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**Defense Nuclear Agency
Alexandria, VA 22310-3398**



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**Summary of the Proceedings of the
Defense Nuclear Agency Conference on
Arms Control and Verification Technology (ACT)
1 - 4 June 1992**

**Kaman Sciences Corporation
Engineering Sciences Division
2560 Huntington Avenue
Suite 200
Alexandria, VA 22303**

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6801 TELEGRAPH ROAD
ALEXANDRIA, VA 22310-3398

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13. ABSTRACT (Maximum 200 words) The first Defense Nuclear Agency Conference on Arms Control and Verification Technology provided an international forum for over 200 individuals from the arms control verification technology and national security communities for discussion on the future of arms control verification and technology developments. Papers were presented in the following sessions: Future Arms Control Initiatives, Interface between Intelligence and Arms Control, Lessons Learned, Proliferation in a Changing World Technologies - Roles and Applications, and Economics of Arms Control. Plenary sessions were held for general presentations on the future role of verification technology and negotiating and implementing verification measures. The conference papers will be published separately.				
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Summary of the Conference on
Arms Control and Verification Technology
Williamsburg, Virginia
1-4 June 1992

PREFACE

With the commencement of the post-Cold War era and the changes occurring in the international security environment, the nature of arms control is evolving in terms of purpose, scope, process, and application. The traditional forms of arms control negotiation and verification, designed to ensure compliance in a bipolar and adversarial climate, are being transcended by arms control initiatives and verification measures that are designed to ensure stability and balance in the rapidly changing and uncertain international environment. Future arms control will likely consist of a mix of approaches involving new formal agreements, modifications to or strengthening of existing agreements, unilateral initiatives, and reciprocal actions. Significant arms control events -- the signing of the CFE and START treaties and the Open Skies Agreement; the effective implementation of the INF Treaty; the conduct of difficult, technically-complex on-site inspections in Iraq by U.N. teams; the potential conclusion of arduous negotiations on a Chemical Weapons Convention; the further reductions in nuclear force structure agreed to by Presidents Bush and Yeltsin -- have demonstrated the need to explore the changes occurring in arms control in general and the role that arms control verification will play, in particular.

The Defense Nuclear Agency, in its capacity as the Executive Agent for research, development, test, and evaluation of arms control verification technologies for the U.S. Department of Defense, in conjunction with the Office of the Under

Secretary of Defense (Acquisition) convened an international conference to examine the changing role of arms control verification in an effort to respond more effectively to the challenge of conducting verification technology research and development. The conference brought together a group of experts and officials from the arms control policy and verification technology communities to discuss future arms control initiatives, the interface between intelligence and arms control, lessons learned, proliferation in a changing world, verification technologies, and the economics of arms control. The conference was attended by government, military, industry, and academic representatives from the United States, Russia, Canada, the United Nations, and the North Atlantic Treaty Organization. It provided a unique opportunity to identify and explore verification approaches and applicable technologies for future arms control agreements and it offered an opportunity for verification technologists and policy-makers to exchange views and insights on the future of arms control policy and verification technology development.

The following summary of proceedings is based on presentations and comments made during the conference sessions. No effort has been made to establish a consensus or agreement in the contents of the report, however some general conclusions are drawn regarding selected issues and questions. With exceptions of selected plenary presentations, participants' remarks are not attributed.

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**Conference on Arms Control and
Verification Technology
List of Attendees**

Don Alderson
DASIAC/KSC
2560 Huntington Ave., Suite 500
Alexandria, VA 22303

Alane A. Andreozzi-Beckman
DNA/OPAC
6801 Telegraph Road, B-55
Alexandria, VA 22310-3398

Robert T. Andrews
LLNL
P.O. Box 808, L-389
Livermore, CA 94550

Kenneth E. Apt
LANL
Box 1663, E550
Los Alamos, NM 87545

Robert August
NRL
4555 Overlook Ave SW MS-4616
Washington, DC 20375-5000

Linda Ault
LLNL
Box 808, L-304
Livermore, CA 94550

Kathleen Bailey
National Security Research
3031 Javier Rd.
Fairfax, VA 22031

Andre A. Bair
SAIC
1710 Goodridge Dr., 1-9-4
McLean, VA 22102

Ellen Banaghan
LLNL
Box 808, L-228
Livermore, CA 94550

James Barden
Kaman Sciences
2560 Huntington Ave.
Alexandria, VA 22303

Jack Bartberger
SNL
Box 5800, 9249
Albuquerque, NM 87185

Lt Col Richard G. Bjurstrom
DNA/OPAC
6801 Telegraph Road
Alexandria, VA 22310-3398

Stephen Black
Carnegie Mellon University
131 Baker Hall
Pittsburgh, PA 15213

Sal Bosco
Battelle
1725 Jefferson Davis Hwy, Suite 600
Arlington, VA 22202-4172

Paul S. Brown
LLNL
7000 East Avenue, L-20
Livermore, CA 94550-9900

LCDR Andrew J. Buesking
U.S. Navy
OP-65
Pentagon, Room 405G2
Washington, DC 20350-2000

Lisa Burdick
OASD/ISP/CF&ACP/ESN
Pentagon, Room 1C477
Washington, DC 20301

Randy Cabeen
BDM
1801 Randolph Rd. SE, BV 40
Albuquerque, NM 87106

Jack Caravelli
CIA
1301 N. Court House Rd., #1611
Arlington, VA 22201

Raymond E. Carpenter
SNL
Box 5800, 9249
Albuquerque, NM 87112

Jerome Chen
LANL
Group MEE-3, J580
Los Alamos, NM 87545

David J. Chesnut
BDM International
7915 Jones Branch Dr., JB SC23
McLean, VA 22102

Ron Cleminson
Ministry of External Affairs &
International Trade, Canada
125 Sussex Dr., IDA
Ottawa, Ontario Canada K1A 0G2

George Connell
Hughes Technical Services
1100 Wilson Blvd., 18th Flr
Arlington, VA 22209

Gary Cruttenden
BDM International
7915 Jones Branch Dr., FB 3B410
McLean, VA 22102

James B. Curren
BDM International
7915 Jones Branch Dr., JB 4C16
McLean, VA 22102

Steven P. Curtis
DOE
2753 S. Highland Dr., #505
Las Vegas, NV 89109

Marie E. Danco
BDM International
7915 Jones Branch Dr., JB 4C18
McLean, VA 22102-3396

Bradley S. Davis
HQ USAF/XOXXI
Pentagon, Room 4C1061
Washington, DC 20330-5057

Robert M. DeBell
Kaman Sciences
2560 Huntington Ave.
Alexandria, VA 22303

Kenneth E. deGraffenreid
JAYCOR
1608 Spring Hill Road
Vienna, VA 22182-2270

Marvin Denny
DOE
1000 Independence Ave. SW (DP 5.11)
Washington, DC 20585

Lee Denson
SAIC/CVR
8500 Cinder Bed Road, Box 1148
Newington, VA 22122-9998

Alexander DeVolpi
Argonne National Lab
9700 S. Cass Ave., Bldg. 207
Argonne, IL 60442

Cosmo DiMaggio
System Planning Corp.
1500 Wilson Blvd., 1540
Arlington, VA 22209-2454

Pauline R. Dobranich
SNL
Box 5800, 9241
Albuquerque, NM 87185

James C. Doyle
LANL
Box 1663, MS F684
Los Alamos, NM 87545

Lewis A. Dunn
SAIC
1710 Goodridge Dr., 1-9-5
McLean, VA 22102

Stephen A. Dupree
SNL
Box 5800, 9249
Albuquerque, NM 87185

Joseph A. Duquette
Raytheon
2 Wayside Road, 100
Burlington, MA 01803

Gary Eifried
EAI Corporation
1308 Continental Dr., Suite J
Abingdon, MD 21009

Donald D. Eilers
EG&G
105 La Vista Drive
Los Alamos, NM 87544

Ambassador Rolf Ekeus
United Nations
New York, NY

Phyllis A. Epstein
BDM International
7915 Jones Branch Dr., 5C26/JB
McLean, VA 22102

Scott H. Evans
DNA/OPAC
6801 Telegraph Road
Alexandria, VA 22310-3398

Mary Margaret Evans
OSD
Pentagon, Room 3B1060
Washington, DC 20301-3100

David W. Evans
JAYCOR
1608 Spring Hill Road
Vienna, VA 22182-2270

COL M.K. Evenson
DNA/OPAC
6801 Telegraph Road
Alexandria, VA 22310-3398

Dennis Fargo
Meridian
4300 King St., Suite 400
Alexandria, VA 22302-1508

James C. Fargo
SAIC/CVR
8500 Cinder Bed Road, Box 1148
Newington, VA 22122-9998

Steve Fetter
University of Maryland
School of Public Affairs
College Park, MD 20742

Patricia A. Fetters
DNA/OPAC
6801 Telegraph Road
Alexandria, VA 22310-3398

Roy S. Finno
BDM International
7915 Jones Branch Dr., JB 4C15
McLean, VA 22102-3396

Mark Fischer
BDM
1801 Randolph Rd. SE, BV 40
Albuquerque, NM 87106

Arthur H. Fitch
Global Outlook
405 Lytton Avenue
Palo Alto, CA 94301

Lt Col Leo Florick
National Security Agency
DIR NSA/V612
Ft. Meade, MD 20755

Ken Fortner
DNA/OPAC
6801 Telegraph Road
Alexandria, VA 22310-3398

Jonathan D. Fox
DNA/OPAC
6801 Telegraph Road
Alexandria, VA 22310-3398

Steve Frankiewicz
Kaman Sciences
2560 Huntington Ave.
Alexandria, VA 22303

Mary Freeman
Kaman Sciences
2560 Huntington Ave.
Alexandria, VA 22303

Dave Freeman
DNA/AM
6801 Telegraph Road
Alexandria, VA 22310

Roger N. Fritzel
PSR
1401 Wilson Blvd.
Arlington, VA 22209

Mark Frondorf
SAIC
1710 Goodridge Drive, 1-9-4
McLean, VA 22102

James Fuller
DOE
1000 Independence Ave., DP 5.11
Washington, DC 20585

Linda Gaines
Argonne National Lab
9700 S. Cass Ave.
Argonne, IL 60439

Barbara Gatti
JAYCOR
1608 Spring Hill Rd.
Vienna, VA 22182-2270

Robert G. Geil
LLNL
7000 East Ave MS-L205
Livermore, CA 94550

Lawrence S. Germain
Logicon RDA
2600 Yale SE
Albuquerque, NM 87106

Gregory Giles
SAIC
1710 Goodridge Dr., 1-9-5
McLean, VA 22102

Ambassador Maynard Glitman
U.S. Delegation to INF Negotiations
Route 108
Fletcher, VT 05464

William C. Golbitz
System Planning Corp.
1500 Wilson Blvd., 1333
Arlington, VA 22209-2454

Sidney Graybeal
SAIC
1710 Goodridge Dr., T1-9-3
McLean, VA 22102

John Green
OUSD(A)
Pentagon, Room 3C124
Washington, DC 20301

Jeffrey H. Grotte
IDA
1801 N. Beauregard St.
Alexandria, VA 22311

Joseph Grubb
Meridian
4300 King St., Suite 400
Alexandria, VA 22302

Maj Gen Kenneth Hagemann
DNA
6801 Telegraph Road
Alexandria, VA 22310-3398

George T. Havrilak
HQ USAF/XOXXI
Pentagon, Room 4C 1061
Washington, DC 20330-5057

Ted Hedin
BDM
1801 Randolph Rd. SE, BV 40
Albuquerque, NM 87106

Jim Higbie
BDM
1801 Randolph Rd. SE, BV 40
Albuquerque, NM 87106

Benny Hill
BDM
1801 Randolph Rd. SE, BV 40
Albuquerque, NM 87106

Capt William D. Hinton
USAF FCDNA/FCPRC
Kirtland AFB, NM 87117-5000

Sally K. Horn
OASD (ISP)
Pentagon, Room 1E 775
Washington, DC 20301-2600

Forrest A. Horton
JAYCOR
1608 Spring Hill Rd.
Vienna, VA 22182-2270

Richard W. Hutchinson
Chem Research, Dev & Eng Ctr
SMCCR-MUM
APG, MD 21010-5423

James L. Hyatt, III
HQ USAF/XOXXI
Pentagon, Room 4C 1061
Washington, DC 20330-5057

Joseph P. Indusi
Brookhaven National Lab
Building 197C
Upton, NY 11973

Gennadiy Ivanov
Institute of Technical Physics
Chelyabinsk 454070
Russia

William N. Jackomis
Allied Signal Aerospace
1530 Wilson Blvd., Suite 1000
Arlington, VA 22209

Randall L. Johnston
DNA/OPAC
6801 Telegraph Road
Alexandria, VA 22310-3398

Ambassador Robert G. Joseph
ACDA
320 21st ST. NW
Washington, DC 20451

J.J. Kelly
PSR
1401 Wilson Blvd.
Arlington, VA 22209

Barbara Killian
Logicon RDA
2600 Yale SE
Albuquerque, NM 87106

Steven King
NRL
4555 Overlook Ave SW MS-4616
Washington, DC 22152

Michelle Kluska
BDM International
7915 Jones Branch Dr., 5C/30
McLean, VA 22102

Nerses H. Krikorian
LANL
Box 503, B224
Los Alamos, NM 87544

Barbara E. Lord
SAIC
1710 Goodridge Dr., 1-9-3
McLean, VA 22102

Dennis L. Mangan
SNL
Box 5800, 9249
Albuquerque, NM 87112

Mark B. Jackson
FCDNA/FCPRC
Kirtland AFB, NM 87117-5000

James L. Jones
Idaho National Eng. Lab.
Box 4000, MS 2802
Idaho Falls, ID 83403

Jack L. Kangas
IDA
1801 N. Beauregard St.
Alexandria, VA 22311

Ruth Kempf
Brookhaven National Lab
Building 197C
Upton, NY 11973

Mark. H. Killinger
Pacific Northwest Laboratory
Box 999, K6-63
Richland, WA 99352

Rick King
USAF
21A Eagan Ave.
Langley AFB, VA 23665

Tom Knutilla
Kaman Sciences
2560 Huntington Ave.
Alexandria, VA 22303

Susan D. Leibbrandt
OUSD(A) OATSD AE
Pentagon, Room 3C124
Washington, DC 20301

William C. Lynch
International Disarmament Corp
1020 19th Street Suite 800
Washington, DC 20036

Thomas J. Marshall
SAIC
1710 Goodridge Dr., 1-7-3
McLean, VA 22102

Frank Jenkins
SAIC
1710 Goodridge Dr., T1-9-3
McLean, VA 22102

Heikki Joonsar
SAIC/CVR
8500 Cinder Bed Road, Box 1148
Newington, VA 22122-9998

David Kay
Uranium Institute
12th Floor, Bowater House
68 Knightsbridge
London, UK SW1 X7LT

Jon Kessmeier
SAIC
1710 Goodridge Dr., 1-9-4
McLean, VA 22102

Charles V. Kincaid
SAIC/CVR
8500 Cinder Bed Road, Box 1148
Newington, VA 22122-9998

Julia L. Klare
IDA
1801 N. Beauregard St.
Alexandria, VA 22311

Helmuth A. Koehler
LLNL
P.O. Box 808 MS-41
Livermore, CA 94550

Paul S. Lewis
LANL
Group MEE-3, J580
Los Alamos, NM 87545

David P. MacKenzie
USAF
HQ ESD/AVJ
Hanscom AFB, MA 01731

Patricia McFate
SAIC
1710 Goodridge Dr., T1-9-3
McLean, VA 22102

Steven J. McKay
Pacific-Sierra Research
1401 Wilson Blvd., Suite 1100
Arlington, VA 22209

Robert E. McMains
SAIC
1710 Goodridge Drive, 1-9-3
McLean, VA 22102

R. William Mengel
EAI Corporation
1308 Continental Dr.
Abingdon, MD 21009

CAPT Ellen Merkle
OSIA
Attn: Monitoring Operation
Washington, DC 20041-0498

COL Michael D. Miggins
NATO
US MSV, PSC81
APO AE 09724

John Milam
BDM International
7915 Jones Branch Dr.
McLean, VA 22102

Milton Miles
Battelle
1725 Jefferson Davis Hwy, Suite 600
Arlington, VA 22202-4172

