum, including the services of personnel from Los Alamos National Laboratory and Sandia National Laboratories, who provided advice on safeguards techniques and technologies that were available or under development. This paper reviews and updates the instrumentation potentially applicable to safeguards for large-scale reprocessing plants.

DOE-121
TITLE: (U) Sensitivity of the Close-in Seismic Source Function to Rock Properties. Document # LA-UR-93-1884

SPONSOR: DOE 17-MAY-93
PERFORMING ORGANIZATION: Los Alamos National Laboratory
RELATED TABLES: C3

(U) The objective of this investigation is to determine and evaluate how rock properties near the origin of an explosion influence the close-in seismic source function. This is work in progress that represents one step in the systematic investigation of parameters important in the remote identification of underground nuclear tests.

DOE-122
TITLE: (U) TIPC User Manual. Document # LA-12644-M

SPONSOR: DOE NOV-93
PERFORMING ORGANIZATION: Los Alamos National Laboratory
RELATED TABLES: C1,C3

(U) The TransIonospheric Propagation Code (TIPC) computer program executes tasks related to the detection of VHF and UHF signals following propagation through the ionosphere. These tasks include: transionospheric propagation, signal detection, signal processing, delta time of arrival study, delta time of arrival uncertainty study, and signal reconstruction. The parameters needed to accomplish each task are defined and the process of using TIPC in each of these tasks is explained step-by-step. TIPC is also capable of saving the parameter values defined for the specific task. In addition, subroutine descriptions are identified.

DOE-125
TITLE: (U) Thermal Neutron Multiplicity Measurements Using the Pyrochemical Multiplicity Counter at Lawrence Livermore National Laboratory. Document # LA-UR-93-2610

SPONSOR: DOE ...
PERFORMING ORGANIZATION: Los Alamos National Laboratory
RELATED TABLES: D4

(U) The pyrochemical multiplicity counter designed and built at Los Alamos has been undergoing tests and evaluation at Lawrence Livermore National Laboratory (LLNL). Measurements have been performed using a variety of plutonium oxide and metal materials. The pyrochemical multiplicity counter uses the information contained in the higher moments of the neutron multiplicity distribution to deduce the three unknowns in the assay problem: 240Pu-effective mass, (a,n) neutron rate, and self-multiplication. This is an improvement over conventional neutron coincidence counting, which must rely on some estimate of the (a,n) neutron rate or self-multiplication to deduce an assay result. Such conventional techniques are generally unsatisfactory for impure materials for which these quantities are unknown.

We present the assay results obtained with the pyrochemical multiplicity counter and discuss the procedures necessary to produce good assay results. Using these procedures, we have obtained assay accuracies of 1%-2% for oxide materials in 1/2 hour measurement times. We also compare these results to those that would have been obtained using conventional neutron assay techniques and discuss the correlations we have observed between assay results and the ratio of total neutron counts in the different rings of the pyrochemical counter.

DOE-126
TITLE: (U) Training for Special Safeguards Inspections. Document # LA-UR-93-649

SPONSOR: DOE ...
PERFORMING ORGANIZATION: Los Alamos National Laboratory
RELATED TABLES: F5

(U) On February 20, 1992, a Joint Declaration on the Non-Nuclearization of the Korean Peninsula came into effect by action of the Prime Ministers of the Republic of Korea (ROK, South Korea) and the Democratic People's Republic of Korea (DPRK, North Korea). This accord was the result of negotiations between the Korean sides prior to the February 20 signing. As part of that accord, both sides agreed to work toward establishing a mutual inspection regime to verify progress toward the non-nuclearization goal. In preparation for their inspection role in the North, South Korea enlisted the technical assistance of the US in training their would-be inspectors in all conceivable areas associated with special inspections to assess the nuclear program in the North and verify its peaceful motivations. The principal role of the US was to train nuclear safeguards inspectors who would operate under the newly formed Joint Nuclear Control Commission (JNCC) in those bilateral inspections.

DOE-127
TITLE: (U) Advanced Techniques for the Chemical Characterization of Microparticles, Particle Levitation Annual Progress Report. Document # K/NSP-145

SPONSOR: DOE SEP-93
PERFORMING ORGANIZATION: Oak Ridge National Laboratory
RELATED TABLES: C3

(U) A method is being developed to characterize individual microparticles by optical spectroscopy and laser ablation/desorption mass spectroscopy (MS). The technique in its current form is suitable for the analysis of a single selected particle. The mass analysis can also be performed on a collected batch of microparticles, one by one. Although the latter measurements are slower than analyzing the entire batch at once, measuring individual particles shows the variation in composition from particle to particle and is more sensitive when target species are present on only a few of the particles.

The experiments show that individual microparticles can be chemically, isotopically, and structurally characterized in a quadrupole ion trap by optical and mass spectroscopy. Involatile organics, such as plastic explosives, can be detected on a single particle at the picogram level. This sensitivity is comparable to or better than that obtained with vapor-phase measurements on thermally desorbed samples collected over a long period of time. We are continuing to explore alternative means to ionize laser-desorbed neutral species and methods for MS/MS with varying total ion yields.

DOE-128
TITLE: (U) Export Control Guide: Spent Nuclear Fuel Reprocessing and Preparation of Plutonium Metal. Document # K/NSP-153

SPONSOR: DOE OCT-93
PERFORMING ORGANIZATION: Oak Ridge National Laboratory
RELATED TABLES: E5

(U) This document was prepared to serve as a guide for export control officials in their interpretation, understanding, and implementation of export laws and controls that relate to the international Trigger List for process components, equipment, and materials used to separate plutonium and uranium from irradiated nuclear fuel elements. Particular emphasis is focused on items that are especially designed or prepared because export controls are required for these by States that are party to the Treaty on the non-Proliferation of Nuclear Weapons.