Lee P. Minichiello
Department of Defense
3109 44th St. NW
Washington, DC 20016

Vladimir E. Minkov
Argonne National Lab
9700 S. Cass Ave MS-316
Skokie, IL 60439

Maurice M. Mizrahi
OASD (PA&E) SOFD
Pentagon, Rm 2E274
Washington, DC 20301

Don Moffett
DASIAC/KSC
2560 Huntington Ave., Suite 500
Alexandria, VA 22303

Bradley L. Moffett
HQ USAF/XOXXI
Pentagon, Room 4C 1061
Washington, DC 20330-5057

Roger Molander
Rand
2100 M Street NW
Washington, DC 20007

Catherine J. Montie
DNA/OPAC
6801 Telegraph Road
Alexandria, VA 22310-3398

William M. Moon
DNA/OPAC
6801 Telegraph Road
Alexandria, VA 22310-3398

Stephen S. Morse
The Rockefeller University
1230 York Avenue, Box 2
New York, NY 10021-6399

Anne Morton
BDM International
7915 Jones Branch Dr., JB SC20
McLean, VA 22102

Sallie A. Mullen
DOE
IN-10, GA-301/FORS
10th & Independence Ave. SW
Washington, DC 20585

Blair L. Murray
SAIC
1710 Goodridge Dr., 1-9-5
McLean, VA 22102

Roy H. Nelson
FCDNA/FCPRC
Kirtland AFB, NM 87109

Matthew A. Nichols
US Army Strategic Defense Com
Box 1500
Huntsville, AL 35807

Alexander Noguera
Computer Resulting
1274 Terra Bella Ave
Mountain View, CA 94039-7244

Louis V. Nosenzo
Meridian
4300 King St., Suite 400
Alexandria, VA 22302

Michael O'Hanlon
Congressional Budget Office
H2-462, U.S. Congress
Washington, DC 20515

George V. Oksza-Chocimowski
DOE
2753 S. Highland Ave., #505
Las Vegas, NV 89109

Morris Outwater
USAF
ESD/AVJB
Hanscom AFB, MA 01731

Maj Gen Robert Parker
OSIA
Washington, DC 20041-0498

John A. Parmentola
MITRE
Burlington Rd., M346
Bedford, MA 01730

LTC B.E. Pate
DNA/OPAC
6801 Telegraph Road
Alexandria, VA 22310-3398

James P. Peak
ACIS
25 Rutherford Circle
Sterling, VA 22170

Paul J. Persiani
Argonne National Lab
9700 S. Cass Ave.
Argonne, IL 60439

Daryl Peterson
Idaho National Eng. Lab
Box 4000, MS 2202
Idaho Falls, Idaho 83403

Alexsey Pevnitskiy
607200, Arzamas-16
Nizhni Novgorod Region
Russia

Gary Phillips
NRL
4555 Overlook Ave SW MS-4616
Washington, DC 20375

Sharon Lee Pickup
U.S. GAO
441 G St. NW, Room 5148
Washington, DC 20548

Anne Poulin
BDM International
7915 Jones Branch Dr., JB 4C19
McLean, VA 22102

Timothy J. Pounds
SAIC
1710 Goodridge Dr., 1-9-5
McLean, VA 22102

Vadim Ptashniy
Institute of Technical Physics
Chelyabinsk 454070
Russia

Thomas F. Ramos
DoD/OATSD (AE)
Pentagon, Room 3E1074
Washington, DC 20301-3050

Philip Resca
Vitro
c/o Horizons Technology
700 Technology Park Dr.
Billerica, MA 01821-4196

Edward C. Reynolds III
PSR
1401 Wilson Blvd.
Arlington, VA 22209

Hal Rhoads
OSIA/DXP
Washington, DC 20041-0498

William E. Richardson
CIA
10703 Wynkoop Dr.
Great Falls, VA 22066

Randy R. Ridley
TASC
1101 Wilson Blvd., Suite 1500
Arlington, VA 22209

Lt Col Richard W. Rock
HQ USAF/XOXXI
Pentagon, Room 4C 1061
Washington, DC 20330-5057

Sergei Rogov
USA & Canada Institute
213 Khlebryper
Moscow, Russia 121069

George Rueckert
Meridian
4300 King St., Suite 400
Alexandria, VA 22302-1508

Julie Sacksteder
Teledyne-Brown Engineering
1700 N. Moore St.
Arlington, VA 22209

Sergei Samylov
Institute of Technical Physics
Chelyabinsk 454070
Russia

Manuel Sanches
System Planning Corp.
1500 Wilson Blvd., 1325
Arlington, VA 22209-2454

Max B. Sandoval
SNL
Box 5800, Div. 9241
Albuquerque, NM 87185

Jacqueline M. Scheidt
SAIC
1710 Goodridge Dr., 1-9-4
McLean, VA 22102

Vitaly Schukin
Institute of Technical Physics
Chelyabinsk 454070
Russia

Richard Scribner
Georgetown University
37th and O Streets NW
Washington, DC 20057

Barbara A. B. Seiders
ACDA
320 21st St. NW
Washington, DC 20451

Patrick M. Shannahan
National War College
Ft. McNair
Washington, DC 22032

Nelson F. Sievering, Jr.
Atlantic Council of the U.S.
1616 H Street NW
Washington, DC 20006

Benard H. Simelton
DNA/OPAC
6801 Telegraph Road
Alexandria, VA 22310-3398

COL Michael L. Simonich
OUSD(A)/S&SS/SACC
Pentagon, Rm 3E121
Washington, DC 20301

Dipen N. Sinha
LANL
Box 1663, MS D429
Los Alamos, NM 87545

Jacqueline R. Smith
SAIC
1710 Goodridge Dr., 1-9-5
McLean, VA 22102

Roger Smith
System Planning Corp.
1500 Wilson Blvd., 1501
Arlington, VA 22209-2454

Gary Sojka
Select Committee on Intelligence
Senate-Hart Bldg, Room 211
Washington, DC 20510

Padmini R. Sokkappa
LLNL
Box 808, L-195
Livermore, CA 94550

Nikolai Sokov
Russian Ministry of Foreign Affairs
Russian Federation
Moscow, Russia

Paul Sparaco
USAF
HQ ESD/AVJ
Hanscom AFB, MA 01731

Robert M. Steele
ENSCO
5400 Port Royal Road
Springfield, VA 22151

Diane Steinberger
DNA/OPAC
6801 Telegraph Road
Alexandria, VA 22310-3398

Jessica Stern
LLNL
Box 808, L-279
Livermore, CA 94550

Sayre Stevens
System Planning Corp.
1500 Wilson Blvd., 600
Arlington, VA 22209-2454

Thomas S. Stewart
BDM International
7915 Jones Branch Dr., JB 4C11
McLean, VA 22102-3396

Lorin R. Stieff
E.J. Brooks/Fiber-Lock Corp
P.O. Box 263
Kensington, MD 20895

Danny B. Stillman
LANL
Box 503, B224
Los Alamos, NM 87544

Jerry R. Stockton
BDM International
7915 Jones Branch Dr., JB 4C22
McLean, VA 22102-3396

Gerry F. Stowe
SAIC
2000 Corporate Ridge Suite 850
McLean, VA 22102

Pamela J. Sullivan
BDM
7915 Jones Branch, FB3A420
McLean, VA 22102

Leonard Sullivan, Jr.
Consultant to SPC
1500 Wilson Blvd., 6th Fl. So.
Arlington, VA 22209-2454

Jerald Sutherlen
Raytheon Service
2 Wayside Rd., 100
Burlington, MA 01803

MAJ Carl A. Swanson
OSIA
Attn: Monitoring Operation
Washington, DC 20041-0498

Ed Tanzman
Argonne National Laboratory
Building 900, 9700 S. Cass Ave.
Argonne, IL 60439

CAPT George E. Temple IV
USAF
HQ ESD/AVJ
Hanscom AFB, MA 01731

Vladimir Teryochin
Institute of Technical Physics
Chelyabinsk 454070
Russia

John P. Tindal
Meridian
4300 King St., Suite 400
Alexandria, VA 22302

Richard G. Towe
PSR
1401 Wilson Blvd.
Arlington, VA 22209

Armando Travelli
Argonne National Laboratory
B207, 9700 S. Cass Ave.
Argonne, IL 60439-4841

Archelaus R. Turrentine
The Harris Group
1801 Robert Fulton Dr., Suite 200
Reston, VA 22091-4347

Halvor A. Undem
Pacific Northwest Laboratory
Box 999, P7-35
Richland, WA 99352

Col Herbert Vadney
DNA
6801 Telegraph Road
Alexandria, VA 22310

Gerald Van Keuren
DASIAC/KSC
2560 Huntington Ave., Suite 500
Alexandria, VA 22303

Michael Vannoni
SNL
Box 5800, MS 9241
Albuquerque, NM 87185

Albert P. Vasilyev
Institute of Technical Physics
Chelyabinsk 454070
Russia

Kemper Vest
SAIC
1710 Goodridge Dr., 1-9-4
McLean, VA 22102

Verne V. Wattawa
SAIC/CVR
8500 Cinder Bed Road, Box 1148
Newington, VA 22122-9998

Major Stephen J. Welch
DNA/OPAC
6801 Telegraph Road
Alexandria, VA 22310-3398

Charles A. Willey
ERIM
Box 134001
Ann Arbor, MI 48113-4001

Bradford Wright
LANL
Box 1663, D 406
Los Alamos, NM 87545

Octavio A. Vela
LANL
Box 1663, J580
Los Alamos, NM 87545

Richard L. Wagner, Jr.
Kaman Sciences
2560 Huntington Ave., Suite 200
Alexandria, VA 22303

Greg Weaver
SAIC
1710 Goodridge Dr., 1-9-5
McLean, VA 22102

Michael Wheeler
System Planning Corp.
1500 Wilson Blvd., 15
Arlington, VA 22209-2454

Allen Williams
SAIC/CVR
1710 Goodridge Dr., T1-7-3
McLean, VA 22102

Albert W. Yoder
ACDA
320 21st St. NW, Room 5741
Washington, DC 20451

Leo Verbruggen
NATO Headquarters
Dir of Verification, Info Sys
Ops, B-1110
Brussels, Belgium B-1110

Col Robert G. Watson
DIA/DEA
Bolling AFB
Washington, DC 20340-5485

David E. Weekman
Kaman Sciences
2560 Huntington Ave.
Alexandria, VA 22303

Thomas F. Wiener
TASC
1101 Wilson Blvd
Arlington, VA 22209

David R. Wilton
SAIC/CVR
8500 Cinder Bed Road, Box 1148
Newington, VA 22122

Leo Zeftel
Consultant to CMA
4619 Sylvanus Dr.
Wilmington, DE 19803

PLENARY SESSION I

Arms Control in the New World Order

Welcoming Comments:

Mr. Lee Minichiello

Director, Strategic Arms Control
and Compliance, Office of the Under
Secretary of Defense (Acquisition)

Chairman:

Mr. Sidney Graybeal

Chief Scientist,
Science Applications
International Corporation

Presentations:

Ambassador Rolf Ekeus

Executive Director,
United Nations Special Commission
*"The Future Role of Arms
Control Verification Technology"*

Mr. Ron Cleminson

Head, Verification Unit,
Ministry of External Affairs, Canada
"A New Concept in Arms Control Verification"

In surveying arms control treaties negotiated since the 1972 Anti-Ballistic Missile Treaty (ABM), a trend is revealed towards increased scope and complexity. Whereas the ABM Treaty consists of ten pages and relies on National Technical Means (NTM) for verification, the 1991 Strategic Arms Reduction Treaty (START) is 280 pages long and contains detailed elimination and verification procedures. Implications of this growing complexity include R&D constraints on weapons developments, modifications to weapons systems and operations, elimination and conversion of weapons, intrusive on-site inspections, and the requirement to protect national security and proprietary information and prevent technology transfer.

With this growing complexity, verification and compliance costs have increased, leading to a search for new approaches to contain costs and to maximize cost-effectiveness. U.S. Department of

Defense arms control implementation costs grew from \$150 million in 1988 to a requested \$505 million for Fiscal Year 1993. However, the current security environment offers new avenues for cooperation, which may help keep costs down -- including quick unilateral initiatives with the republics of the former Soviet Union and multilateral agreements to curb proliferation. In the future, the desire for simpler, cheaper "unilateral initiatives" should lead to more flexible verification regimes. However, this tendency should be balanced by new international challenges posed by proliferation monitoring.

Recent bilateral and multilateral arms control implementation and verification experiences are providing valuable guidance for future verification requirements. While there will be new challenges for future arms control regimes, it is urgent that the valuable knowledge gained from the United Nations Special Commission (UNSCOM)

experience in Iraq and from the implementation of the Treaty on Conventional Armed Forces in Europe (CFE) be used in the future.

The New Arms Control Environment

The following characteristics serve as referents in defining the future arms control and verification environment.

- * Increasingly, enforcement of arms control may involve uncooperative parties.
- * More and complex multilateral and regional arms control regimes will be negotiated.
- * The United Nations will assume a larger leadership role through organization and integration of regimes, enforcement and compliance, and sharing in the cost of implementation.

Although the dissolution of the Soviet Union has lessened East-West tensions, it has also ushered in an era of greater instabilities. Tensions rising from territorial and ethnic conflicts (particularly, in the areas in and around the former Soviet Union) will continue to foment unstable and uncooperative security relationships. This uncooperative environment will be the context in which a large portion of arms control agreements must be managed in the future.

The UNSCOM experience of verification and destruction in Iraq has proven to be extremely valuable, because UN inspection teams have gained experience in dealing with belligerents in an uncooperative host country. Moreover, plan-

ning for management and enforcement of arms control verification and compliance in such a hostile environment will be critically important in the future, especially in the area of proliferation.

Although some arms control fora will continue to require formal, negotiated agreements and treaties along with effective verification regimes (especially on-site inspection), certain aspects of arms control and verification must be reconstituted to meet new security needs. Specifically, the proliferation of negotiating parties will increasingly require multilateral and regional regimes as opposed to the bilateral arrangements that have dominated past experience. Hence, verification should help reassure participating parties by providing early warning and enhanced transparency of national activities.

However, these multilateral agreements will pose new difficulties for verification authorities, since all parties involved must have faith in the ability to verify compliance to a level of military significance. Since each country may have a different idea of what constitutes a militarily significant offense, treaties and agreements involving large numbers of signatory parties may make universal agreement to verification provisions difficult. Consequently, U.S. leadership and participation in this area will prove extremely valuable, since the United States has a unique and highly effective capability to increase confidence in compliance through national technical means.

With the expected increase in multilateral verification regimes, many nations are looking towards the United Nations to play an increased role in organizing and, more importantly, leading enforcement activities.

As United Nations' leadership develops in this realm, perhaps enforcement should be automatically linked to this body to deal more effectively with belligerents as was demonstrated in the case of Iraq.

In addition, budgetary constraints will increasingly influence the evolving arms control environment. Many countries face serious challenges in the area of verification, since national budgets are shrinking as the number of parties to treaties is increasing. This situation creates more complex and costly verification requirements and contributes negatively to the debates on arms control verification "burden-sharing" and cost-effectiveness. However, certain synergies among treaties could be used to help control costs and realize cost efficiencies. By using a set of fundamental resources, mechanisms, and procedures to fulfill a wide range of verification requirements, time, financial resources, and manpower may be saved.

Lessons Learned - Iraq as a Model for the Future

Recent experiences in Iraq demonstrate that verification can work under adverse conditions. For example, UN inspection teams were responsible for the verification and destruction of Iraq's nuclear and chemical weapons and ballistic missile capabilities. To accomplish this task, UNSCOM looked to the experience and expertise of the parties involved in the CFE Treaty to develop a framework for organizing baseline inspections and elimination and destruction measures.

However, once UN inspection teams had verified the existence of illegal weapons and capabilities in Iraq, the tasks of

comprehensive verification of capabilities and destruction of weapons and hardware proved to be a very difficult task because of the uncooperative atmosphere. Moreover, Iraq still retains much of its human capability to re-establish its production potential. As a result, monitoring of the capability to reconstitute military forces and weapons may become a central element in future verification regimes.

Hence, more comprehensive, and potentially costly, verification regimes may be required to supplement on-site inspection to ensure full compliance in a nation such as Iraq. Elements of such a regime may be comprised of an integrated and dimensionally layered system of technologies and capabilities that might include:

- * Space imaging and use of national technical means;
- * Commercial satellite imaging;
- * High-altitude aerial surveillance;
- * Low-altitude ground imaging sensors (helicopters); and
- * Human intelligence.

Ultimately, as nations increasingly look to multilateral and multinational organizations to organize, implement, and enforce arms control verification regimes, more cooperative measures will have to be undertaken to ensure compliance and enforcement of verification provisions. Where verification may be conducted under adverse circumstances, parties involved should take this eventuality into account in planning and negotiating verification regimes. In addition, the United Nations and other inter-

national organizations, such as the Conference on Security and Cooperation in Europe, may be called upon to take a more active role in providing leadership in the verification community, while the inter-

national verification community may look increasingly to western nations to supplement on-site inspection with more elaborate technologies and national technical capabilities.

PLENARY SESSION II

Negotiating and Implementing Verification Measures

Introduction and Closing Remarks:
Major General Kenneth L. Hagemann
Director, Defense Nuclear Agency

Chairman:
Colonel Michael Evenson
Assistant Director, Arms Control
and Test Limitations,
Defense Nuclear Agency

Presentations:
Ambassador Maynard W. Glitman
U.S. Department of State, and
former Chief, U.S. Delegation
to the INF Negotiations

Major General Robert Parker
Director, U.S. On-Site
Inspection Agency

As demonstrated in the negotiations on INF, START, and CFE, there is a critical relationship between the arms control policy making and negotiating process on the one hand and the technical requirements for implementation and verification of treaties on the other. Developing a close working relationship between the policy and technology communities will play an increasingly important role in future verification regimes as the arms control process becomes more complex due to greater multilateral and multinational participation.

Negotiated Arms Control Verification

Negotiated arms control treaties should continue to be a primary means of controlling and reducing weapons capabilities, and verification should remain an integral part of all types of future agreements. Yet, while detailed outlines of verification procedures have been the rule in the past, there is some question over the continuation of such strictly defined regimes in the future.

Opposing sides in the debate over the desirability of continuing to require rigorous verification provisions in arms control treaties make the following points.

Proponents

- * As it implies, verification can provide the parties involved in a treaty with a greater measure of confidence that reductions are being made in a timely and observable fashion, instead of relying on good faith pledges of the parties involved.
- * It would be unwise to plan on the current political climate to last forever, and a cooperative verification regime can help to gauge and improve the state and predictability of the relationship between treaty parties.
- * Verification regimes in arms control treaties are legally binding obligations that require the parties involved to comply with them or

face potentially intense international political pressure, and possibly sanctions.

- * As the global balance of forces is reduced, reconstitution of military capabilities bears a greater risk. Rigorous verification of ceilings and limits can alert nations to potentially aggressive or hostile behavior.

Opponents

- * In the new, more cooperative global environment, there is no longer a need for rigorous and intrusive verification measures.
- * Requiring stringent, intrusive verification has negative consequences to the relationship of parties involved in that it causes tensions between treaty signatories.
- * In an increasingly budget-constrained environment, arms control verification can seem costly and resource intensive. High cost considerations may dissuade some parties from participating in a treaty or agreement.

Lessons from Negotiating the INF Treaty

The on-site inspection verification measures negotiated under the INF Treaty created an unprecedented regime of cooperative measures. This radically new venture in arms control had significant positive ramifications for the political and security relationships between the United States and the former Soviet Union in terms of transparency, predictability, and confidence.

Important lessons taken from INF implementation include the following guidelines for future negotiations.

- * Move forward on verification at the same time that central limits are being negotiated. At the outset of the negotiations, design possible scenarios that might require verification and incorporate technical elements to allow for the verification of these contingencies in the treaty.
- * Do not ask for more verification than may be politically, strategically, or technically acceptable to your side. Bring in opinions from technical experts, operators, and the legislative branch early. Do not let negotiating end-games dilute the verification regime.
- * It is useful to look towards treaty implementation and establish processes for developing verification technologies so that equipment is available before a treaty is entered into force.
- * The synergy of national technical means (NTM) and on-site inspection (OSI) capabilities should be exploited. NTM can sometimes alert a party to potential violations of another party that may be missed by OSI. OSI can help alleviate ambiguities that may exist with NTM.
- * Each treaty verification regime should be a self-contained entity. Collectivization of treaty regimes might be cost-effective, but are very complex and pose risks to both effectiveness and national security, if

treaty participants become uncooperative.

- * All necessary details should be negotiated before entry into force. Detail is needed to codify and implement the treaty. The worst possible outcome would be an unclear, ambiguous accord that could lead to disputes and tensions that could potentially unravel the treaty.

By applying experience gained in the relatively complex verification and implementation provisions in the INF, START, and CFE treaties, the efficiency and effectiveness of future verification regimes can be improved by understanding the benefits, challenges, and opportunities associated with negotiating rigorous verification measures.

Harmonizing Policy and Technology Considerations

As demonstrated in the INF, START, and Nuclear Testing negotiations, technology is playing an increasingly larger role in arms control verification regimes. Therefore, it is vitally important to coordinate cooperation between the policy and technology communities. The inclusion of technical experts in negotiating fora provides negotiators with a unique resource to draw upon in understanding the realities and complexities of verifying tabled or notional provisions and designing verification strategies that result in technically cost-effective and manageable provisions.

In addition, input by technical experts can help determine ahead of time if equipment can be designed that will be practical and manageable in the field. The

experience of on-site inspection teams during the implementation phase of the INF Treaty shows that, portable, rugged, dependable equipment is critical to effective and timely verification. And although on-site inspection can be an expensive and manpower intensive method of verification, it has proven to be effective and should be continually developed and refined to meet new and diverse verification requirements.

The concept of reciprocal relationships between the policy and technology communities is important for negotiators to remember when tabling positions on verification provisions. Consulting with technology experts can help increase the negotiators' awareness of the complexities associated with intrusive verification measures and the potential impact of these measures on sensitive national security programs.

The changes taking place in the global political environment and the positive movements towards stability are encouraging, but plans must be in place to deal with any type of environment that develops in the future. In light of the fluctuating global political situation, the practice of verification should not be discarded, but should continue to be developed, particularly with respect to efforts in support of stemming the proliferation of weapons of mass destruction.

As the United States and the republics of the former Soviet Union continue to reduce their nuclear force structures, the significance of breakout or cheating will become more militarily important in the global balance of forces. Consequently, effective verification of treaties and agreements can play a key role in building

confidence, predictability and transparency in an international environment characterized by substantially lower levels of nuclear forces.

Finally, verification measures and requirements will be increasingly subjected to cost-effectiveness criteria and cost trades among various capabilities such as national technical means, on-site inspection, and

human intelligence, and will weigh more heavily in planning verification requirements. Moreover, research and development of verification technologies to meet current and future verification requirements should proceed apace to ensure that the strategic capabilities required to field such technologies are not lost to technological neglect and industrial degeneration.

PANEL SESSION I

Future Arms Control Initiatives

Chairman:

Ambassador Maynard W. Glitman
U.S. Department of State, and
former Chief, U.S. Delegation
to the INF Negotiations

Presentations:

Dr. Sergei Rogov
Deputy Director,
USA and Canada Institute

Mr. Archelaus Turrentine
The Harris Group

Mr. Timothy Pounds
Science Applications
International Corporation

Presentations:

Dr. Stephen Morse
Rockefeller University

Mr. Leonard Sullivan, Jr.
System Planning Corporation

Dr. Vitaly Schukin
All Russian Research
Institute of Technical Physics

Will Arms Control Survive the Cold War?

Prior to the end of the Cold War, arms control provided the barometric reading that gauged the super-power relationship. Now that the Cold War is over, there is greater uncertainty and debate as to what future arms control agreements will look like and what range of issues will they address. Will agreements be less intrusive with greatly reduced verification procedures? Will future agreements rely more on confidence-building measures than agreements of the past? How will the trend towards multilateralism affect the cost and verifiability of arms control agreements? Will formal arms control agreements give way to non-legally binding accords or unilateral measures? Or, will future agreements develop along the lines of

traditional arms control treaties, employing highly structured frameworks in order to achieve quantitative numerical limits and reductions?

These issues and the ensuing debate over the future role of arms control have raised questions about how arms control agreements will be negotiated and structured in the next decade. With the end of the Cold War, some constituents of the arms control community believe that fully developed and legally-binding arms control treaties have become outmoded by the pace and scope of recent international events; hence, unilateral initiatives may be sufficient to address future security concerns; and, negotiations themselves may even promote and perpetuate tensions between and among nations. Traditional arms control can be viewed as the obverse side of mutual deter-

rence, making competition more predictable and less dangerous and costly. However, as with the changing international environment, the nature of arms control is undergoing an accelerated evolution. This evolution can be categorized into three broad stages of evolution. In the first stage, joint agreements, such as SALT, produced weapons ceilings. Next, agreements, such as INF, START, and CFE, eliminated entire classes of weapons and reduced force structures in order to create an equilibrium of forces. In the third stage and future stage, more efforts will be made to contain and reduce force effectiveness through deep reductions.

Future arms control initiatives will also include more qualitative elements, such as confidence building, transparency measures, data exchanges, technology limitations, and joint decision-making, to support regional and international cooperative security concepts. There may even be some instances where unilateral initiatives can serve a useful purpose, i.e., when expediency is preferable to precision and detail.

Nonetheless, traditional treaty negotiations will continue to be the basis for ensuring compliance through verification and for reducing ambiguities concerning the responsibilities of the signatory parties. Given the fluidity of recent events in Europe and elsewhere, the importance of reducing ambiguities cannot be over-emphasized, because the current favorable international climate may be ephemeral, and legally-binding treaties will endure beyond cooperative relations. The recent START Protocol, signed by Russia, Ukraine, Belarus, and Kazakhstan in May, 1992 in Lisbon, demonstrate this concept.

New Initiatives

Since the dissolution of the Soviet Union has played such a large role in shaping the future strategic environment, special attention should be focused on producing stabilizing measures in the geopolitical environment created by the Soviet break-up. Potential stabilizing initiatives include:

- * reduction and restructuring of strategic nuclear forces;
- * limitation of economic competition;
- * transformation of defense doctrine;
- * creation of comprehensive transparency measures;
- * institutionalization of the arms control process; and
- * creation/expansion of direct military-to-military contacts.

High-level negotiations and discussions concerning the continued reduction and restructuring of strategic forces are likely to continue, even prior to the ratification of START. Given the monumental change in the former Soviet Union, the collapse of the Warsaw Pact, and the general reduction in tension between East and West, the current reductions agreed to under START do not go far enough in rendering sufficient progress towards a more stable strategic forces environment. More than reductions in numbers, both the United States and Russia need to remove volatile components of the nuclear escalatory ladder, such as incentives to gain an advantage in conflict through the first use of land-based multiple-

warhead ballistic missiles. If removal of these escalatory incentives can be achieved, each side will attain a force structure aimed more at the prevention of nuclear war, rather than one designed for war fighting and the propagation of military conflict.

Transforming the defense doctrines of former adversaries will entail comprehensive restructuring of force postures and operational concepts in order to transcend the concept of mutual deterrence and proceed to a security environment more attuned to the new international situation. New qualitative arms control initiatives, such as limitations on technology development and increased use of confidence-building and transparency measures may support this objective.

Some policy experts contend that because of the expanded multilateral character of the arms control process, negotiations need to move away from quantitative limits and instead emphasize cooperative security-building measures. For example, the international community should focus more sharply on containing the proliferation of production capabilities for nuclear and chemical weapons and ballistic missiles by limiting indigenous development of technologies critical to the fabrication of these capabilities in nations that threaten regional and international stability. In addition, the international community must work harder to control the competing priorities of economic development and the proliferation of components for the production of weapons of mass destruction.

In pursuing effective multilateral arms control initiatives, international and regional organizations should take a more active role in the arms control process by

increasing the institutionalization of arms control as a *modus vivendi*. That is, organizations such as the United Nations and the Conference on Security and Cooperation in Europe should use arms control as a vehicle for achieving desired political objectives.

The United States may be in a unique position to assist international and regional organizations in compliance matters by sharing intelligence, monitoring techniques and verification technologies.

The concept of direct military-to-military contact provides an inexpensive and progressive forum for developing cooperative transparency measures, soothing former rivalries, and constructing joint relationships that can create more effective and positive working relationships in the international environment.

Biological and Radiological Arms Control Measures

Strategies for verifying limitations, control, and reductions of biological weapons production is a critical area which requires increased attention by the international community, since these weapons can be easily produced and, through the use of biotechnology, be disguised and possess a highly destructive capability. It may be possible to devise an international regime which obligates states to declare all facilities engaging in the production of certain controlled agents and to use independent international inspections (like the IAEA) to monitor compliance. However, constructing mechanisms for the resolution of disagreements in the event of alleged non-compliance, and then enforcing sanctions in the event of validated non-compliance could

pose difficult challenges. To encourage states to become parties to a Biological Weapons Convention (BWC), a global infectious disease surveillance program involving the BWC members could be instituted.

Radiological Weapons (RW) are included in the long-standing, internationally accepted definition of weapons of mass destruction. Radiological weapons use the radioactive properties of nuclear material, created and distributed independently from a nuclear explosion, as the mechanism for damaging a target or denying access to an area. The 39-nation Conference on Disarmament (CD), following a U.S. initiative presented at the United Nations in 1976, and a joint U.S.-Soviet proposal tabled in 1979, has been seeking for more than a decade to negotiate a convention prohibiting RW. However, during this time, most of the energies of the CD have been focused on

negotiating a Chemical Weapons Convention, and RW negotiations have not received much serious attention. While no country is known to possess radiological weapons at present, any country with a modest nuclear program, which produces a sufficient quantity of radioactive isotopes and/or high-level radioactive nuclear waste, has an inherent RW capability.

Concerns have been expressed, on the one hand, that it would be difficult to verify a RW Convention, and, on the other hand, that a vigorous RW verification regime could cost more and risk disclosing more sensitive information than it would yield in terms of enhancing international security, in general, and U.S. security in particular. However, a RW verification regime could be built, for the most part, on selected existing international arrangements and could avoid excessive costs and security concerns.

PANEL SESSION II

The Interface Between Intelligence and Arms Control

Chairman:

Mr. Kenneth E. deGraffenreid
JAYCOR

Presentations:

Ms. Sarah (Sallie) Mullen
Office of Intelligence,
U.S. Department of Energy

Dr. Sayre Stevens
System Planning Corporation

Presentations:

Dr. Jack Kangas
Institute for Defense Analyses

Mr. Gary Sojka
Senate Select Committee
on Intelligence

The interfaces between intelligence and arms control are evolving with the changing international security environment. These interfaces provide new opportunities for and challenges to constructing effective verification regimes for future multilateral and regional arms control measures. Trends in this area include:

- * Future verification requirements will focus more on cooperative measures and less on NTM;
- * Arms control and counter-proliferation will be more politically driven than in the past;
- * Intelligence collection and analysis will be at a premium;
- * Greater attention will be focused on the cost-effectiveness of verification regimes and monitoring techniques;
- * The role of the intelligence community will increase as a means for

cuing and alerting political authorities to potential non-compliance and proliferation;

- * There is an increased need to balance data collected by human intelligence (HUMINT) with data collected by technical collection methods; and
- * There is a greater need to address the motivations and intended results of proliferation.

The Intelligence - Arms Control Relationship

The hostile atmosphere in which the SALT and ABM treaties were negotiated required that verification be non-intrusive, yet highly effective. It was within this framework that the intelligence community (IC) was reluctantly recruited to support compliance monitoring through national technical means (NTM). Prior to these

treaties, monitoring activities were driven by other, high-level intelligence requirements. With SALT and ABM, however, monitoring activities were designed to fulfill treaty-specific requirements. Indeed, verification provisions were limited by the capabilities of NTM. Over time, dissatisfaction with Soviet compliance precipitated new efforts designed to place qualitative and behavioral constraints on Soviet modernization. With these new demands, it became clear that NTM alone could not produce satisfactorily high levels of confidence in compliance monitoring.

Cooperative measures were developed to increase confidence in negotiated verification regimes. Recent agreements (INF, CFE, START) have taken the principle of cooperative measures to an extreme through on-site inspection (OSI), exhibitions, disclosures, data exchanges, etc. In so doing, novel sources of information have been opened -- creating an avalanche of resource management requirements. To exploit fully the opportunities created by intrusive cooperative measures, new players, such as the On-Site Inspection Agency (OSIA) were created to support compliance monitoring. As a result, monitoring operations have become more than a by-product of other intelligence activities.

Looking to the future, the challenge for the IC is to preserve access to the information available under cooperative measures, even as the concerns that drove these requirements become less relevant. In more open circumstances and with more permissive verification regimes, new monitoring systems can have an important role to play in the areas of cuing and alerting other organizations of potential non-compliance or threatening technology

developments.