DOE-134
TITLE: (U) Nuclear Fuel Reprocessing Technology: Non-Proliferation Considerations in Public Disclosures. Document # K/NSP-181

SPONSOR: DOE NOV-93
PERFORMING ORGANIZATION: Oak Ridge National Laboratory
RELATED TABLES: D1,D2

(U) There is continuing concern about the proliferation of nuclear weapons. A non-weapons State conceivably can obtain fissile material for use in a nuclear weapon by any of the following routes: (2) reprocessing irradiated uranium or thorium to recover plutonium or 233U, respectively; (2) enriching uranium; (3) acquiring plutonium or highly enriched uranium (HEU); and (4) recovering HEU from HEU fuel such as that which is being used in research reactors. This report addresses one aspect of the first route, namely reprocessing irradiated uranium to recover plutonium. Specifically, the proliferation implications of information disclosure on reprocessing plant design, operations, and management are addressed.

DOE-135
TITLE: (U) Nuclear Machine Tool Guide. Document # K/NSP-169

SPONSOR: DOE OCT-93
PERFORMING ORGANIZATION: Oak Ridge National Laboratory
RELATED TABLES: E5

(U) This document was prepared to serve as a guide for individuals associated with the evaluation of machine tools and dimensional inspection machines destined to those nations which pose a nuclear proliferation concern as well as to those nations which are a strategic threat.

The guide portrays the equipment and identifies (2) the type of machine; (2) typical builders throughout the world; (3) uses of the machines in nuclear, military, and civil programs; and (4) other equipment that might be used in lieu of that described.

DOE-136
TITLE: (U) Nuclear Material Safeguards for Uranium Enrichment Plants. Document # K/NSP-136/PT1-4

SPONSOR: DOE JUN-93
PERFORMING ORGANIZATION: Oak Ridge National Laboratory
RELATED TABLES: D4

(U) This four-part manual is a training course on nuclear material safeguards for uranium enrichment plants that has been developed to train professionals who are responsible for safeguarding uranium enrichment facilities on the safeguards relevant principles of enrichment technology, particularly as related to centrifuge and gaseous diffusion enrichment plants. The main objective of this training course is to provide the course participants with the necessary skills to perform their inspection activities at enrichment plants. A variety of enrichment technologies are characterized and compared and basic cascade and separation theory are reviewed. The major components and systems of a uranium enrichment plant are described. The objectives of International Atomic Energy Agency safeguards at a uranium enrichment plant, specifically as agreed to in the Hexapartite Safeguards Project, are reviewed. Discussion then focuses on potential diversion and undeclared production scenarios at an enrichment facility and applicable safeguards inspection activities for detecting these scenarios.

DOE-137
TITLE: (U) Potential Enrichment Plant Chemical Signatures. Document # K/NSP-139

SPONSOR: DOE 19-MAY-93
PERFORMING ORGANIZATION: Oak Ridge National Laboratory
RELATED TABLES: E1

(U) This report lists potential chemical effluents from uranium enrichment processes, including gaseous diffusion, gas centrifuge, electro-magnetic isotope separation (EMIS), chemical exchange, ion exchange, laser-based processes, the plasma separation process, and aerodynamic-based processes.

DOE-142
TITLE: (U) Automated Nuclear Track Characterization, Advanced Concept Final Report

SPONSOR: DOE 30-SEP-93
PERFORMING ORGANIZATION: Pacific Northwest Laboratory
RELATED TABLES: D2,D3

(U) The objective of the Automated Nuclear Track Characterization project is to develop an automated prototype system to scan, identify, characterize, and locate groups of nuclear etch tracks in polycarbonate plastic slides. Certain track patterns are associated with the presence of fissionable material in samples. By locating the position of these tracks on the slide, one may locate the fissile sources in the sample and isolate them for subsequent analysis. The objective of the research described in this report was to demonstrate automated sample manipulation under a microscope, image digitization, and pattern characterization.

DOE-143
TITLE: (U) Chemical Signatures. Document # PNL-NST-0257

SPONSOR: DOE 1-APR-93
PERFORMING ORGANIZATION: Pacific Northwest Laboratory
RELATED TABLES: D1,D2,D4,D5

(U) The report contains a comprehensive list of chemical, radionuclide, and isotopic signatures that result from processes used in the development, manufacture, and deployment of nuclear weapons. The information was compiled from various sources with the aid of personnel at Los Alamos National Laboratory, Lawrence Livermore National Laboratory, Martin Marietta Energy Systems (including the Oak Ridge K25, and Y12 facilities), Pacific Northwest Laboratory, Sandia National Laboratory, and Savannah River Technology Center.

DOE-144
TITLE: (U) Comments on Statistical Issues in Numerical Modeling for Underground Nuclear Test Monitoring. Document # PNL-SA-22847

SPONSOR: DOE AUG-93
PERFORMING ORGANIZATION: Pacific Northwest Laboratory
RELATED TABLES: C1,C2,C3

(U) There are important issues associated with conducting and evaluating numerical modeling for underground nuclear test monitoring that are familiar to statisticians and often treated successfully by them. The comments addressed the role of statistical design/analysis in the quantification process to answer the question "what do we know about the numerical modeling of underground nuclear tests?" and the peculiar nature of uncertainty analysis for situations involving numerical modeling.

DOE-145
TITLE: (U) Comparison of Neutron and Gamma Radiation on Ribbon or Bundles of Scintillating Fibers. Document # PNL-9318

SPONSOR: DOE 8-NOV-93
PERFORMING ORGANIZATION: Pacific Northwest Laboratory
RELATED TABLES: D4

(U) Pacific Northwest Laboratory (PNL) has developed cerium-activated lithium-silicate fibers for use in neutron detection. An issue has been the effect on gamma sensitivity of bundling the fibers at the photomultiplier tube. This report describes measurements undertaken to evaluate the magnitude of the effect.

DOE-149
TITLE: (U) Effluent Collection and Analysis for Nuclear Proliferation Detection

SPONSOR: DOE 27-JUL-93
PERFORMING ORGANIZATION: Pacific Northwest Laboratory
RELATED TABLES: D4

(U) Pacific Northwest Laboratory, with input from Lawrence Livermore National Laboratory, Los Alamos National Laboratory, Martin Marietta Energy Systems (Oak Ridge), Sandia National Laboratory, Savannah River Technology Center, and DOE/USG sources, will prepare a report on effluent collection that addresses the current capabilities and development needs for Nuclear Proliferation Detection Technology. PNL is expected to call on the expertise of the other national laboratories for input on specific areas of the report and funding for their efforts has been provided for in this project.

The report on proliferation signatures will provide a reference source for DOE/NN program development and direction on effluent collection and analysis for identifying and detecting nuclear proliferation activities. The report will be useful for developing new technologies and applying new and currently available technologies for nuclear proliferation detection and arms control treaty verification. The report will also serve as a reference source for the application of effluent collection and analysis within the nuclear communities.

DOE-150
TITLE: (U) Energy Transfer of Ionizing Radiation into Light Emitting Dielectric Materials

SPONSOR: DOE MAR-93
PERFORMING ORGANIZATION: Pacific Northwest Laboratory
RELATED TABLES: D4

(U) The electron-hole transition probability caused by a fast charged particle in a solid is shown to be influenced by the dielectric response function. This is a manifestation of the well-known fact that the primary loss mechanism is to plasmons. Plasmons, as cooperative electron-hole excitations, decay via the creation of a single electron-hole pair. Thus, a plasmon, which will carry away 10-20 eV from the fast charged particle, will generate a single electron-hole pair of a few eV; the remainder going into heat. The meaning of this observation to scintillation, semiconductor nuclear detectors, and phosphor science is discussed.

DOE-151
TITLE: (U) Excitation Rate and Background Measurements During LIF Studies on Krypton. Document # PNL-8629

SPONSOR: DOE 1-APR-93
PERFORMING ORGANIZATION: Pacific Northwest Laboratory
RELATED TABLES: D1,D2,D3

(U) The Krypton Isotope Laser Analysis method is being developed to measure 85Kr concentrate air samples. The technique uses high resolution lasers to excite individual isotopes of krypton to specifically induce 85Kr to fluoresce for detection by optical means. This report describes the development of a vacuum ultraviolet fluorescence detection system and work to characterize and reduce the background during fluorescence measurements. Also described are the results of initial experiment to characterize various schemes that will eventually be used for isotopically selective detection of 85Kr.

DOE-152
TITLE: (U) Export Control and International Safeguards Applications of Ultrasonic Intrinsic Tags

SPONSOR: DOE JUN-93
PERFORMING ORGANIZATION: Pacific Northwest Laboratory
RELATED TABLES: A0

(U) This paper examines the potential use of unique identification of metallic components by ultrasonic imaging as applied to international safeguards applications. The basic instrument, first designed for use in the START treaty, is described. The physical principles of collecting unique ultrasonic "fingerprints" from structures is then discussed. The ability to apply the system to metal structures is demonstrated. Finally, test results are displayed, the ability to miniaturize the system is discussed, and applications are examined for nonproliferation and export control.

DOE-157
TITLE: (U) Interim Report on Effluent Signatures.
Document # PNL-NST-0301

SPONSOR: DOE 30-SEP-93
PERFORMING ORGANIZATION: Pacific Northwest Laboratory
RELATED TABLES: D1,D2,D4,D5

(U) PNL-NST-0301 contains information on signatures and their quantified release rates for processes used in the development, manufacture, and deployment of nuclear weapons. Although more comprehensive than the report issued in April, 1993 (PNL-NST-0257, "Chemical Signatures"), this report represents an early draft version of the final report to be issued in September, 1994. Where possible, information has been included; where anticipated, placeholders have been used to denote where information will be supplied over the course of the upcoming year. Thus, this report will provide a framework for assembling the data and supporting information that will be used to create the final report on effluent signatures.

The information in PNL-NST-0301 was compiled from various sources with the aid of personnel at Allied Signal, Kansas City Division, Los Alamos National Laboratory, Lawrence Livermore National Laboratory, Martin Marietta Energy Systems (including the Oak Ridge K25, and Y12 facilities), Pacific Northwest Laboratory, Sandia National Laboratory, and Savannah River Technology Center.

DOE-158
TITLE: (U) Ion Trap Mass Spectrometry Combined with Inductively Coupled Plasma/Mass Spectrometry (IT-ICP/MS).
Document # PNL-SA-22550S

SPONSOR: DOE 1-JUN-93
PERFORMING ORGANIZATION: Pacific Northwest Laboratory
RELATED TABLES: D2,D3,D4

(U) The combination of an intense ion source, the inductively coupled plasma (ICP), and the unique three dimensional quadrupole ion trap mass spectrometer (ITMS) (claimed by many to be the most sensitive of mass spectrometers) suggests some significant analytical benefits. Although the current ICP/N45 capabilities with linear quadrupoles are impressive there are significant limitations, including matrix related polyatomic ions with the same nominal m/z as analytes of interest and isobaric conflicts between analytes especially those of non-natural abundance composition. The possibility of MS/MS and collisional dissociation with the ITMS and its demonstrated mass resolution capabilities indicate potentially significant benefit by its development in elemental analysis.

A prototype IT-ICP/MS instrument has been assembled using components of a commercially available ICP/MS and ITMS. Initial results indicate that atomic ions can be passed to the ITMS and successfully trapped and mass analyzed, the argon ion beam is significantly attenuated in passage to the ITMS presumably by charge transfer reactions with neutrals and/or Auger neutralization, there are significant reactions with residual water vapor in the vacuum chamber especially with strong oxide forming metals (e.g. U, Th, REEs), and the initial unoptimized detection of better than 1 ppb. Also the remaining argon ions can be neutralized after trapping leave concomitantly introduced calcium to be detected, impossible with current ICP/MS technology.

Overall the initial results are very encouraging and interesting. Future work will include techniques to reduce the background water vapor pressure. enhance sensitivity, and attempt greater mass resolution scanning techniques.

DOE-163
TITLE: (U) Letter Report on Aging in PNL Scintillating Fibers. Document # PNL-9319

SPONSOR: DOE 8-NOV-93
PERFORMING ORGANIZATION: Pacific Northwest Laboratory
RELATED TABLES: D4

(U) The Pacific Northwest Laboratory (PNL) has developed cerium-activated lithium-silicate fibers for use in neutron detection. Stability over time of the sensor units prepared from these fibers is an important issue. These fibers show a degradation in light transmission which is reference. This report describes the aging phenomenon. its cause, and methods that have been developed minimize its effects.