Non-Proliferation and Intelligence

Intelligence Community efforts at cuing and alerting are directly related to counter-proliferation. The Gulf War raised serious doubts about the NPT regime and brought the issue of proliferation to the fore of public attention. In this context, the IC may have an important role to play in designing new means of overcoming the deficiencies of the current NPT monitoring regime. In reassessing counter-proliferation strategies and methodologies to fit a world characterized by "instant" proliferation threats in the republics of the former Soviet Union, the reality of clandestine nuclear programs, and *de facto* nuclear weapons states, such as Israel, Pakistan, and India, the following issues should be addressed:

- * Are the right questions being asked? Is a test ban relevant outside the U.S.-Russian context?
- * Are the United States and the international community focused on the proper framework? Robert Gates, U.S. Director of Central Intelligence has explained the failure to detect Iraqi nuclear ambitions as the result of a misplaced focus on Iran. Could the same mistake be taking shape in the case of India and Pakistan?
- * After proliferation, then what? The traditional assumptions regarding proliferation have been based on the logic that the more nations that have the power to trigger a nuclear war, the greater the chance that some nation might use this power in "haste or blind folly." This logic overlooks

the possibility that small powers may use nuclear weapons in a calculated way to advance regional and global interests, e.g., calculated catalytic wars.

- * Are longer term intelligence projections being sacrificed to short-term assessments? What are the long-term strategic goals of proliferants like North Korea or India?

In addressing these questions, greater attention should be focused on the decision-making processes in the countries of concern. Such an approach would complement OSI and NTM by drawing on data acquired through both means and employing the analytical methodology of adversarial analysis. In order to accomplish this objective, proliferant supply and demand motivations must be understood; non-sequential acquisition of weapon/sensor system components must be guarded against; and changing signature data bases must be assessed.

In addition, there are many similarities between arms control verification activities and monitoring counter-proliferation efforts. Indeed, the potential for intelligence to detect new forms of proliferation is great, provided the IC is able to redirect some assets in the direction of HUMINT and analysis, while preserving its current NTM capabilities. However, one important difference between verification and intelligence monitoring efforts is that the former takes place in a cooperative environment whereas the latter takes place in a clandestine, and sometimes hostile, environment. That said, the technological requirements of the two activities may be similar. These similarities include non-

destructive assay, environmental sampling, satellite surveillance, and training and support.

Through efforts like the ones outlined above, the IC can support the work of the limping International Atomic Energy Agency (IAEA) regime. However, institutional road-blocks must first be overcome. Simply put, the IAEA is an institution with a role but, as was made clear after the Gulf War, has little means to accomplish its role. Conversely, the IC is an organization with highly capable resources, but unable to act in a lead role on the international stage. Closer cooperation between the IAEA and the IC could be facilitated through coordination and information exchange, such as:

- * tipoffs of undeclared activities;
- * assistance with translating seized documents;
- * assistance with sample analysis;
- * assistance with technical assessment of seized equipment; and
- * assistance in verifying declarations.

However, given the political nature of current counter-proliferation initiatives and lacking a cohesive U.S. Government counter-proliferation organization, as well as a clearly-articulated U.S. policy on counter-proliferation, direction to the intelligence community and others will probably remain sporadic and uncoordinated.

Congress and Treaty Verification

Constitutionally, the U.S. Senate

provides advice and consent during the treaty ratification process. However, it is in a position to influence a negotiated verification regime not only through the treaty ratification process, but through the budget cycle as well. Moreover, the House can play a similar role during the appropriations and authorization process.

Furthermore, because of the time demands put on most Members of Congress, both houses tend to think broadly and intuitively about arms control. This equates to the following Congressional thought process on arms control verification: undertaking an arms control agreement with a dangerous, hostile adversary will require a more stringent verification regime than agreements undertaken with more benign signatories.

Following this line of reasoning, it is possible to discern the mood of Congress towards arms control verification. That is, given a relatively benign former Soviet Union, verification will receive less attention

and less funding) than in the past. Similarly, while proliferation is currently the focus of much attention, it will never approach the level of threat posed by a unified, totalitarian Soviet Union and Warsaw Pact. Therefore, it is possible that as defense spending and force structures are reduced, the need for air-tight verification regimes and spending on intelligence goes up; nonetheless, Congress will be inclined to reduce all expenditures and not emphasize verification over other issues.

In the future, Congressional Members are unlikely to delay treaty ratification unless there is an egregious problem with a treaty's provisions, and Congress is highly unlikely to push for more stringent verification requirements than proposed by the Executive. In sum, Congress will probably cut the verification budget in the short-term future, but not as severely as the budgets of the military forces. And, Congress will be more inclined to fund intelligence resources devoted to proliferation monitoring.

PANEL SESSION III

Lessons Learned

Chairman:
Dr. David Kay
The Uranium Institute

Presentations:
Lieutenant Colonel Hal Rhoads
U.S. On-Site Inspection Agency

Dr. Vadim Ptashney
All Russian Research Institute
for Technical Physics

Presentations:
Dr. Richard Scribner
Georgetown University

Dr. Edward Tanzman
Argonne National Laboratory

Analysis of recent verification efforts has found that verification technologies can be organized into three distinct functional areas: mission performance technology, security technology, and support technology. All three functions must operate adequately and in a coordinated manner, because a failure in any one area can prevent the effective use of the others, jeopardizing the verification mission. For example, if security technology is ineffective in deterring and countering adversarial spoofing efforts, the effectiveness of the mission performance technology is rendered irrelevant.

In addition, all three functional areas must take user requirements into consideration in both technology design and development to ensure effective operability in the field. Based on user experience in on-site inspections, priorities regarding design criteria include:

- * Effectiveness in providing data that meet the test of evidence;

- * Reliability and maintainability;
- * Portability; and
- * Applicability to specific provisions of an agreement, including reciprocity of inspection rights and techniques, intrusiveness of inspection procedures and techniques, precedents that might affect future negotiations and verification, and exportability of the technology used.

Moreover, end users (i.e., inspectors and intelligence analysts) should have a substantial involvement in the design, development, and selection of verification technologies from their inception in order to ensure that they will prove useful and effective in the field.

Experience in Iraq has shown that it is important to avoid "mirror-imaging" an inspectee's thinking and actions when performing and assessing verification and inspection activities. Assuming that the

inspectee will act as a rational actor can result in important non-compliance evidence being overlooked or misinterpreted. Second, inspectors and verification policy-makers must recognize that other parties "learn lessons" from previous U.S. and Western verification and inspection experience. This includes both the inspectees and third parties observing established methods and their results. A concerted, systematic effort should be made to understand what lessons other nations might be drawing from past verification efforts in order to anticipate potential counter-measures in the future.

There are also lessons to be drawn from the weapons design community. These experiences focus on the inherent tension between gathering information required to verify compliance and the need to protect national security information not needed for such verification. The goal of both future verification regime negotiations and verification technology designs should be the maximization of treaty compliance-related information collection and the minimization of verification intrusiveness.

There are at least two other types of unintended information losses which deserve concern. First, information that might assist the inspecting party (or a third party given access to such information) in proliferating weapons of mass destruction should be actively protected in the construction and implementation of future verification regimes. Second, commercial secrets may also be put at risk by verification activities, making the limitation of verification intrusiveness important even among military allies.

The best means of limiting such intrusiveness is to select verification re-

quirements, goals and methods from the outset of the negotiation of an arms control agreement that will permit effective verification of treaty compliance without the use of highly intrusive technologies or inspection regimes. This concern needs to be highlighted early in the arms control policy and negotiation process.

Emerging Lessons in On-site Inspection

As in the case of the inspections in Iraq, on-site inspections work well in the detection of non-compliance with an agreement, if inspectors are properly selected and trained. However, detection of violations does not automatically allow correction of the identified non-compliance problems.

Second, future emphasis is likely to be placed on low-cost, low-tech on-site inspection regimes and technologies, in part because more multilateral agreements are to be expected, and in part because future standards of compliance may be lower than those required in the U.S.-Soviet context.

However, costs and standards associated with proposed verification regimes, dominated by inspections and their attendant technologies, may fluctuate as a function of the level of international tension among the signatories to an agreement. In some cases, more costly verification methods and technologies may be more likely to be accepted (and perhaps demanded) in situations where agreements are negotiated between or among actively hostile or adversarial parties.

The Iraq experience pointed out the difficulties inherent in effectively performing and assessing on-site verification activities when the inspectee is a recalcitrant violator.

On-site inspections were critical in the Iraqi case; nevertheless, national technical means and aerial surveillance proved to be extremely useful adjuncts to on-site inspection activities. In addition, the combination of remote sensors and on-site inspections in a coordinated verification effort reduced dramatically the estimated number of on-site inspections, while improving the accuracy and precision of the verification effort. Furthermore, it became apparent that sensors alone cannot substitute for challenge inspections properly cued and performed.

Equally significant, the Iraq experience illustrated the importance of ensuring that inspection teams avoid dependence on the inspectee for basic operational needs, such as food, transportation, communications, etc. Also, persistent and consolidated high-level political support of on-site inspection teams' rights and responsibilities played a critical role in gaining access to sites and materials in Iraq.

In the future, parties to treaties must recognize the risks of reciprocity in verification provisions, and should consider specifically the inability to "live with" certain elements proposed by one's negotiators (e.g., anytime, anywhere on-site verification of the Chemical Weapons Convention as originally proposed by the United States).

In addition, in democratic countries there are risks involved with intrusive and pervasive verification regimes, which portend conflict between a nation's treaty obligations and the rights of its citizens. For example, in the United States the Fourth Amendment of the Constitution provides for a "reasonable expectation of privacy," which means that the Constitution protects the sanctity of private homes more vigorously

than that of commercial facilities, and that methods such as remote sensing may be employed if such sensing is not considered to be a "search." The Supreme Court has found that remote sensing does not constitute a search if, and only if, it can detect a violation of the law. Thus, if an on-site inspection regime focuses on government and commercial facilities and relies on technologies that can only detect treaty compliance-related data, most Constitutional problems can be avoided.

Observations

The design of future verification regimes and the requirements determining those regimes should take account of the following considerations:

- * "Mirror-imaging" an inspectee's planning can be dubious;
- * Hostile environments pose many operational difficulties in performing verification activities;
- * Weigh carefully the trade-offs between desired data collection and undesirable intrusiveness;
- * Examine the implications of the domestic burdens of implementation, such as security risks, costs, and legal matters;
- * Assess the probabilities and implications of a cooperative treaty participant(s) becoming an uncooperative, recalcitrant violator; and
- * Ambiguous indicators of non-compliance are more difficult to adjudicate than clear violations.

PANEL SESSION IV

Proliferation in a Changing World

Chairman:

Dr. Lewis A. Dunn
Science Applications
International Corporation

Presentations:

Dr. Nikolai Sokov
Russian Ministry of
Foreign Affairs

Dr. Louis Nosenzo
Meridian Corporation

Mr. Joseph Grubb
Meridian Corporation

Mr. Steve McKay
Pacific-Sierra Research Corp.

Presentations:

Dr. Paul Persiani
Argonne National Laboratory

Dr. Michael Wheeler
System Planning Corporation

Ms. Jacqueline Smith
Science Applications
International Corporation

Traditionally a forgotten aspect of arms control, non-proliferation has seen an unprecedented amount of attention lately. This new focus is due, in part, to the revelations of Iraq's progress towards development of nuclear weapons, the Soviet nuclear break-up, and the post-Cold War search for new military rationales. In formulating a new non-proliferation agenda, a number of challenges and opportunities must be addressed.

"Thinking Right" About Proliferation

Proliferation is a problem with multiple dimensions, be they political, military, or economic. To address these dimensions, the United States has developed a loose collection of measures, such as export controls and security guarantees. Yet, there

is no single coherent "non-proliferation policy." Undertaking a systems approach to the problem, that is, examining the relationship between these dimensions and responses, could improve policy coordination. One way of introducing more analytical rigor into the U.S. coordination process would be to issue an annual "Proliferation Net Assessment," which could serve as an interagency mechanism for discussing proliferation threats as well as diplomatic and economic levers. The creation of a single repository in the U.S. Government for non-proliferation measures also would help produce a more coordinated response.

As part of a more integrated international policy approach, the United States may also need to take up the defense planning implications of more widespread

proliferation. For example, how would the U.S. and coalition response to Iraq's invasion of Kuwait have changed if Saddam Hussein had had nuclear weapons in his possession at the time? Would the threat of a U.S. amphibious assault have lost its credibility in such a situation? How will the United States respond to future threats of weapons of mass destruction in the Third World?

The Intelligence Dimension

Intelligence is the foundation for countering proliferation, from export controls to defense responses. Despite this pivotal role, however, resource constraints on intelligence resources are likely to grow. This points to the need to make more effective use of those resources on hand. One way to do so is to avoid analytic pitfalls, such as the formation of a rigid mind-set regarding countries of proliferation concern. Iraq provides a useful reminder of how a proliferator's capabilities can be underestimated. It also underscores the need to focus more on "back end" proliferation issues, such as the development of advanced nuclear weapons, delivery systems, command and control arrangements, and doctrine.

Proliferation Risks of the Soviet Nuclear Break-Up

Despite the recent signing of the Lisbon protocol, which will leave Russia as the sole inheritor of the former-Soviet nuclear arsenal, there is still considerable uncertainty regarding the intentions of Ukraine. A new political bloc has emerged there, comprised of the military and former-communists. This group adheres to Cold War thinking regarding nuclear strategy and

the military's role in politics. Its emergence coincides with Ukraine's attempts to achieve greater administrative, technical, and physical control over the nuclear weapons stationed on its soil.

Should Ukraine fail to relinquish its nuclear capability, it will spark a major crisis in the non-proliferation regime, with implications for stability and the wider spread of nuclear weapons. At this point, Russia alone cannot ensure non-proliferation in the former-Soviet Union. Support from the international community is needed. Still, Moscow can help reduce Ukraine's incentives for retaining a nuclear capability by assuring it that Russia poses no threat to it.

The Regional Dimension

Greater attention needs to be focused on the regional security drivers of proliferation. Establishing a political dialogue between and among adversaries is the first step. With that, both confidence-building measures and other forms of regional arms control can be pursued. In the Middle East, for example, such modest measures can help lay the conceptual foundation for detente.

Global-Regional Linkages

New global initiatives may, in some cases, reinforce regional arms control efforts, both in terms of raising proliferation barriers and disincentives. For example, export control regimes could be bolstered if more suppliers were to join. Similarly, the production of weapons-grade fissile material could be de-legitimized through the application of "no-enrichment or reprocessing

zones." The creation of an international plutonium storage facility could help further reduce the chances of diversion. As gestures of good faith, the United States and Russia could deposit some of the plutonium from their dismantled weapons in such a facility. Washington and Moscow also might help de-legitimize nuclear testing by accepting new testing constraints of their own.

Role of the Security Council

Building on its role in the denuclearization of Iraq, the United Nations Security Council could make a substantial contribution to global non-proliferation efforts. That contribution could range from mustering political support for International Atomic Energy Agency (IAEA) challenge inspections to providing backing for military action against a proliferator. In order to preserve flexibility, the exact details of the Council's response need not be set in advance. However, it is important to put in place new procedures that would help create the expectation that the Council would take action. Additionally, the Security Council could be used to help conform the various non-proliferation verification regimes (e.g., IAEA, Chemical Weapons Convention, etc.).

A Few Other Issues

As the 1995 NPT review conference approaches, a re-examination of negative

security assurances is warranted. With France and China joining the NPT, there is an historic opportunity to strengthen the existing U.S. policy statement not to use nuclear weapons against non-nuclear weapons states party to the Treaty. At the same time, chemical and biological weapons threats could call for the retention of an escalatory option. A comprehensive nuclear test ban (CTB) also will be a topic of discussion at the review conference. In addressing the CTB issue, a number of trade-offs must be considered. For example, in joining a CTB, the United States could strengthen its hand in confronting proliferants. Yet, this could come at the expense of ensuring the flexibility, safety and reliability of the U.S. nuclear stockpile.

As witnessed by the nuclear roll-back successes in Argentina, Brazil, and South Africa, countries change, leaders change, and leaders change their minds. The goal of non-proliferation efforts, therefore, is to buy time to permit the political climate to change. This process can be assisted by lessening regional conflicts and putting in place regional security structures. At the same time, it is important to maintain global non-proliferation norms and institutions. For all these efforts, however, the United States must ensure that its forces are adequately prepared to meet the threat of a more proliferated world.

PANEL SESSION V

Verification Technologies: Roles and Applications

Chairman:

Dr. Richard Wagner
Kaman Sciences Corporation

Presentations:

Mr. Cosmo DiMaggio
System Planning Corporation

Mr. Roger Fritzel
Pacific-Sierra Research Corp.