DOE-164
TITLE: (U) Letter Report on PNL Progress in Fabricating Glass-on-Glass Scintillating Fibers. Document # PNL-9320

SPONSOR: DOE 8-NOV-93
PERFORMING ORGANIZATION: Pacific Northwest Laboratory
RELATED TABLES: D4

(U) One potential solution to the aging problem associated with the PNL neutron-sensitive scintillating fibers is the development of a fiber in which the optical interface is buried within another glass so that corrosion does not affect the optical interface. This technique is referred to as glass-on-glass fiber drawing. This report describes the development of glass-on-glass technology in PNL's glass laboratory and the performance of these fibers.

DOE-165
TITLE: (U) Low-temperature Thermoluminescent Investigations of Trap Distributions in Scintillating Glasses

SPONSOR: DOE AUG-93
PERFORMING ORGANIZATION: Pacific Northwest Laboratory
RELATED TABLES: D4

(U) It is believed that traps control the photoluminescent lifetime and light output in scintillating glasses. In this work, the distribution of sub-thermal traps in a lithium alumino silicate glass series is measured, as a function of the composition, for samples for which the light output is known. (In some of these, the photoluminescent lifetime is also known.) The distribution of traps is determined by thermoluminescent measurements stimulated via both UV and ionizing radiation. The results were discussed the model.

DOE-166
TITLE: (U) Method for Measuring The Light Output of Scintillating Glass Shards. Document # PNL-SA-23681

SPONSOR: DOE ...
PERFORMING ORGANIZATION: Pacific Northwest Laboratory
RELATED TABLES: D4

(U) In order to determine the physical processes that govern the production of light in scintillating glasses, it is necessary to work with as-produced samples which have not been subjected to heat treatment, polishing, or other preparation. A combination of an optical system, which is insensitive to sample size and shape, and a Compton backscatter coincidence technique provides a method which gives precise and reproducible results when working with such samples.

DOE-167
TITLE: (U) Methods for Determining the History of HEU

SPONSOR: DOE 28-JUN-93
PERFORMING ORGANIZATION: Pacific Northwest Laboratory
RELATED TABLES: A6

(U) The title paper describes two methods for determining the history of HEU that will be used to produce LEU for purchase from the Russian Federation. The methods have the potential for dating the dating manufacture of the HEU and to confirm that the HEU has undergone exposure to low-level neutrons, as occurs in a nuclear weapon. A feasibility study could be completed in 12 months, which would include development of sample processing methods (based on those developed at the Pacific Northwest Laboratory for the isotopic analysis of extremely low levels of plutonium and other actinide elements) and measurements of various test samples using isotope dilution mass spectrometry. Analysis of HEU, or samples from the HEU to LEU conversion process, can potentially provide information critical to the assessment of the origin of the HEU. Isotope Dilution Mass Spectrometry is an established method that has the required sensitivity and selectivity to provide the results. A laboratory method could be in place within one year after completion of a test study.

DOE-172
TITLE: (U) PNL Scintillating Glass Fiber Neutron Sensors: Glass Fiber Production Facilities

SPONSOR: DOE 13-DEC-93
PERFORMING ORGANIZATION: Pacific Northwest Laboratory
RELATED TABLES: D4

(U) This poster described the development of PNL's glass optical fiber neutron detector systems. These systems were designed from first principles using nuclear science criteria to define the optimal characteristics. Successful execution of the sensor system has required a multi-disciplinary approach balancing the dictates of nuclear science, materials science, and optical science.

This poster told two related stories. The first describes the interplay, as seen in retrospect, of the nuclear, material, and optical science in the development of the neutron-sensitive fiber. The second describes the resolution of discrepancies between the actual performance of an operating sensor package and the expected performance.

DOE-173
TITLE: (U) PNL Scintillating Glass Fiber Neutron Sensors: Sensor Design Issues

SPONSOR: DOE 13-DEC-93
PERFORMING ORGANIZATION: Pacific Northwest Laboratory
RELATED TABLES: D4

(U) The production and optical characterization of cerium-doped lithium silicate scintillating fibers used as thermal neutron detectors was shown. Detector panels of various sizes and geometries were shown.

DOE-174
TITLE: (U) Performance and Applications of Scintillating-Glass-Fiber Neutron Sensor. Document # PNL-SA-23085

SPONSOR: DOE 24-OCT-93
PERFORMING ORGANIZATION: Pacific Northwest Laboratory
RELATED TABLES: D4

(U) Cerium-doped lithium-silicate glass fibers enriched in 6Li have been developed for use as thermal neutron detectors. Advantages of scintillating fibers over 3He or BF3 proportional tubes include flexibility in geometric configuration, ruggedness in high-vibration environments, and less detector weight for the same neutron sensitivity. Neutron detectors in a variety of shapes, configurations, and lengths up to 2 m have been produced at PNL for various applications. Flat ribbons with photomultipliers at each end are used to minimize the possibility of gamma interference. Signal pulse height spectra and data on neutron/gamma discrimination are presented.

DOE-175
TITLE: (U) Potential for Reflected S Wave Contamination of Lg RMS Measurements, as Measured at LLNL Seismic Stations from NTS Events. Document # PNL-8522

SPONSOR: DOE JAN-93
PERFORMING ORGANIZATION: Pacific Northwest Laboratory
RELATED TABLES: C1,C2,C3

(U) This report examines the potential bias in Lg RMS magnitude measurements due to reflected S wave energy. The isostatic expression of the topographic relief surrounding the Nevada Test Site is proposed as the potential reflecting mechanism for seismic waves generated by underground nuclear explosions as recorded at the four regional seismic stations run by Lawrence Livermore National Laboratory. The measured Lg RMS magnitudes are compared to the Pn magnitudes for ten nuclear events ranging in size from 4.1 to magnitude. Minimizing the error in the model:

mbPnijk = mbLgijk - *kSijk*ij + *ijk

solves for a where * is the fractional amount of original S wave energy (S) that gets reflected and attenuated and is present in the Lg RMS time window, * is an indicator of whether or not a potential reflector exists for each station (i)-event (j)-reflector (k)-datum. Data analyzed indicated that no, or very little fractional portion of the original S wave energy is added to the LG RMS (mbLg) energy. Theoretical calculations of potentially reflected S wave energy place an upper limit of 0.1 X 10-6% of the original energy arriving at the LLNL seismic stations.

The agreement between the theoretical and empirical analysis indicates that no bias in Lg RMS magnitudes due to reflected S wave energy from within the Basin and Range is detectable in the study's data set.

DOE-176
TITLE: (U) Potential for Reflected S Wave Contamination of Lg RMS Measurements, as Measured at LLNL Seismic Stations from NTS Events

SPONSOR: DOE JUN-93
PERFORMING ORGANIZATION: Pacific Northwest Laboratory
RELATED TABLES: C2,C3

(U) This work examined the potential for reflected S wave contamination of Lg RMS measurements as measured at LLNL seismic stations for NTS events. An Lg wave is a short period (0.5 to 6 sec) surface shear wave generated by earthquakes or underground nuclear explosions. It is detectable at regional distances (1500 to 3000 km) and can be used to estimate the yield of such nuclear explosions. The root mean square (RMS) average of Lg amplitudes within a time window is linearly related to the yield of an underground nuclear test. The hypothesis that reflected surface wave components (S waves) could be present in the Lg time windows and bias Lg results was tested. No such biasing was found in the study's data set.

DOE-180
TITLE: (U) Review of RPP Gas Laboratory Operations: Report of the RPP Task Force on Gas Uncertainty Estimation (GLUE). Document # PNL-8503

SPONSOR: DOE SEP-93
PERFORMING ORGANIZATION: Pacific Northwest Laboratory
RELATED TABLES: D4

(U) This report contains the findings and recommendations of a Reactor Products Program (RPP) Panel task force established to determine the basis for and resolution of an apparent 0.3% difference in counting rates between the Laboratory (MCL) at McClellan AFB, CA, and the BOC Group Technical Center Laboratory (BOC) at Murray Hill, NJ.

The primary source of the between laboratory difference is attributed to different counting rates of calibration gas at the two laboratories. The culprit has been identified as the higher counting rate of the specific calibration gas cylinder BOC between 1986 and August 1992. The cause for the different counting rate for this cylinder is unknown. A new draw was taken from the original granddaddy cylinder and the gas split between the two laboratories. The adequacy of the split has been verified and the new calibration gases are in use at both laboratories.

The impact on cumulative estimates of the program is minimal. The impact on annual estimates is minimal except 1987 for which the annual estimate is probably biased by as much as several percent.

Five methodologies were developed to improve/enhance the laboratory QC process. Some QC efforts were modified as a result of query by the Gas Laboratory Uncertainty Estimation (GLUE) task force. The methodologies developed are: partitioning the laboratory errors, afterpulse detection and effects, electro-negative impurity detection, calibrated volume evaluation, and pay sample error analysis. Efforts that were discontinued or modified are: high voltage adjustments at MCL and the method of relative load-line volume calibration at MCL.

Six recommendations for improved operations are cited in the text. The recommendations should be interpreted in the context that the laboratory operations under investigation are the best in the world at doing low level counting. This is exhibited by the fact that a 0.3% between laboratory counting bias could be measured. The six recommendations are:

1. Maintain the two laboratory capability; 2. Determine the laboratory precision/accuracy requirements for the revised program mission; 3. Understand the counter behavior at the present error levels; 4. Adopt the straight forward "fixes" for potential error sources identified by GLUE; 5. Establish a consistent procedural mechanism for loading and counting gas between the laboratories; and 6. Although the focus of the GLUE task force was laboratory operations. establish some kind of QC for field sampling.

DOE-181
TITLE: (U) SYNTH: A Gamma-Ray Spectrum Synthesizer. Document # PNL-SA-22412

SPONSOR: DOE
PERFORMING ORGANIZATION: Pacific Northwest Laboratory
RELATED TABLES: D4

(U) A computer code has been written to synthesize the results of typical gamma-ray spectroscopy experiments. The code, dubbed SYNTH, allows a user to specify physical characteristics of a gamma ray source, the quantity of the nuclides producing the radiation, the source-to-detector distance and the presence of absorbers, the type and size of the detector, and the electronic set up used to gather the data. In the process of specifying the parameters needed to synthesize a spectrum, several interesting intermediate results are produced, including a photopeak transmission function Vs energy, a detector efficiency curve, and a weighted list of gamma and x-rays produced from a set of nuclides. All of these intermediate results are available for graphical inspection and for printing.

The user interface to the program was specifically designed to allow the technical or unsophisticated operator to quickly make reasonable estimates of the final result of a measurement. The user input (either interactive or from a file) required to run the program is very simple:

- Description of the source geometry (point or disk) - A list of radionuclides and their activities (or mass) in the source -The source-detector distance and the thickness of specified absorbers - Physical parameters of the detector such as dead layer thickness, cryostat material, and others (supplied for certain default detectors) - Counting time, ADC gain, amplifier zero, gain and non-linearity.

The result is a spectrum which includes features such as photopeaks, Compton edges, single and double escape peaks, statistical fluctuations, and appropriate Peak-to-Compton ratios. Since the code allows actual background spectra to be incorporated, extraordinarily accurate spectra are generated. Th code has been validated against laboratory measurements with excellent correlation.

DOE-186
TITLE: (U) Separation of Oxide Particles by Capillary Electrophoresis. Document # PNL-SA-23190

SPONSOR: DOE 30-SEP-93
PERFORMING ORGANIZATION: Pacific Northwest Laboratory
RELATED TABLES: D1,D4

(U) Methods have been developed for fast separations of various oxide particles by capillary electrophoresis. The influences of electric field strength, buffer type and buffer concentration on effectiveness of separations have been determined and evaluated and optimum separation conditions have been identified. The effect of particle size on electrophoretic migration times for UO2 and Fe3O4 particles has been determined and shown to be negligible. Reproducibility of electrophoretic runs of oxide particles was high with the average of the relative standard deviations of the migration times of 27 different particle zones being 0.4%. From these studies a capillary electrophoretic method for separations of UO2 particles from aluminum oxide particles and from ambient dust particles was developed and demonstrated.