Dr. Max Sandoval
Sandia National Laboratory

Dr. Kenneth Apt
Los Alamos National Laboratory

Mr. James Barden
Kaman Sciences Corporation

Presentations:

Dr. John Parmentola
MITRE Corporation

Mr. Mark Fischer
BDM International

Mr. Arthur Fitch
Global Outlook

Dr. Alexsey Pevnitskiy
Arzamas-16 Laboratory

Mr. Lawrence Germain
Logicon-RDA Corporation

In the changing arms control environment, critical questions concerning both cooperative and enforced verification must be addressed; What needs to be verified? What kinds of technologies will the provisions of future treaties require? And of utmost importance, how will the policy community and the technology community coordinate their activities on verification technology in the future? In considering these questions, specific attention must be paid to the following issues:

- * What should be the balance between intrusiveness and cost-effectiveness?
- * What strategies should be used in developing verification technologies?

- * How should resources be spent on verification technology in the future?
- * What institutions and processes should be used to develop technology?
- * How can flexibility and coordination be enhanced to increase the efficiency of industry in the verification technology research and development process?

The Verification Equation

Requirements for verification technology need to be better defined and translated into research and development

programs. In the past decade, the position of the United States was that no form of arms control is beneficial unless fully verifiable. Policy makers asked, "What needs to be verified and at what cost?" In addition, research and development planning horizons were short, and it was not uncommon for a verification requirement to materialize at the final stage of negotiations. However, due to a variety of circumstances, there has been a forced reassessment of verification strategies.

The objectives in formulating and developing verification strategies should focus on the following criteria:

- * Confidence in verification measures;
- * Compliance objectives;
- * Prevention of cheating (spoofing);
- * Confidence and security-building measures to aid in stability;
- * Pressures against deviant behavior;
- * R&D costs associated with monitoring equipment;
- * Acquisition and procurement processes;
- * Operations and maintenance of monitoring equipment;
- * Costs associated with infrastructure, analysis, and inspection;
- * Technological risks;
- * Counter-intelligence risks; and

- * Risks of divulging proprietary information.

In addition, factors to be considered in improving the coordination of resources in the verification technology research and development process are:

- * Identifying treaty limits;
- * Deriving monitoring requirements;
- * Identifying observables associated with monitoring;
- * Analyzing observables;
- * Identifying and analyzing means of exploiting observables;
- * Technology surveys;
- * Evaluating results of surveys; and
- * Developing and adjusting research requirements.

Applications of Commercial Satellite Imagery in Arms Control Monitoring

The use of commercial satellite imagery (CSI) to monitor compliance with arms control agreements provides an interesting opportunity in the arms control verification community. Several technologies, such as electro-optical, synthetic aperture radar and multi-spectral CSI may be useful in treaty monitoring and confidence building.

Considerations for using CSI in monitoring compliance under arms control treaty verification provisions include:

- * Identifying observables CSI are able to detect;
- * Determining CSI collection requirements, taking into account Open Skies and other relationships among CSI capabilities;
- * Estimating the costs for purchasing CSI resources and processing and interpreting CSI collected data; and
- * Evaluating implications of relying on commercially available sources to meet national security requirements, and assessing changes in the international arena which may facilitate the use of CSI.

Open Skies Treaty: Imaging Radar Technology Issues

The Open Skies Treaty was negotiated to increase and strengthen confidence through transparency measures. The sharing of data, equipment and data products, and the inspection of equipment are requirements of the Treaty. However, in considering the sharing of synthetic aperture radar (SAR) data with treaty parties, the United States should consider cost and export restrictions versus performance requirements so as not to jeopardize U.S. strategic technology capabilities.

In addition, judging required levels of technology for verification is an important aspect in considering the use of SAR for arms control applications to arrive at a balance between the need for timely information and cost-effectiveness.

However, since the arms control policy community is many times segmented

from important national technical capabilities such as SAR, it is important for policy-makers and technologists to attempt to coordinate potential verification requirements with technology capabilities. This coordination might best be accomplished in the planning stages of negotiations and during the negotiations themselves.

Acoustic Resonance Spectroscopy in Arms Control Monitoring

Acoustic Resonance Spectroscopy (ARS) can provide the arms control verification community with non-destructive techniques for use in verifying compliance with treaty provisions.

The ARS principle is based on the phenomena that every solid object has modes of acoustic resonance. Through research, it has been discovered that similar objects demonstrate similar acoustic resonance. However, in the monitoring of weapons and weapons systems, there is a clear difference in acoustic resonance between solid-filled and liquid-filled projectiles. Advantages of ARS technologies are that only a relatively small amount of equipment is needed to perform monitoring activities in the field. In addition, ARS is easy to operate, and it has a high-level of non-intrusive accuracy.

Therefore, ARS might prove useful in monitoring chemical weapons stockpiles if integrated with other monitoring techniques, such as:

- * Visual observation;
- * Weighing or use of pulse-echo acoustics to determine fill levels;

- * Neutron interrogation to determine composition of fills; and
- * Sampling of destroyed munitions.

However, ARS has some advantages over the above techniques, such as:

- * Less intrusive than pulse-echo acoustics;
- * Does not present a radiation hazard like neutron interrogation;
- * Not time-intensive and does not present environmental and safety hazards like destructive methods;
- * Difficult to spoof; and
- * Portable, easy to operate, cost-effective, and reliable.

Using Gravity to Monitor Arms Control Treaties

Gravity gradiometer technology can be useful as an arms control monitoring technique by measuring the effect of gravity on observable objects. During the research and development phase, gravity gradiometer technology has been demonstrated to be able to distinguish between dual-use items, count warheads, and distinguish between high-explosive and chemically armed weapons. However, early models of this technology are expensive, though final costs are dependent on the results of additional work in the demonstration/validation phase and prototype development. Advantages to this technology are that it is non-intrusive, difficult to spoof, and is comparatively accurate.

Tagging Technologies and Applications

Tags and seals can take many forms in arms control verification. The following is a listing of some of the types of tags based on off-the-shelf-technology, which are available for use in current and future verification regimes:

- * Reflective Particle Tags
- * Non-linear Junctions
- * Cobra Seals
- * Secure Loop Inspectable Tags/Seals
- * Passive Tamper Indicating Loop Seals
- * Ultra-sonic Intrinsic Tags
- * Electronic Identification Devices
- * Micro-videography
- * Optical Encoding
- * Secure Registration Systems

However, the use of tags may be more effective in arms control regimes which track or verify the existence of a relatively small number of weapons, since each tagged piece of treaty limited equipment (TLE) must be accounted for, as in START. That is, using tags in the CFE Treaty may prove to be an overwhelming task since there are several thousand TLEs to be verified. Hence, if one or two or even ten tagged tanks are missing, the accounting problems (and resulting political fallout) may prove to be greater than the potential military significance of the missing items.

The Potential Role of Aerial Monitoring in Verifying Compliance with a Chemical Weapons Ban

The use of aerial monitoring can be useful in verifying compliance with agreements limiting chemical weapons by enhancing on-site inspections in the following ways:

- * Serves as a deterrent to cheating or deception;
- * Familiarizes inspectors with sites prior to inspection via photographs;
- * Responds quickly to time urgent situations when OSI teams cannot;
- * Uncovers clandestine sites and cues inspections;
- * Obtains images in inclement weather; and
- * Serves as a confidence-building measure in and of itself.

Several sensor technologies are applicable to aerial monitoring, the most obvious being aerial photography. However, aerial imaging is not confined to the visible spectrum. Multi-spectral, infrared, thermal infrared, and radar technologies can also be used in aerial monitoring. Both high-resolution images of individual sites and low-resolution sweeps of terrain to identify potential sites for inspection might be useful to the international inspectorate. And in some cases, inspectors might use multi-spectral imagery to look for vegetation stress, which is an indicator of chemical activity.

In addition to imagery, air sampling systems can be mounted on aircraft as a supplementary tool. Gas chromatography coupled with either fourier-transform infrared (FTIR) devices or mass spectrometers can identify chemicals in picogram quantities. In addition, software controlling these devices can be designed to screen out chemicals irrelevant to the Chemical Weapons Convention (CWC), thus protecting proprietary data.

In the short-term, several remote-sensing aerial imaging techniques should be available. Light detection and ranging (LIDAR) and passive FTIR sensors can potentially detect chemicals from several kilometers away. Moreover, differential absorption LIDAR techniques can detect concentrations in the parts-per-million range from one kilometer distances.

Under current CWC provisions, the application of aerial sensors might be most useful in monitoring CW production plants. Closed production facilities can be monitored from the air. Any significant thermal signature could be a trigger for an on-site inspection. Likewise under the CWC, a nation's Single Small-Scale Facility could be a likely object of aerial monitoring. Since the Single Small-Scale Facility would be dormant most of the year, the inspectorate could use aerial monitoring to verify the declared production schedule.

In each of these applications, aerial monitoring would be a supplement to, not a replacement of, OSI. Aerial monitoring can reduce the number of inspections, and can act as a filter, directing OSI to high-risk facilities.

Phase I Development of a CW-Verification Expert System

Development of a Chemical Weapons Verification Expert System is designed to provide a predictive model that can determine the likely locations and concentrations of chemicals released from a production site for variable periods after production has ceased. The impetus for this work has been the development of a means to conduct sampling more efficiently under the provisions of current proposals for a CWC challenge inspection regime.

The model focuses on stack emissions, and can accommodate fugitive emissions. A source not considered in the model is effluent discharges. This can be a significant source of signature chemicals. In fact, if a CW facility does have effluent discharges, these discharges can contain concentrations of signature chemicals several orders of magnitude higher than stack emissions.

The model adapts stack dispersion, chemical deposition, and chemical degradation models to accommodate hourly meteorological data for a period of up to a year in a single model. The two most significant variables in determining the results are stack height, air stability, and wind direction. The dispersion model requires accurate meteorological data for the period of interest. The model is based primarily on a U.S. Environmental Protection Agency model designed for complex industrial sites, and can handle some complicated terrain situations. While the model is operational, further work is in progress to develop a more generic model that requires less site-specific data.

Yield Verification of Non-standard Underground Nuclear Weapons Tests by HYDRO-PLUS

Although the Threshold Test Ban Treaty (TTBT) was signed in July 1974, the lack of a verification protocol prevented its ratification until 1990. In 1980, the Defense Nuclear Agency initiated a test measurement development program that would eventually allow for the measurement of stress with sufficient accuracy for effective verification. By 1990 when the verification protocol was completed, this technology was ready for use.

Standard tests, those normally conducted by the Department of Energy, will use the Continuous Reflectometry for Radius Time Experiment (CORRTEX) system for verification. CORRTEX alone is inadequate for verification of non-standard tests, those normally conducted by the Department of Defense. A non-standard test employs a horizontal, rather than vertical shaft, and the detonation occurs in a cavity up to 20,000 m³. Therefore, the resulting shockwave is not well coupled with the ground, making accurate measurement of the stress more difficult.

HYDRO-PLUS, the chosen system for verifying non-standard tests, uses CORRTEX plus three gauge measurements to determine yield: peak particle velocity, peak stress, and shock value. Time of arrival measurements provided by CORRTEX alone are insufficient in low-pressure domains. HYDRO-PLUS extends effective verification into this low-pressure domain, allowing verification of detonations in larger cavities.

To obtain an accurate measure of the yield, the geometry of the cavity and the

location of the canister, the identification and location of geologic materials, and the dynamic material properties must all be understood, since each site has different characteristics. And, since the time available to conduct surveys is limited under the TTBT Protocol, surveys must be well planned and executed.

HYDRO-PLUS also provides a high degree of confidence that the yield is within $\pm 30\%$ of the measurement. The two largest factors in the error bar are Equation-of-State uncertainties and uncertainties in gauge measurements. Each of these factors accounts for about 10% of measurement error.

HYDRO-PLUS has been used in four tests to date and is being deployed for use on a fifth. Although current results using this technique have been satisfactory, incremental technical improvements can be made to ensure greater accuracy of test data and results. Future requirements may include the need to measure lower thresholds, to monitor tests resulting in lower-stress regimes, and to monitor multiple tests.

Reviewing the Verification Equation

- * In general, verification policy-makers and technologists function adequately as a community, but institutions and processes can be improved to produce better products in a more cost-effective manner.
- * Verification requirements are becoming more diverse. The range of technologies under consideration is growing, as are the number of treaties under negotiation.

- * Technology seldom works well the first time it is applied, and most advances in technology occur through product improvements. Verification regimes, however, are very difficult to modify once negotiated and ratified. Better methods for improving existing verification regimes need to be found.

- * U.S. Government policy should not prejudice R&D. Former policies of not conducting RDT&E of methods of warhead dismantlement is now limiting our ability to dismantle warheads. Current reluctance to investigate methods for verifying biological arms control agreements may have similar consequences.

- * There needs to be an effective system of peer review for verification technology, particularly in the early stages of development.

- * The U.S. Government needs to develop a priority list for potential verification requirements that are not yet incorporated into treaties. Examples of such potential requirements are verification of low-yield nuclear tests, verification of warhead dismantlement, and verification of the Biological Weapons Convention. Without a list of priorities, developers do not know where to invest scarce resources. The establishment of priorities must be coordinated. Individual departments and agencies should not be allowed to set their own priorities.

- * U.S. technology policy is overly threat oriented. Without a threat, funding tends to be cut. Verification technology development must avoid the trap of continually responding to "the threat of the month." If reasonable priorities are established, existing technology can be adapted to respond to new requirements as they develop.
- * Policy makers and technologists need to consider options related to uncooperative on-site inspections (like

those carried out in Iraq) when defining requirements and developing technology. While the majority of potential uses of verification is in cooperative regimes, a precedent may have been set in the use of uncooperative regimes.

- * There may be a "critical mass" of expertise and funding required to maintain a viable verification technology development program. If so, the U.S. Government must be careful not to fall below this required level.

PANEL SESSION VI

The Economics of Arms Control

Chairman:

Mr. John Milam
BDM International

Presentations:

Dr. Jeff Grotte
Institute for Defense Analyses

Dr. Michael O'Hanlon
Congressional Budget Office

Mr. Leo Zefitel
CMA Consultant

Presentations:

Dr. Stephen Black
Carnegie Mellon University

Ms. Blair Murray
Science Applications
International Corporation

In an environment of dwindling resources, U.S. Government agencies and the military services will be forced to examine arms control verification budgets carefully in order to use allotted funds more effectively as the national budget decreases. Given this trend, it may be possible to construct several guidelines for determining the relative cost-effectiveness of various arms control verification regimes.

Verification Remains Important in the Changing Environment

Current and future monitoring regimes should implicitly incorporate a high degree of confidence that cheating is not occurring, including a high degree of confidence in declared data provided at entry into force, because as forces are reduced, the significance of cheating and deception increases.

This proposition is particularly valid in verifying chemical weapons stocks.

Confidence in declared data should be confirmed during baseline inspections, and inspectors must have access to the interior of undeclared sites. This approach would provide a high degree of confidence in detecting any diversion or illegal production of equipment, since inspectors would have a valid set of data to compare to suspect equipment stocks.

Searching for Savings and Cost-Effectiveness

In using the provisions of the START and CWC agreements as models for application of this principle, substantial savings might be found by reducing the number of START and CWC production and potential production sites that are considered declared under current provisions. If these are considered undeclared sites (with on-site inspection provisions) rather than declared sites, savings could occur, since fewer pieces of monitoring equipment would need to be procured for START and fewer inspections

would take place for the CWC. As a result, the United States may be able to realize savings of up to \$3 billion over 15 years if this approach is taken.

Additional cost-cutting measures should be considered in conjunction with the changing nature of global and regional military threats. Support for monitoring and verification should be maintained during future budget cuts to plan for potential negative trends in the international environment. Over the next decade, strategic nuclear weapons stockpiles in the United States and Russia will eventually be reduced to approximately 3000 to 4000 warheads under the START and Bush-Yeltsin initiatives; and, due to reduced tensions between the United States and Russia, U.S. Government agencies and the military services could begin to reduce force structure spending and channel cost-savings to verification and monitoring programs as requirements to implement an expanded range of arms control treaties and agreements continue to grow.

For example, since the threat from Russian ballistic missile submarines (SSBN) may not be as great as it once was, the U.S. Navy should reassess its need for a large attack submarine (SSN) fleet, whose mission, in part, includes trailing Russian SSBNs; and, the Navy should begin to consider reducing its requirements for SSNs. The same analysis could be applied to the Navy's P-3 submarine hunter aircraft fleet, which also has a strategic anti-submarine warfare role. Savings from reductions in these programs could be applied to the U.S. Government's arms control compliance and implementation budget or applied specifically to U.S. Navy arms control compliance and implementation responsibilities under

START.