DOE-187
TITLE: (U) Spectrally Resolved Fluorescence Decay Lifetimes for Scintillators

SPONSOR: DOE MAR-93
PERFORMING ORGANIZATION: Pacific Northwest Laboratory
RELATED TABLES: D4

(U) It is known that fluorescence decay lifetimes for rare-earth-doped silicates differ for stimulation by lasers and by ionizing radiation. In most cases, stimulation by ionizing radiation results in additional components to the fluorescent decay time, compared to that for stimulation by lasers. Understanding the nature of the light emission in the two cases can give important insight into the nature of the scintillation process. We have examined the spectrally resolved fluorescence decay lifetimes for several cerium-containing scintillating glasses and crystalline materials stimulated by laser radiation.

DOE-188
TITLE: (U) The Effects of Thermal History and Structure on Light Output of Scintillating Glasses

SPONSOR: DOE MAR-93
PERFORMING ORGANIZATION: Pacific Northwest Laboratory
RELATED TABLES: D4

(U) The spectral output of lanthanide-containing, fluorescing glasses has been shown to vary significantly with small changes in composition.(b) This variation has been attributed to spatial correlations between network modifiers and fluorescent centers. We measure the scintillation light output, for fixed energy deposition, of cerium-doped, lithium-silicate based glasses as a function of alkali, aluminum oxide, cerium oxide concentration, and annealing history. In this system, the cerium outer electron cloud serves as a sensitive probe of the local glass structure. From these measurements, a sensitivity matrix relating the light output to the structure is developed and presented and related to previous work. A conceptual model for the behavior of the light output is also presented.

DOE-189
TITLE: (U) The Nevada Test Site All-Sources Data Base: A First Look Assessment

SPONSOR: DOE JUN-93
PERFORMING ORGANIZATION: Pacific Northwest Laboratory
RELATED TABLES: C2,C3

(U) A preliminary evaluation of the Nevada Test Site (NTS) All-Sources Data Base has been completed. Several labs maintain this database, which is composed of a significant number of measurements and data pertaining to nuclear weapons testing at NTS. The contents of the LLNL portion of the database was evaluated. The project concluded that, although the data within coding fields appears consistent, and there are no gross errors in non-missing data items, more detail in the data descriptions would encourage more widespread use by other researchers in treaty verification or seismic analysis.

DOE-193
TITLE: (U) Technical Design and Performance Evaluation of Rapid-Cure Adhesive Systems for the Commercial Production of Tamper Tape Seals

SPONSOR: DOE JUN-93
PERFORMING ORGANIZATION: Pacific Northwest Laboratory /Battelle Columbus Laboratories
RELATED TABLES: D4

(U) The objective of this work was to develop the technical concepts for a rapid-cure adhesive system that could be applied to commercial tamper tape materials. These efforts involved elimination of the pressure sensitive adhesive on the present tamper tape materials and substitution of a reactive, thermoset adhesive more suitable to the security performance goal. To meet this objective, it was necessary to select and develop adhesives with the best balance of 1) fast cure time, 2) good adhesion to a wide range of substrates, and 3) resistance to mechanical, heat and solvent attack that may be used by an adversary to remove the tamper tape without damaging it.

Extensive adhesive formulation work was carried out using commercially available components with three types of reactive, thermoset systems: polyurethanes, epoxies, and acrylics. The best results were achieved with an epoxy adhesive, utilizing four synergistic curing agents. Tamper tapes bonded wiTh this epoxy formulation had strong adhesion to The substrates used in earlier work. i.e., roughened steel and aluminum, wood, and concrete block. Good adhesion was also obtained on two of the new substrates introduced during this work, i.e., MIL Spec polyurethane paint and epoxy fiberglass board. Moreover, this adhesive also performed well on oily and wet steel surfaces and on substrates equilibrated at 38oF. Bonding to two of the new substrates (Lexan polycarbonate and rigid PVC) was inadequate with any of the reactive systems to prevent removal of The tamper tapes without damage. Other candidate adhesives were also identified.

Continuing work is addressing the packaging and dispensing options for a user friendly and effective rapid-cure adhesive system for tamper tape seals.

DOE-194
TITLE: (U) Vitrification Destruction of Nerve Agents

SPONSOR: DOE AUG-93
PERFORMING ORGANIZATION: Pacific Northwest Laboratory /Battelle Memorial Institute
RELATED TABLES: D5,E2

(U) This study examines the efficacy of vitrification destruction of nerve agents. Exploiting the Battelle Hazardous Materials Research Facility in West Jefferson, OH, two trials were conducted in which 1.9 grams GB and 1.26 grams VX were destroyed in a bench- scale vitrification furnace. The GB trial consisted of 15 flasks of agent being introduced into the furnace at the rate of one per minute. The VX trial consisted of 10 flasks of introduced at the rate of one per minute. The furnace had an agent residence time of 6.06 seconds for GB and 3.96 seconds for VX. The GB trial data was generated by analyzing impingers collected during the agent destruction phase by gas chromatography. The VX trial data was generated by analyzing impingers collected during the agent destruction phase by Autotechnicon II Autoanalyzer. The destruction efficiency for each trial indicate furnace is capable of destroying agent from 99.999 (GB) to 99.99999 (VX) percent efficiency.

DOE-195
TITLE: (U) Recommendations Regarding a Clean Laboratory Facility for Processing Environmental Samples

SPONSOR: DOE 11-OCT-93
PERFORMING ORGANIZATION: Pacific Northwest Laboratory /DOE NN-40
RELATED TABLES: D4

(U) The IAEA invited two cost free experts from U.S. Department of Energy laboratories to meet with various IAEA representatives between 27 September and 1 October, 1993. The Agency was interested in obtaining expert advice on the siting, design, and operation of a clean laboratory that will support the recommended environmental sample measurements. The following issues were addressed:

1. What is the need for clean laboratory? 2. What operations should a clean laboratory support? 3. Where should it be located? 4. What is the optimum design for this facility? 5. What analytical procedures should be implemented? 6. What are the manpower requirements for operating the clean laboratory? 7. What technical assistance may be provided by member state laboratories for design, personnel training, and procedure development? 8. Archiving of samples.