Alternatively, cost-savings may be found not only in the reduction of force structures and force technology programs, but in re-structuring various arms control verification regimes. By "collectivizing" verification monitoring bodies and functions already in place, redundancy and waste could be avoided, while increasing efficiencies of verification efforts. For instance, an international verification agency could be established which could eliminate the need for national verification agencies. Moreover, a multilateral consultative committee could be established, which would assume the functions of all the joint consultative groups in CFE, INF, START, etc. The United States and its NATO allies could then coordinate their verification activities more accurately and effectively by instituting interactive databases across treaties for the purposes of tracking data, such as notifications, treaty-limited equipment, and the elimination of weapons systems.

In fact, several proposals of this type are already beginning to take place. NATO has established the Verification Consultative Committee to coordinate verification activities among parties to the CFE Treaty, and the U.S. Air Force and the U.S. Navy are now sharing START data over an integrated computer link.

Another approach to increasing cost-effective verification is the concept of avoiding negotiated disincentives to treaty parties in implementation. That is, negotiators should be careful not to deter parties to an agreement by proposing overly expensive verification regimes to ensure compliance. Proposed costs of implemen-

tation should not outweigh the benefits of complying with a given verification regime.

For example, under the current provisions of the Chemical Weapons Convention, most U.S. industry partners favor stringent monitoring schemes, such as inspections of all sites in all states parties. However, this would yield some 20,000 sites in the U.S. alone. Inspections, though, could be qualitative and of a limited duration (relative to the size of the operation); and, to ensure a high degree of confidence against violations of the provisions of the CWC agreement, all chemical industrial sites could be open to inspection.

U.S. industry is also ready to contribute several million dollars per year to support CWC monitoring regimes by providing escort assistance during inspections and by providing data to the CWC parties. For the U.S. part, "anytime; anywhere" inspections may not be as disruptive as previously thought, since the U.S. chemical industry already receives short-notice inspections from the Environmental Protection Agency, the Occupational and Safety Administration, and the Food and Drug Administration.

Cost savings in the CWC may also be found by restructuring the architecture of the proposed verification regime around a "dynamic enforcement system." This system takes advantage of several verification and monitoring techniques, such as detection

and world-wide localization, site inspections, and national technical means. Although each technique has a relatively low detection probability individually, when several techniques are combined into a "verification package," the cumulative effect of detection probabilities substantially increases the probabilities of detecting violations. In addition, since national capabilities may also be combined, costs to state parties may be reduced.

Observations

New ways must be found to make the monitoring of arms control treaties more stream-lined and more efficient. Cost savings might be found through channelling resources previously earmarked for force structure programs into verification and monitoring programs designed to verify the reductions of those forces. In addition, national verification agencies may develop greater efficiencies in verification regimes through increased national, regional, and international cooperation. Also, more coordinated efforts in developing verification and monitoring technologies through more effective interagency coordination could yield additional efficiencies. In spite of their costs, verification and monitoring activities will remain important elements of the future arms control process in the uncertain future. Reductions in resources to support these programs should be considered carefully against the backdrop of national security priorities and changing international trends.

OPENING ADDRESS

AMBASSADOR ROBERT JOSEPH

U.S. Commissioner, Standing Consultative Commission
U.S. Arms Control and Disarmament Agency

The Future of Arms Control in the Global Environment

Presented to

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It is a pleasure to be here and an honor to give the opening address for this important conference. The subject of my talk is ***The Future of Arms Control in the Global Environment***. The nature of that environment has been altered in fundamental ways over the past several years and, in all likelihood, will continue to evolve in a dramatic fashion. With the demise of the Soviet Union and the Warsaw Pact, resulting in the end of the Cold War, and the expanding instabilities due to the proliferation of advanced weapon systems throughout the world, the role of arms control as a component of our national security policy has changed. What that role is today and what it will be in the future is not a question that can be easily answered. Part of the answer, perhaps the most important part, will only be clear after the historic events set in motion in Russia, in the Gulf, and elsewhere have progressed further. What I will provide is one perspective -- a personal perspective -- on how we can best employ arms control as a tool of our current national security policy and how arms control might be of assistance in helping to shape the future.

Arms control does have the potential

to contribute significantly to the international security situation. We now have an opportunity to work with the reformist elements in the former Soviet Union, who recognize the need for change in both their domestic and foreign policies. We also have maximum leverage in the Third World, given the pre-eminence of the United States on the world stage. How long this opportunity will exist is open to question, but clearly the changes are already evident in the arms control dialogue.

The goals for arms control, to enhance our national security and to promote international stability, remain both valid and vital. In many ways, although their scope and importance have grown, today's challenges to global security are not new. For example, ballistic missile technology has existed for many years, and chemical and biological weapons have been around even longer; and, problems of security among neighbors have existed as long as there have been competing tribes, nations, city-states, and empires.

To ensure that arms control is pursued in a worthwhile way within a balanced security strategy, we must shape it to

respond to the new international security environment, and we must pursue it with full awareness of the lessons learned from the past. Let me turn now to these lessons.

Lessons Learned

Until recently, U.S. arms control efforts were primarily, though not exclusively, focused on the massive military capability of the Soviet Union and the Warsaw Pact. We sought restrictions on the conventional threat to Europe as well as on various classes of other weapons -- strategic offensive arms, intermediate-range nuclear forces, and chemical and biological weapons. Our principal objectives were to: (1) reduce military capabilities that could be used against the United States or our allies and that could provide an enemy incentives to initiate an attack; (2) to enhance predictability in the size and structure of forces through openness and transparency; and (3) to ensure confidence in treaty compliance, through effective verification. Although the nature of the primary threat has changed, these remain valid goals of arms control. The challenge is to ensure that the arms control policy, in the context of the changed nature of the threat, is adjusted to meet these enduring objectives.

In making the appropriate adjustments to our arms control policy, we can learn from past experience. In addressing the Soviet threat through the arms control process, we learned a number of lessons. Among the principal lessons learned are:

First, participation pays. Going to the negotiating table and staying there allowed us to secure agreements that were in our national interest. In addition, engaging the Soviets in arms control negotiations

enabled us to develop a common language for communicating about security issues. By participating in arms control negotiations, the United States was able both to encourage "glasnost" and to reap its benefits as it progressed. In the last several years, the outcome of this process includes a long list of achievements:

- * The INF agreement, providing for the elimination of U.S. and Soviet intermediate-range and shorter-range missiles and for a comprehensive program of on-site inspections. This experience provided an unparalleled precedent that enabled the parties to conclude agreements rapidly once the fundamental changes in Eastern Europe and the Soviet Union began to unfold.
- * The START Treaty that will result in significant reductions in the strategic offensive arms of the former Soviet Union. The Treaty provides for reductions on the order of 40 percent in accountable strategic nuclear warheads. START also provides for a comprehensive array of verification measures, including provisions for on-site inspection of declared items; notifications, data exchanges, and telemetry provisions; and cooperative measures that enhance each side's ability to confirm by National Technical Means that obligations are being fulfilled.
- * The U.S.-Soviet Bilateral Chemical Weapons Destruction Agreement, which provides for destruction of declared chemical weapons stocks and inspections to confirm destruction.

- * New verification protocols to the Threshold Test Ban Treaty (TTBT) and Peaceful Nuclear Explosions Treaty (PNET) that enable direct, on-site measurement of yields of underground nuclear tests.
- * A U.S.-Soviet agreement on advance notification of major strategic exercises, and an agreement on dangerous military activities -- designed to prevent misunderstandings that could trigger conflict.
- * Landmark multilateral agreements such as the Conventional Armed Forces in Europe (CFE) Treaty and the Vienna Document on Confidence- and Security-Building Measures (CSBMs). The former will ensure the destruction of thousands of tanks, artillery and other pieces of offensive military equipment. The latter will bring a climate of openness and transparency to military activities, reducing the risk of war by accident or miscalculation. Both agreements will work to ameliorate a long history of military confrontation in Europe.
- * An Open Skies Treaty that will provide parties with overflight rights not tied to arms control limitations, but which will reinforce transparency provisions of other agreements.

The second major lesson we have learned is that democracy is an asset, not a liability. Many observers have lamented that having an open society is a disadvantage when facing an adversary like the Soviet Union. Tight Soviet control over information did pose problems. But through it

all, the United States and its allies openly pursued shared objectives, even when policies became controversial or there were other costs.

For example, in the early 1980s, the United States and its allies weathered a bruising public debate on the two-track proposal to deploy INF missiles in Europe while conducting negotiations -- first to reduce, then to eliminate these missiles worldwide. In another area, precautions were necessary to preclude the loss of national security information in 1988 when the U.S. allowed a Soviet team on the Nevada Test Site for an experiment to demonstrate an on-site method of determining the yield of underground nuclear tests.

Nevertheless, an open approach paid off in the INF Treaty, and it paid off in new verification protocols for the TTBT and PNET treaties. An open approach allowed the West to take its message to those that did not participate directly in the bilateral talks; these include Congress, the media, the general public, our allies, and international audiences. Our willingness to explain our arms control policies also demonstrated a desire to work hard at shaping a consensus among all relevant players.

A third lesson is summarized by the phrase, "trust but verify." Negotiations will always be difficult between states that bring to the bargaining table differing objectives and operating principles. We have learned that differences between negotiating partners create the need to spell out clearly the rights and obligations of arms control agreements and to secure precise verification arrangements that allow parties to confirm that obligations are being met. This is closely

related to the notion that no agreement is better than a bad agreement.

In addition, our insistence on scrupulous compliance with existing pacts has led to subsequent arms control agreements which have improved upon their predecessors. Our efforts to secure compliance with SALT and the ABM Treaty made START a better treaty than it might otherwise have been.

In part because of our steadfast pursuit of effective verification, past reliance on National Technical Means (NTM) has been supplemented by elaboration of new cooperative measures that enhance the effectiveness of NTM, and systems of notifications and inspections where these are appropriate. On-site inspection is a key element in the INF, START, and CFE treaties. In the process of negotiating these treaties, we learned that future ambiguities or disputes may be eliminated or simplified to the extent verification concerns are dealt with before treaty signature, and to the extent effective verification provisions are spelled out in detail within each agreement.

Even with the finest technology and the most detailed verification provisions, some undetected cheating is possible. But we have labored to design monitoring provisions which can help detect cheating before it becomes a threat to the United States or its allies and friends. While we have reached agreement that in some treaties, on-site inspection should be one element of an overall verification regime, on-site inspection cannot by itself guarantee effective treaty verification. Nor does it guarantee compliance. All verification approaches have limitations. The challenge is to tailor that approach to the objective

desired.

The final lesson, and to me the most evident, is that in negotiating arms control agreements the best leverage comes from demonstrating the political will and commitment of resources to ensure our national defense. In the 1980s, this was the critical ingredient of success. Only after the United States and NATO began INF deployments did the Soviets agree to eliminate all INF systems. Likewise, only when it was clear that the United States would go forward with strategic modernization -- both offensive and defensive -- did we make progress in START. Our experience in the chemical weapons area is also telling in the same manner. Now let me turn to the future.

Arms Control in the Future

During the Cold War, arms control was viewed by some as a "yardstick" by which to measure the state of the U.S.-Soviet relations. At times it was elevated by the media and others as an end in itself. But arms control alone cannot provide for our security. Rather, it can be a helpful tool, along with diplomacy and defense policy, to be used as we strive to address threats to our security. While our basic security objectives remain the same, arms control can no longer be viewed primarily as a way to address the East-West confrontation.

In many ways the role of arms control will remain constant: to foster U.S. security and promote stability abroad. At the same time, it is evident that the world, once dominated by superpower confrontation, has been fundamentally altered by the dissolution of the former Soviet Union and the end of Soviet domination of Eastern

Europe. This reality requires that we change the methods by which we approach and implement arms control, and it adds to the challenges in securing arms control agreements and the benefits they can provide.

Challenges

The failure of the August 1991 coup in Moscow opened up new prospects for arms reductions. Our relations with the independent republics of the former Soviet Union will allow us to achieve arms reductions using approaches that complement or in some cases replace traditional negotiations. For example, we are now engaging Russia in discussions to determine how the United States can assist it in safe and secure transport, storage, and dismantlement of former Soviet nuclear weapons; the handling of emergency nuclear weapons accidents; and the ultimate disposition of fissile materials recovered from dismantled weapons. In addition, we will soon begin discussions with Ukraine on nuclear material accounting and control and physical protection systems.

And in September of last year and again in this year's State of the Union Address, the President announced bold new initiatives, calling for measures which were almost unthinkable a year ago:

- * Pursuing reductions in strategic nuclear warheads below levels agreed in START.
- * Limiting ICBM modernization efforts to one type of single warhead missile.
- * Pursuing early agreement to

eliminate from U.S. and former Soviet inventories all ICBMs with multiple warheads.

- * Continuing reductions and withdrawals in tactical nuclear weapons.
- * Cooperation on ballistic missile defense.

In embracing both unilateral and bilateral steps, Presidents Bush and Yeltsin have set in motion a process of drawing down, and, in some cases, eliminating, whole categories of tactical and strategic nuclear weapons which were made unnecessary by the recent political changes in the former Soviet Union and Warsaw Pact.

In some ways, the formulation of the new initiatives was facilitated by building upon the framework achieved through the long years of painstaking negotiations in INF and START. But the new situation in the former Soviet Union suggests that using traditional practices and frameworks will not always be appropriate. Future arms control efforts with the former republics are expected to be more challenging because of a number of factors:

- (1) **A "proliferation" of negotiating partners.** The United States will have to approach, respond to, and attempt to influence the behavior of more than one player across the table. As we learned in the lead-up to the recent Lisbon Conference, this will make bargaining more complex, and will involve additional time and resources to secure a given outcome. We have also seen evidence of this in START JCIC deliberations in

Geneva, which recently were attended for the first time by representatives of Ukraine and Belarus.

- (2) **The difference in experience and priorities among the former republics.** When former Soviet officials represent the Russian Federation in arms talks, the dialogue is fairly predictable and familiar. But when this is not the case, more effort is required to lay the groundwork for progress. In addition, whether because of internal ethnic disputes or harsh economic conditions, the agendas of individual republics may differ and, in some cases, are in conflict.
- (3) **Increased requirements for consultation.** The United States has had a long history of briefing its NATO allies on the status and prospects of arms control talks. Consultations regularly take place both within and outside traditional NATO mechanisms. Now that some NATO proceedings include "liaison states" - the former Warsaw Pact countries and Soviet Republics -- the consultation burden is greater. In addition, consultations outside traditional NATO structures are rapidly multiplying. The most important result of this expanded consultation process is that the U.S. will have to take a wider range of views into account in formulating its arms control approaches.

Up to this point, I have been discussing the challenges to arms control efforts in a trans-Atlantic context. If these challenges

appear daunting, then consider those that arise as we pursue meaningful arms control in other regions of the world, such as the Middle East and South Asia. Because of instability in those regions and elsewhere, our arms control efforts have become increasingly directed toward stopping the proliferation of weapons of mass destruction, namely nuclear, chemical, and biological weapons and the means to deliver them, primarily ballistic missiles. There is no doubt that stopping proliferation deserves added emphasis in arms control.

To capitalize on past multilateral efforts, and in recognition of the new global environment, we are urgently pursuing strategies to strengthen existing non-proliferation arrangements, to expand the membership of multilateral non-proliferation regimes, and to encourage the development of regional stability initiatives. We are committed to strengthening the Nuclear Non-Proliferation Treaty regime and securing its indefinite extension at the 1995 NPT Extension Conference. We have achieved a substantial strengthening of the NPT by gaining Chinese adherence in March, and very significantly, by our recent successes in Lisbon in gaining commitments from Ukraine, Belarus, and Kazakhstan to join the NPT as non-nuclear weapon states.

We are also committed to strengthening the International Atomic Energy Agency, the United Nations body that negotiates nuclear safeguards agreements and inspects nuclear facilities under the NPT to assess whether there has been diversion of nuclear material from peaceful programs.

In addition, we are working closely with the Republic of Korea as it seeks to verify its agreement with the North on a

non-nuclear Korean peninsula. The agreement bans the production, acquisition, and development of nuclear weapons and uranium enrichment and nuclear reprocessing facilities, which produce nuclear materials for weapon production. This complements our efforts to support the international community in pressing the government of North Korea to accept long overdue IAEA inspections of its nuclear facilities, which began on May 26, 1992. It is our view that the two inspection regimes, one multilateral and the other bilateral, will reinforce each other.