This report describes the results of addressing the above questions, including a discussion of recommendations for the facility and for continued expert consultation.

DOE-201
TITLE: (U) DOE Task ST557 Advance Tamper Indicating Packaging (TIP) Technologies FY93 Report

SPONSOR: DOE DEC-93
PERFORMING ORGANIZATION: Sandia National Laboratory
RELATED TABLES: D4

(U) Tamper Indicating Packaging (TIP) technologies and devices provide an indication of a tamper attempt either visually or electronically. These technologies have been developed to detect the penetration of a container, the unauthorized opening of a container, the substitution of a container, and the tampering of sensitive components within a container. TIP technologies are adapted to containers, packages, or equipment that require indication of a tamper attempt. Examples include: nuclear material sample containers, surveillance equipment, monitoring sensors, and medicine and food products. The Department of Energy has tasked Sandia National Laboratories (SNL) to develop a technology base for advanced TIP materials, sensors, designs, and processes which can be adapted to various future monitoring systems. The purpose of this project is to investigate potential new technologies, and to perform basic research of advanced technologies, thereby providing leverage to future monitoring systems by decreasing the development time and cost. This report describes the FY93 achievements of this task.

DOE-202
TITLE: (U) Python Fiber-Optic Seal

SPONSOR: DOE JUL-93
PERFORMING ORGANIZATION: Sandia National Laboratory
RELATED TABLES: D4

(U) Sandia National Laboratories (SNL) has developed a high-security fiber-optic seal that incorporates tamper-resistance features not available in commercial fiber-optic seals. The Python Seal is a passive fiber-optic loop seal designed to give indication of unauthorized entry. The seal includes a fingerprint feature that provides seal identity information in addition to the unique fiber-optic pattern created when the seal is installed. The fiber-optic cable used for the seal loop is produced with tamper-resistant features that increase the difficulty of attacking this component of a seal. A Seal Reader has been developed that records the seal signature and the fingerprint feature of the seal. A Correlator software program compares seal images to establish a match or mismatch. SNL also is developing a Polaroid Reader to permit hard copies of the seal patterns to be obtained directly from the seal.

DOE-203
TITLE: (U) Sample Vial Secure Container (SVSC)

SPONSOR: DOE JUL-93
PERFORMING ORGANIZATION: Sandia National Laboratory
RELATED TABLES: D4

(U) International Atomic Energy Agency (IAEA) inspectors must maintain continuity of knowledge on all safeguard samples and, in particular, on those samples drawn from plutonium product and spent fuel input tanks at a nuclear reprocessing plant's blister sampling station. Integrity of safeguard samples must be guaranteed from the sampling point to the moment of sample analysis at an accepted local laboratory or at the IAEA's Safeguards Analytical Laboratory (SAL) in Seibersdorf, Austria. The safeguard samples are drawn at a blister sampling station with inspector participation and then transferred via a pneumatic post system to the facility's analytical laboratory. Transfer of the sample by the pneumatic post system, arrival of the sample in the operator's analytical laboratory, and storage of the sample awaiting analysis are very time consuming activities for an inspector, particularly if continuous human surveillance is required for all these activities. These activities could be observed by ordinary surveillance methods, such as a video monitoring system, but this would be cumbersome and time consuming for both the inspector and the operator. This paper describes a secure container designed to assure sample vial integrity from the point the sample is drawn to treatment of the sample at a facility's analytical laboratory.

DOE-209
TITLE: (U) China's Future As A Nuclear Supplier

SPONSOR: DOE 30-APR-93
PERFORMING ORGANIZATION: Science Applications International Corp.
RELATED TABLES: D1

(U) This paper examines China's military and civilian nuclear infrastructure, to determine capabilities and potential. In addition China's nuclear export mechanisms are assessed. Both China's past record as a nuclear supplier and recent international behavior are examined. Finally, the paper discusses possible future directions in Chinese nuclear trade and looks at possible U.S. responses.

DOE-210
TITLE: (U) Country Statements at the Preparatory Committee Meeting on the Renewal of the Nuclear Non-Proliferation Treaty

SPONSOR: DOE 25-JAN-93
PERFORMING ORGANIZATION: Science Applications International Corp.
RELATED TABLES: D1

(U) The purpose of this paper was to assess whether the statements of a cross-section of Nuclear Non-Proliferation Treaty (NPT) parties could provide insight on potential issues and outcomes for the 1995 NPT Extension Conference.

DOE-211
TITLE: (U) Country Statements at the Preparatory Committee Meeting on the Renewal of the Nuclear Non-Proliferation Treaty

SPONSOR: DOE 19-MAY-93
PERFORMING ORGANIZATION: Science Applications International Corp.
RELATED TABLES: D1

(U) This document summarizes the main themes of a set of NPT States Parties at the first meeting of the Preparatory Committee for the 1995 Review Conference, May 1993. In some instances it comments on the consistency of these statements with earlier statements made by the same States.

DOE-212
TITLE: (U) Department of Energy Foreign Deployment Planning For Nonproliferation Missions: A Checklist and Handbook

SPONSOR: DOE 19-MAR-93
PERFORMING ORGANIZATION: Science Applications International Corp.
RELATED TABLES: D5

(U) This paper was intended to raise the questions that the Department of Energy (DoE) should ask itself when preparing to deploy personnel overseas in support of important new missions, i.e. the deployment of DoE personnel in Iraq to assist in locating and destroying or rendering harmless the components of Iraq 's nuclear weapons program. The paper is the result of two conferences, which examined the lessons to be learned from the experience.

DOE-213
TITLE: (U) Effect of Export Nonproliferation Export Controls

SPONSOR: DOE 24-SEP-93
PERFORMING ORGANIZATION: Science Applications International Corp.
RELATED TABLES: D1,D9

(U) This briefing reviewed the effects of nonproliferation export controls on the weapons programs of its target countries based on their political commitment to developing weapons of mass destruction.

DOE-214
TITLE: (U) Enhancing The Effectiveness Of Nonproliferation Export Controls

SPONSOR: DOE 4-MAR-93
PERFORMING ORGANIZATION: Science Applications International Corp.
RELATED TABLES: B4,E5,D9

(U) Past revelations of secret nuclear acquisitions by countries like Iraq emphasize the need to improve the Nuclear Suppliers group, Missile Technology Control Regime, Zangger Committee, and Australia Group export control regimes. This paper reviews measures which could be taken by the regime members and by various international organizations to raise the cost of proliferation and increase the effectiveness of export controls in stopping the spread of weapons of mass destruction.

DOE-221
TITLE: (U) Strategic Planning Workshop on Chemical Weapons Convention Support

SPONSOR: DOE 3-JUN-93
PERFORMING ORGANIZATION: Science Applications International Corp.
RELATED TABLES: E1

(U) This workshop report discusses a number of steps that DOE could consider taking to support the CWC Preparatory Commission and plan for DOE's internal implementation of the CWC's requirements. Specific actions that are discussed include utilizing the practical lessons from U.S. experience with support for implementation of IAEA safeguards; using DOE experience in the selection, modernization and development of equipment for the IAEA; assisting PrepCom planning for rapid start-up of CWC inspections and other implementation activities; identifying technology gaps that should be addressed by the Provisional Secretariat to the PrepCom; and helping to draft "model" implementing legislation that the U.S. government could introduce into the PrepCom process.

DOE-222
TITLE: (U) Strengthening Biological Weapons Nonproliferation: An Inventory of Proposals

SPONSOR: DOE OCT-93
PERFORMING ORGANIZATION: Science Applications International Corp.
RELATED TABLES: E2

(U) This paper provides a brief overview of BW proliferation trends, including the potential implications of the biotechnology revolution. It identifies and assesses the pros and cons of a set of measures that have been proposed to strengthen BW nonproliferation.

DOE-223
TITLE: (U) Supplement to the Briefing Book on the 1995 Extension Conference for the Non-Proliferation Treaty

SPONSOR: DOE 30-MAR-93
PERFORMING ORGANIZATION: Science Applications International Corp.
RELATED TABLES: D1

(U) The supplement provides background documents used in the analysis of both procedural and substantive issues that maybe faced at the 1995 Extension Conference for Nuclear Non-Proliferation.

DOE-224
TITLE: (U) The Proliferation of Weapons of Mass Destruction: Current Situation, Policy Responses, and Possible Future Initiatives

SPONSOR: DOE 10-FEB-93
PERFORMING ORGANIZATION: Science Applications International Corp.
RELATED TABLES: D1,B4

(U) This paper addresses nuclear weapons proliferation and missile proliferation. It examines the current situation, the policy responses to proliferation, along with future potential problems and policy initiatives for nuclear proliferation. In addition the paper discusses the both potential and current nuclear rollback and capping scenarios.

The paper also addresses the current missile proliferation situation and various existing means of preventing proliferation. It also reviews potential opportunities for capping or rolling back missile proliferation.

DOE-225
TITLE: (U) The Soviet Successor States and U.S. Nuclear Cooperation Agreements: Export Control and Safeguard Issues

SPONSOR: DOE 13-APR-93
PERFORMING ORGANIZATION: Science Applications International Corp.
RELATED TABLES: D1

(U) This paper surveys the civilian nuclear assets of the non-Russian former Soviet republics, concentrating on U.S. non-proliferation goals and safety concerns. The study contains point-by-point recommendations for specific Newly Independent States facilities or problem areas of a non-proliferation or safety character.

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DOCUMENT NO. AND TYPE	SUBJECT/TITLE	DATE	RESTRICTION
001. draft	Classified Addendum to the Report to Congress on Arms Control, Nonproliferation and Disarmament Studies Completed in 1993. [incomplete copy] (9 pages)	07/29/1994	P1/b(1)

COLLECTION:
Clinton Presidential Records
National Security Council
Defense Policy and Arms Control (Robert Bell)
OA/Box Number: 266

FOLDER TITLE:
Chron File - August 1994 #3 [3]

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UNITED STATES ARMS CONTROL AND DISARMAMENT AGENCY

Washington, D.C. 20451

OFFICE OF
THE DIRECTOR

JUL 29 1994

MEMORANDUM FOR:

MR. WILLIAM H. ITOH
Executive Secretary
National Security Council

MR. MARC GROSSMAN
Executive Secretary
Department of State

COL ROBERT P. MCALEER
Executive Secretary
Department of Defense

MS. ANN W. LAVIN
Director, Executive Secretariat
Department of Energy

MR. DOUGLAS F. GARTHOFF
Executive Secretary
Central Intelligence Agency

COL T. R. PATRICK
Secretary, Joint Staff
Joint Chiefs of Staff

SUBJECT: Report to Congress on Arms Control, Nonproliferation and Disarmament Studies Completed in 1993 (U)

Attached are the "Report to Congress on Arms Control, Nonproliferation and Disarmament Studies Completed in 1993," including a classified addendum as called for by Section 39 of the Arms Control and Disarmament Act, and the associated transmittal letters to the Congress. This year's report, which was due to Congress on 30 June, has been revised to include an assessment. (U)

Please provide clearance to Al Lieberman (202-647-4695) **by Noon, Thursday, August 11, 1994.** (U)

Barbara Starr
Barbara Starr
Executive Secretary

Attachments:
As stated

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NATIONAL SECURITY COUNCIL
WASHINGTON, D.C. 20506

6171

August 24, 1994

ACTION

MEMORANDUM FOR WILLIAM H. ITOH

THROUGH: ROBERT G. BELL RGB for

FROM: ANNE WITKOWSKY AAW

SUBJECT: ACDA Report to Congress on Arms Control, Nonproliferation and Disarmament Studies Completed in 1993

ACDA has submitted the subject report to NSC staff for review. The report has been interagency cleared as drafted. We have made minor changes which are marked on the report and which have been transmitted to ACDA telephonically. With these changes we recommend approval.

In draft In draft SAB

Concurrences by: Bill Danvers, Elisa Harris, Steve Andreasen

RECOMMENDATION

That you forward the attached memorandum approving the ACDA Report.

Attachments
Tab I Memorandum to ACDA Executive Secretary
Tab A ACDA Report to Congress

UNCLASSIFIED
~~with SECRET Attachment~~

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