Our efforts to prevent the proliferation of ballistic missiles center on the Missile Technology Control Regime (MTCR), whose 19 member states subscribe to a common set of export control guidelines on missiles and missile technology. Similarly, the twenty-two nations of the "Australia Group," formed in 1984 in response to the use of chemical weapons in the Iran-Iraq war, now control 50 chemicals and equipment which could be used to produce chemical weapons.

Another top U.S. priority is the completion of negotiations on a global Chemical Weapons Convention which will ban the development, production, and storage of chemical weapons. The United States is also working to strengthen the 1972 Biological and Toxin Weapons Convention (BWC) through implementation of new and improved confidence building measures. These two efforts, which address the spread of chemical and biological weapons through multilateral arrangements, complement our policies of implementing national export controls and harmonizing our controls with those of other countries.

These attempts rely mainly on existing strategies. But we are also working to develop new approaches. These include:

- * Providing a direct grant to the IAEA to enable it to carry out inspections of newly declared facilities in the territories of new parties to the NPT.
- * Pursuing efforts to provide computers to the republics of the former Soviet Union in a bid to help them implement the provisions of the CFE Treaty and to promote full participation in declarations associated with the Conference on Security and Cooperation in Europe.
- * Establishing science and technology centers in Moscow and in Kiev with the goal of providing weapon scientists and engineers with opportunities to redirect their talents to non-military endeavors. These scientists might otherwise be tempted to seek employment with renegade states or sub-national groups bent on developing weapons of mass destruction.
- * Exploring with our allies, with Russia and others, a concept for a global defense system, to include sharing of early warning information on ballistic missile launches, and cooperation in improving or acquiring a ballistic missile defense.

In promoting these initiatives, the United States is serving as a "strategic broker" to the benefit of U.S. arms control objectives.

In our continuing attempts to devise

new strategies for dealing with arms control and the related problem of proliferation, we face a number of challenges. These include:

- (1) Some states have little or no experience in arms control. This is the case with Korea. Indeed, even the establishment of contacts between the Republic of Korea and the North is fairly new.
- (2) Some states have as a top national priority, the acquisition of missiles and weapons of mass destruction - the very antithesis of our arms control objectives. Iraq comes to mind, but it is certainly not alone. Even as a defeated power that had extremely intrusive inspections imposed on it as a result of its defeat in the Gulf War, Iraq has continued to pursue aggressively its quest for nuclear weapons. Moreover, despite the intrusive inspections imposed on Iraq, international inspectors were unable to gather conclusive evidence of a biological warfare program -- despite knowledge to the contrary. The Iraqi case demonstrates the limits of even the most intrusive monitoring procedures. A government like that of Saddam Hussein's -- and we could all name others -- simply cannot be trusted to fulfill its obligations. Thus, there is a continuing need for strong defenses, whether it be national forces or a coalition of conventional forces such as that which achieved victory in the Gulf, or the deployment of

strategic defenses to protect us against the threats of the future.

- (3) Reconciliation of fundamental political differences is a requirement for effective regional arms control. As long as countries perceive a threat to their territorial integrity or national security, they will continue to stockpile weapons. This is why the United States is working hard to promote the Middle East peace process. This is also the basis for our diplomatic efforts to address concerns that create pressures for nuclear weapons on the Indian subcontinent.

Conclusion

It is clear that our efforts to promote security, both at home and abroad, include but are not limited to arms control. For the foreseeable future, arms control will remain an important facet of a multi-dimensional security strategy that includes diplomatic efforts and, most important, a strong defense. We are proud of the strategy that enabled us to win the Cold War. Nevertheless, the challenge of creating a safer world is made more difficult by continuing instability in various regions of the world combined with the spread of weapons and technology of mass destruction and the means for their delivery. Clearly, the complexities of the new global environment will make the pursuit of security gains a long and arduous process. Arms control will have an important role to play.

DINNER ADDRESS

MR. LEO A.J. VERBRUGGEN

Director, Verification, Information Systems,
and Council Operations,
North Atlantic Treaty Organization

***Verification and Cost-effectiveness
Within the North Atlantic Alliance***

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The relationships between verification and technology in arms control constitute an interdependent series of measures arranged much like a multi-layered system. There are space-based systems for optical remote sensing and aircraft platforms which use a variety of sensors. However, at the heart of the verification regime supporting the Treaty on Conventional Armed Forces in Europe (CFE Treaty) lies a system of regular and random on-site inspections.

Some nations, like the United States, operate satellite reconnaissance systems, while others are developing them, such as France with the interaction of the Western European Union. Some nations have sophisticated aircraft equipped for imagery or signals intelligence collection. And, although these systems are capable of high-technology missions, they are very expensive and can be deceived with counter-measures.

Therefore, every single member state of the North Atlantic Treaty Organization (NATO) can demonstrate its commitment to

the common cause of the CFE Treaty by offering men and women as inspectors, which is the key common denominator; though the more technologically sophisticated air- and space-monitoring systems enhance the effectiveness and efficiency of the limited numbers of on-site inspections provided for in the Treaty.

Of all the activities of the North Atlantic Alliance, few areas offer partners as much scope for cooperation as verification of arms control treaties -- in preparation, planning, execution, and evaluation of compliance. No one nation could run an effective credible verification regime of the CFE Treaty on its own. The size of the Atlantic to the Urals region and the scale of the treaty limited equipment are too extensive for any one country to verify.

**Cost-Effectiveness Through Cooperation
and Coordination**

Cooperation among the Alliance

members on the CFE Treaty provides a method for achieving cost-effectiveness in verification matters. According to Webster's Dictionary, cost-effectiveness means the relative benefit for the costs involved. Relative benefit can be measured in several ways. One method is in terms of fiscal resources in relation to verification technology that is available and which needs to be developed. It is also useful to focus on the benefits in diplomatic and political terms. This presentation addresses the diplomatic and political benefits of cooperation among the Alliance members in implementing the CFE Treaty verification regime.

NATO's experience in the coordination of arms control verification activities among NATO member states and the efficiency gained from these activities provides an excellent case study. The parameters within which NATO coordination takes place are established by the modalities of the arms control agreements or treaties, alliance policy, and the fundamental principle that verification is inherently a national sovereign responsibility.

For applicable multilateral agreements or treaties, the member states of NATO coordinate their policies, positions, and implementation activities through two bodies established by the North Atlantic Council specifically for this purpose. These bodies are the High Level Task Force (HLTF) on conventional arms control and the Verification Coordinating Committee (VCC) on implementation.

Although, the CFE Treaty has three distinct and different interrelated groups dealing with the provisions of the treaty, the states parties (signatories to the treaty) are

responsible for all obligations of the treaty. Therefore, verification is a national prerogative. However, since no state party can carry out an effective inspection regime on its own, NATO has opted for intra-alliance coordination via the Verification Coordinating Committee. In addition, the Treaty provides for the Joint Consultative Group (JCG), located in Vienna, Austria, which deals with all issues and matters concerning verification among the signatories.

Whereas the High Level Task Force is the primary body for the establishment of overall NATO policy for conventional arms control negotiations, the Verification Coordinating Committee has been tasked to coordinate Treaty implementation.

To indicate where the VCC fits into the NATO organization, it is useful to understand the NATO organization. At the top of NATO is the North Atlantic Council (NAC), which in permanent session is composed of the permanent representatives (ambassadors) from each of the 16 member states. The NAC is chaired by the secretary general. The Council directs the work of the VCC and provides its terms of reference. The VCC reports directly to the Council and is composed of representatives from each of NATO's 16 member nations and is chaired by the international staff. The Verification Support Staff (VSS) is in direct support of the work of the VCC. Additional support is provided by the Political Affairs Division of the International Staff (supporting the HLTF) and the international military staff, who also represent the NATO military authorities.

The VCC is the forum within which member states have agreed to coordinate

their conventional arms control verification policies and programs. This process is designed to lead to an economy of effort on verification activities. First and foremost, the VCC is a forum for active exchange of information and experience on all matters pertaining to verification. Through the use of this body, a more efficient and cost-effective verification regime is possible. By pooling resources of experience and information it is possible to cue inspections, to harmonize them, to detect deficiencies, to interpret problems, and thus, activate the JCG process in Vienna. This function is the most important one and should be used extensively, especially in the first phases of implementation of the CFE Treaty.

The objectives of the VCC can be roughly divided into four different categories. These are verification policy, inspection coordination, information management, and inspection support. The subject matter for the VCC concerns all current and future multilateral arms control agreements and treaties such as the Vienna Documents, CFE 1, CFE 1A, Open Skies and the Post-Helsinki Security Negotiations. Each forum has its own distinct context, and in most cases different monitoring modalities. Their requirements range from simple observations under the terms of international agreements to the counting of treaty limited equipment under the aegis of international law. The bottom line on Alliance cooperation on verification is that by working together member states can maximize their effectiveness, while reducing their overall costs in implementing regimes.

The task of verification policy coordination and the establishment of a unified policy approach to the verification regime of these agreements and treaties is a basic

method of assuring efficient and cost-effective implementation, while at the same time nurturing Alliance solidarity.

"Harmonization" - An Approach for the Future

To date, the inspection regimes, with which the VCC deals, are based on a national quota system. The negotiated result, in itself, was driven by concerns from the participating states that these regimes be affordable and effectively executable. For example, the CFE Treaty covers approximately 195,000 items of highly mobile treaty limited equipment distributed in the Atlantic to the Urals region, which covers about 2.5 million square miles of the territory of 32 sovereign nations. By any measure, CFE verification by itself is a daunting task, which if taken to extremes would not be affordable or executable by most of the participating states on their own. So procedures have been developed to harmonize policies, to establish multinational teams, and to coordinate verification issues which have to be dealt with in the JCG.

The difficulty and complexity of CFE verification implementation leads to the task of inspection coordination to ensure that the available national quotas are effectively utilized, and unnecessary duplication is avoided. So that national inspection plans are not in conflict with one another, the VCC is tasked with the responsibility of harmonizing 16 national inspection plans. Based on the original CFE information exchange, the VCC has harmonized the CFE inspection plans and is standing ready to do so again when the newly independent states of the former Soviet Union provide their notifications on objects of verification

(OOVs). The emphasis here is to cut down on the duplication of national efforts in making sure that inherent limitations in amounts of simultaneous inspections have been taken care of (by making use of information from other partners) and to ensure proper geographical spread and timing. The fewer number of inspection quotas for the Confidence and Security Building Measures Agreements (the Vienna Documents) require less harmonization, but coordination is still necessary to ensure the best use of limited resources.

The CFE Treaty itself provides for a system of multinational teams to conduct declared site and challenge inspections in addition to destruction monitoring. The VCC has agreed on procedures for the establishment of these multinational teams within the Alliance. This should provide the opportunity for nations to be able to expand their opportunities for inspections beyond their national quotas and to increase monitoring of the destruction of excess treaty limited equipment.

An additional political objective in this case, which also leads to cost-effectiveness, is that through contributions to multinational teams it is more difficult for nations to opt out of the inspection obligations. Under the CFE Treaty it is of utmost importance that all signatories to the treaty, at least from the NATO side, comply with their obligations of the Treaty, and the multinational team system provides a method of achieving this objective.

The Verification Coordinating Committee also acts as the Alliance's operational manager for the execution of the various inspection phases of the CFE verification regime. In this context, the VCC with the

support of the international military staff has provided for common Alliance training of CFE inspectors and reduction monitors. Over 250 inspectors have now graduated from inspection courses which are conducted at the NATO school at Oberammergau, Germany. With the full support of the United States, an advanced inspectors course is also being offered with the first course being given at the beginning of June at NATO headquarters in Brussels. The benefit of these courses is not only economy of scale, but also the international contacts which exist during these courses and which will have a positive effect on the execution of inspections, be it with national or international teams.

Within the Alliance, a very ambitious CFE trial inspection program has been conducted in preparation for Treaty implementation. These inspections have been carried out not only between Alliance members, but also by mutual consent with the Central and Eastern European countries, and with many of the newly independent states of the former Soviet Union. To date there have been approximately 350 of these inspections carried out in full compliance with the terms of the CFE inspection protocol. Reports of these inspections are provided to the VCC for lessons learned and for the information and preparation of all members. The VCC has also conducted a number of seminars on CFE verification for Alliance members. The next seminar will be conducted on the 11th and 12th of June with all CFE participating states invited to attend.

The VCC is also responsible for certain data management activities related to CFE Treaty implementation. Data management is very important to the success

of the implementation phase in order to ensure that compliance through inspections is not diminished. The VCC has required the development of a common interactive data base, initially, for CFE implementation purposes. This data base will be the repository for the Alliance of treaty required information and notifications that are to be provided by all CFE participating states. This interactive data base system will also collect all of the Alliance inspection reports from both declared site and challenge inspections.

In the past, there have been two types of coordinated arms control negotiations -- those between two nations like the START and INF negotiations, and multinational agreements like the CFE 1, CFE 1A, and Open Skies negotiations. In addition, there is the Conference on Security and Cooperation in Europe (CSCE), which also concluded agreements in the fields of confidence building measures based on a regime with inspections, evaluation visits, and airfield visits. However, all these treaties and agreements have their own verification and inspection regimes. In order to achieve some cost-effectiveness measures, efforts have begun to harmonize some of the verification regimes among these treaties and agreements.

The idea of harmonization is based on the premise that the CFE Treaty, the Open Skies Agreement and a CFE 1A Agreement enter into force. After Helsinki, when the future arms control process will be opened to all of its 52 participants, harmonization will serve as a tool to build a closer relationship between agreements with comprehensive participation and the agreements with limited participation.

The Open Skies Agreement is designed in such a way that should make harmonization relatively simple: "Harmonization by Accession;" and similarly, the CFE 1A Agreement, based on national obligations, may also provide for the possibility of harmonization by accession.

Yet, verification issues are much more complicated with the CFE Treaty, whose architecture is built on the "group of states" concept, albeit significantly modified in the latter stages of the negotiation by the provisions of the individual signatories' rights and obligation as laid down in Article VIII. Thus, the main issue will be the harmonization of the relationship between the regimes of the CFE Treaty and the Vienna Document of 1992.

One approach sees harmonization as an effort designed to eliminate unnecessary duplication of effort and to rationalize the overlap between the CFE and the Vienna Document arms control regimes. In this view, complete harmonization between these two regimes is neither practicable nor desirable. The creation of a common basis for further arms control measures among all CSCE participating states is seen as an essentially technical task.

This view implies that the CFE Treaty would remain untouched by harmonization efforts into the long-term future; CSCE-states would only develop the Vienna Document further with the aim of bringing it closer to some features of the CFE Treaty.

The other approach sees "harmonization" as a more political exercise with the long-term goal of creating for all CSCE participating states equal rights and

obligations. In this context, harmonization of existing commitments on transparency, verification and limitations on armed forces would provide a common basis for all states participating in the CSCE on which further arms control measures could be built. As a consequence, "harmonization" and further efforts in the post-Helsinki forum towards arms control and disarmament should not be considered a separate exercise, but should form an integral whole. As a result, CFE participants and non-CFE participants could at some point in time be subject to the same regime of rights and obligations, which in the distant future may even supersede or replace present CFE Treaty provisions.

One should take account of the differences in approaches between the CFE Treaty and its legal obligations and the 1992 Vienna Document with its mainly political obligations. If CFE Treaty obligations remain untouched, most of the flexibility for harmonization should then come from the Vienna Document adaptation. Another approach could be a "harmonized Vienna document 199X," however, this scenario might be difficult to define at present. In any case, an incremental, step-by-step approach seems to be the proper direction for the near-term.

An area of interest to look towards for the future is the information exchange system as a prerequisite for notification, verification and limitations. Without a proper notification system, there will be no proper verification and inspection regime. Common definitions and descriptions of equipment subject to limitations are necessary requirements. Information on location and enhanced information on the structure of land and air defense forces, and potentially including naval forces will enhance

transparency.

The Vienna Document notification and information exchange regime could be enriched by some elements from the CFE treaty. In so far as non-CFE states would be ready to accept CFE-type obligations for themselves, it would be appropriate if compliance with these obligations could be verified, at least in principle. As a consequence of this, the possibility of a request by non-CFE states for some participation in the CFE inspection regime could raise difficult legal and technical questions.

The questions of limitations is another important area. With regard to harmonization without a readiness on the part of the non-CFE states to accept for themselves some form of limitations for the main conventional weapons limited by the CFE Treaty, harmonization would lose a lot of its meaning.

Only on a common basis of limitations within the entire "harmonized" area of application could all CSCE states participate in negotiations on further reduction in the post-Helsinki environment. This basis could lead to practical arrangements for non-CFE states to be linked to the work of the JCG, to participate in their meetings, and to exchange views and information. It is even conceivable that procedural arrangements among the CFE Joint Consultative Group, the CSCE Conflict Prevention Center, and the Committee of Senior Officials could meet back-to-back without interfering with their legal statuses.

As NATO continues to evolve to meet the realities of a changing Europe, new opportunities will develop for the creation of a system of security and stability based on

true cooperation instead of confrontation. This objective will require higher levels of trust and confidence, which can be developed through a step-by-step process via greater openness and transparency to which effective verification regimes can make a substantive contribution.

In this context, the Alliance will continue to strive to make its collective verification efforts as effective as possible through the harmonization of national policies, plans, and programs. In so doing, real cost savings can be achieved, while at the same time providing greater efficiencies in the conduct of complex verification regimes. The next several months will demonstrate if the preparation towards the implementation of the CFE Treaty will be successful.

On June 5, 1992, there will be the Extraordinary Conference in Oslo, Norway where Ministers will sign the final document of the state parties to the Treaty on Conventional Armed Forces in Europe. After the Helsinki Review Conference, the implementors will be tested. It seems sure that NATO will be able to take account of the new realities in the aftermath of the demise of the Soviet Union and the establishment of emerging democratic and free market states in its place. NATO must stand ready to help the inheritor states to come to grips with the intricacies and complexities of the Treaty and its inspection protocol to ensure a successful beginning towards a new more stable and secure Europe.

CLOSING REMARKS

MAJOR GENERAL KENNETH A. HAGEMANN

Director, Defense Nuclear Agency

Presented to

The Conference on Arms Control and Verification Technology

Williamsburg, Virginia

June 4, 1992

Thank you all for attending and participating in the Defense Nuclear Agency's *Arms Control and Verification Technology Conference*. I want to express my appreciation to the panel members, speakers, and session chairmen for their preparation and participation, which contributed largely to the success of this conference. I also want to convey my thanks to our foreign guests, who have made this a truly international event.

The speeches and panel presentations that took place over the past three days dealt with a number of critical aspects of arms control policy and verification technology. The sessions provoked a great deal of thought and discussion. I believe the level of interest and the quality of thinking bode well for the future of arms control and our ability to adapt arms control to changing world conditions. Now, I would like to pass on to you some of my observations concerning global dynamics and the changing role and nature of arms control and verification.

Over the past two years, the world has witnessed political and military shifts as sweeping and dramatic as any in history. These shifts have culminated in the replacement of communist regimes across Eurasia and Eastern Europe with political

systems whose announced goals indicate commitment to democratic ideals and peaceful relations. Accompanying these changes has been a growing recognition in both the West and the East that approaches to conducting arms control, including verification provisions, must adapt accordingly.

On the whole, current trends in world affairs are positive. However, some emergent conditions require that the rationale for verifying arms control agreements not be discarded, but be reconsidered within the new framework. These conditions include domestic uncertainties in some former Soviet republics and the continuing strain in relations elsewhere, with the attendant prospects of proliferation of weapons of mass destruction and advanced delivery systems.

As U.S. Forces are reduced over the next several years, the relative military importance of the remaining forces will increase. The relative importance of potential opposition forces will increase, too. Non-compliance with a future arms control agreement by a treaty signatory might have serious impacts.

In this environment, arms control can

be a cost-effective way to help to contain a military threat, but only if a given arms control regime is implemented in a manner that is equitable and reciprocal, and all parties comply. Otherwise, the agreement satisfies the economic, but not the effectiveness, aspect of cost-effectiveness.

With the end of the Cold War, some observers are arguing that classic START-type or CFE-type arms control regimes and verification provisions appear to have outlived their utility. This is both because of the collapse of the Communist system, and because the marginal utility of non-compliance in the START and CFE is still small, given the relatively large numbers of weapons remaining on each side.

However, as the cooperative, non-adversarial relationship with the former Soviet Union continues to grow, cuts in both sides' forces can continue to deepen. The draw-down in forces will also increase the potential significance of any failure to comply with agreements. I will discuss how we are working to address that potential problem in a few moments.

The types of verification provisions embodied in current agreements will continue to be relevant and useful under these circumstances. Given these trends, we have a totally unique perspective now. We are at an unprecedented and probably unrepeatable juncture in strategic relationships.

Verification will remain a cornerstone of arms control, and the development and application of transparency and monitoring technologies likewise will remain critical. The need to maintain a verification technology base within the future international security environment is

entirely consistent with the overall philosophy guiding DoD-related technologies.

Under this new philosophy, a variety of technologies are pursued until they are fully matured and ready for application to systems development efforts. This provides a hedge against unforeseen threats and treaty breakout that is both flexible and cost-effective, although it also requires a capability to anticipate potential future needs.

DNA's Assistant Directorate for Arms Control and Test Limitations, along with its U.S. Government partners and contractors, has been performing many of these functions -- identifying possible needs; tasking research, development, testing, and evaluation; and assessing the stage of technological maturity and potential application - - very ably and with a good understanding of the changing environment. The organization, content, and execution of this very conference are testimony to this capability. DNA is also working closely with the On-Site Inspection Agency to implement the arms control verification provisions that use these technologies and systems.

The job of anticipating developments bearing on arms control compliance and verification traditionally belonged to the policy and intelligence communities. We have learned over the years that various types of activity are able to escape detection by national technical means or, more broadly, national intelligence means. The main hedge against these gaps -- gaps of which the United States is extremely mindful after revelations based on on-site inspections of Iraqi nuclear weapons development -- is to continue to develop on-site monitoring

technologies and systems and employ them in appropriate contexts.

Given the continuing requirement for on-site monitoring, (particularly in future regimes that are intended to control proliferation of weapons of mass destruction and advanced delivery systems) verification technologies, systems, and procedures such as those described and discussed at this conference will be needed. Assembled in this room are the key representatives of the verification technology talent base for realizing these capabilities, and I urge you to continue your efforts in both traditional and innovative directions.

I believe that during this conference we all have achieved a better understanding of the problems we face and the solutions we have available in controlling weapons of mass destruction. The largest number of papers presented at the conference addressed the role technology plays in verification and, more specifically, what new and exciting technologies, systems, and techniques are being developed. However, technology

should not be allowed to exist in a vacuum, nor should policy. I am very pleased, therefore, that this conference has been a meeting place for ideas and discourse concerning both technology and policy. Ambassador Maynard Glitman and Major General Robert Parker, during the interesting and fruitful preceding discussion, demonstrated the power and strength that such a joining together of policy and technology, of negotiation and implementation, can have.

In closing, I want to thank all of you again for making this conference such a success. But, it will really be successful if we all take what we have learned here and carry it forth into the policy and technical worlds in which we work the rest of the year.

These are historic and exciting times, filled with hope. But, as we all know, there may be dangers and pitfalls ahead, many of new and unprecedented nature. You and I are fortunate to be in a position where we can help turn the hope of international peace into reality.

PROGRAM AND AGENDA

***Conference on Arms Control and
Verification Technology***

**1-4 June 1992
Williamsburg, Virginia**

Tuesday, 2 June 1992

0800 Registration/Exhibits

0900 Conference Introduction

Colonel Michael Evenson
Assistant Director, Arms Control and
Test Limitations, Defense Nuclear Agency

Welcoming Comments

Mr. Lee Minichiello
Director, Strategic Arms Control and Compliance,
Office of the Under Secretary of Defense (Acquisition)

**Opening Address: The Future of Arms
Control in the Global Environment**

Ambassador Robert Joseph
U.S. Commissioner, Standing Consultative
Commission, Arms Control and Disarmament Agency

1015 Break/Exhibits

PLENARY SESSION I - Arms Control in the New World Order

1045 Chairman's Introduction

Mr. Sidney Graybeal
Chief Scientist, Science
Applications International Corporation

**The Future Role of Arms
Control Verification
Technology**

Ambassador Rolf Ekeus
Executive Director, United
Nations Special Commission

**A New Concept in Arms
Control Verification:
Learning from Experience**

Mr. Ron Cleminson
Head, Verification Unit, Ministry
of External Affairs, Canada

1155 Introduction to Panels

Colonel Michael Evenson
Assistant Director, Arms Control and
Test Limitations, Defense Nuclear Agency

1200 Lunch/Exhibits

PANEL SESSION I - Future Arms Control Initiatives

(Note: Panel Session I runs parallel to
Panel Sessions II & III on Tuesday afternoon)

1315 Chairman's Introduction

Ambassador Maynard Glitman
U.S. Department of State and former Chief,
U.S. Delegation to the INF Negotiations

**The Evolution of Arms Control:
Towards a Positive Security Interaction**

Dr. Sergei Rogov
Deputy Director, USA and Canada
Institute, Russian Academy of Sciences

**Verification of a Future Convention
Prohibiting Radiological Weapons**

Dr. Archelaus Turrentine
The Harris Group

**Changing Roles for Arms Control
in a Changing Europe**

Mr. Timothy Pounds
Science Applications
International Corporation

1500 Break/Exhibits

1530 PANEL SESSION I (Continued)

**Strategies for Biological Weapons
Verification**

Dr. Stephen Morse
The Rockefeller University

**Conventional Arms Control and Verification
for the 90's: A Broader Context**

Mr. Leonard Sullivan, Jr.
System Planning Corporation

**Nuclear Warhead Dismantlement and
Verification Procedures**

Dr. Vitaly Schukin
All Russian Research Institute
for Technical Physics

PANEL SESSION II - The Interface between Intelligence and Arms Control

1315 Chairman's Introduction

Mr. Kenneth deGraffenreid
JAYCOR

**Arms Control, Proliferation, and Intelligence:
A Potentially Beneficial Partnership**

Sarah (Sallie) Mullen
Office of Intelligence, DOE

**An Evaluation of the Relationship
of Intelligence and Verification**

Dr. Sayre Stevens
System Planning Corporation

**International Dimensions of Intelligence,
Arms Control, and Counter-Proliferation**

Dr. Jack Kangas
Institute for Defense Analyses

Congress and the Future of Verification

Mr. Gary Sojka
Senate Select Committee
on Intelligence, U.S. Senate

1500 Break/Exhibits

PANEL SESSION III - Lessons Learned

1530 Chairman's Introduction

Dr. David Kay
The Uranium Institute

**Verification Technology:
OSIA Experience**

Lieutenant Colonel Hal Rhoads
U.S. On-Site Inspection Agency

**Problems of Non-Intrusive Verification
of Nuclear Weapons**

Dr. Vadim Ptashney
All Russian Research Institute
of Technical Physics

**Lessons for Guiding Future
Verification Requirements**

Dr. Richard Scribner
Georgetown University

**Constitutional and Legal Implications
of Arms Control Verification Technologies**

Dr. Edward Tanzman
Argonne National Laboratory

DINNER ADDRESS

***Verification and Cost-effectiveness
Within the North Atlantic Alliance***

Mr. Leo A.J. Verbruggen
Director, Verification Information Systems and Council Operations,
North Atlantic Treaty Organization

Wednesday, 3 June 1992

PANEL SESSION IV - Proliferation in a Changing World

(Note: Panel Sessions IV and VI run parallel
Panel Session V on Wednesday morning)

0800 PROLIFERATION: NEW CHALLENGES AND OPPORTUNITIES

Chairman's Introduction

Dr. Lewis A. Dunn
Science Applications
International Corporation

**Non-Proliferation Issues in the CIS:
The Quest for Survival of the NPT**

Dr. Nikolai Sokov
Russian Ministry of Foreign Affairs

**Non-Proliferation and Regional Security:
An Integrated Approach**

Dr. Louis Nosenzo
Meridian Corporation

0850 MEASURES TO PREVENT OR CAP PROLIFERATION IN CONFLICT-PRONE REGIONS

Non-Proliferation Progress in Korea: How to Consolidate It and How to Apply it Anywhere

Mr. Joseph Grubb
Meridian Corporation

Non-Proliferation Aspects of Commercial Nuclear Fuel Cycles

Dr. Paul Persiani
Argonne National Laboratory

Global Measures and Constraints: Making Headway in the Middle East

Ms. Jacqueline Smith
Science Applications
International Corporation

1010 Break/Exhibits

1040 DEALING WITH PROLIFERATION CONSEQUENCES

A Systems Approach to Dealing With Proliferation in a Changing World

Dr. Michael Wheeler
System Planning Corporation

Weapons Proliferation After the Storm: What Implications Should the United States Draw from the Iraqi Experience?

Mr. Steven McKay
Pacific-Sierra Research
Corporation

1200 Lunch/Exhibits

PANEL SESSION VI - The Economics of Arms Control

1315 Chairman's Introduction

Mr. John Milam
BDM International

Balancing Cost and Effectiveness in Arms Control Verification

Dr. Jeffrey Grotte
Institute for Defense Analyses

Nuclear Verification and Intelligence: Where to Cut and Where Not To

Dr. Michael O'Hanlon
Congressional Budget Office

1430 Break/Exhibits

1500 Some Industry Proposals on Verification of a Chemical Weapons Convention

Mr. Leo Zeffel
CMA Consultant

Assessing the Verifiability of Multilateral Arms Control Agreements

Dr. Stephen Black
Carnegie Mellon University

The Effectiveness of Integrating Verification Regimes

Ms. Blair Murray
Science Applications
International Corporation

1625 Discussion/Session Wrap-Up

PANEL SESSION V - Verification Technologies: Roles and Applications

(Note: Panel Sessions V runs parallel to Panel Sessions IV & VI on Wednesday morning)

0815 Chairman's Introduction

Dr. Richard Wagner
Kaman Sciences Corporation

The Verification Equation

Mr. Cosmo DiMaggio
System Planning Corporation

Practical Application of Commercial Satellite Imagery to Arms Control Monitoring

Mr. Roger Fritzel
Pacific-Sierra Research Corporation

Open Skies Treaty: Imaging Radar Technology Issues

Dr. Max Sandoval
Sandia National Laboratory

1010 Break/Exhibits

1040 Acoustic Resonance Spectroscopy in Arms Control Monitoring

Dr. Kenneth Apt
Los Alamos National Laboratory

Using Gravity to Monitor Arms Control Treaties

Dr. John Parmentola
MITRE Corporation

Survey of Candidate Tags and Their Applications

Mr. Mark Fischer
BDM International

1200 Lunch/Exhibits

1315 PANEL SESSION V (Continued)

The Potential Role of Aerial Monitoring in Verifying Compliance with Chemical Weapons Ban

Mr. Arthur Fitch
Global Outlook

Phase I Development of a CW Verification Expert System

Mr. James Barden
Kaman Sciences Corporation

1430 Break/Exhibits

1500 Verification of a Threshold Test Ban Treaty

Dr. Alexsey Pevnitskiy
Arzamas-16 Laboratory

Yield Verification of Non-Standard Underground Nuclear Weapons Tests by HYDRO-PLUS

Dr. Lawrence Germain
Logicon-RDA Corporation

1625 Wrap-Up and Recapitulation: The Verification Equation

Dr. Richard Wagner
Kaman Sciences Corporation

Thursday, 4 June 1992

PANEL SESSION SUMMARIES

- 0830 Introduction to Panel Summaries** **Colonel Michael Evenson**
Assistant Director, Arms Control and
Test Limitations, Defense Nuclear Agency
- Panel I - Future Arms Control Initiatives** **Ambassador Maynard Glitman**
U.S. Department of State and former Chief,
U.S. Delegation to the INF Negotiations
- Panel II - The Interface Between Intelligence
and Arms Control** **Mr. Kenneth deGraffenreid**
JAYCOR
- Panel III - Lessons Learned** **Dr. David Kay**
The Uranium Institute
- Panel IV - Proliferation in a Changing World** **Dr. Lewis A. Dunn**
Science Applications
International Corporation
- Panel V - Verification Technologies: Roles
and Applications** **Dr. Richard Wagner**
Kaman Sciences Corporation
- Panel VI - The Economics of Arms Control** **Mr. John Milam**
BDM International
- 1000 Break/Exhibits**

PLENARY SESSION II - Negotiating and Implementing Verification Measures

- 1030 Chairman** **Colonel Michael Evenson**
Assistant Director, Arms Control and
Test Limitations, Defense Nuclear Agency
- Introduction** **Major General Kenneth L. Hagemann**
Director, Defense Nuclear Agency
- The Negotiation Experience** **Ambassador Maynard Glitman**
U.S. Department of State and former Chief,
U.S. Delegation to the INF Negotiations
- The Verification Experience** **Major General Robert Parker**
Director, U.S. On-Site Inspection Agency
- 1200 Closing Remarks/Conference Adjournment** **Major General Kenneth Hagemann**
Director, Defense Nuclear Agency

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