Princeton University
Woodrow Wilson School of Public and International Affairs
Graduate Program

TOPICS IN INTERNATIONAL RELATIONS

Protection Against Weapons of Mass Destruction (WMD)

(WWS-556c, Spring 2004)

Sessions: Tuesdays, 1:00-4:00 PM
Draft: 1/12/04

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This course surveys and assesses the threats and the different approaches to protection against WMD. It provides essential technical, historical and organizational background for students interested in getting involved in WMD policy.

Schedule

Date D=Draft PM F= Final PM	**Unit**/Topic (guest lecturer)
Feb. 3	1. History of the different approaches to protection against WMD
Discuss proposed paper with one of us during second week	
Feb. 10	2. Nuclear proliferation, Atoms for Peace, export controls & the NPT (Ellsberg)
The Weapons	
Feb. 17, D1	3. Nuclear weapons
Feb. 24	4. Biological and chemical weapons
Defenses	
Mar. 2, F1	5. Defense against biological weapons
Mar. 9, D2	6. Deterrence and/or preemption
break	
Mar. 23	7. Missile proliferation and defense
Diplomacy	
Mar. 30, F2	8. Multilateral arms control: CTBT and the Fissile Cutoff, export controls
Submit draft papers and begin presentations	
Apr. 6	9. Dealing with the legacy of the Cold War: arms reduction agreement
Apr. 13	10. Cooperative threat reduction (Bukharin, Luongo, Weiner)
The hard questions	
Apr. 20	11. The goal of WMD policy: abolition or not? (discussion)

Apr. 27	12. The future of U.S. nonproliferation policy (discussion/Perkovich)

Course requirements and deliverables. No prerequisites other than a serious interest in arms control. Undergraduates may enroll with permission from the instructor. Two short (less than1000 word) policy memoranda (PMs) due in draft February 17 and March 9. Feedback will be provided within a week and the memos are due in final form two weeks later. One policy memo, at least, should include some BoE quantitative analysis (advice will be provided as needed). One 4000-6000 word research paper on an agreed topic to be presented in draft and oral as well as in final written form. The draft paper is due during the weeks of March 30 or April 6. Two volunteer student presentations on the readings each week. No final.

Reading Materials. For those readings for which URLs are not supplied, multiple copies will be available on e-reserve and/or on reserve in the WWS library in the basement of Wallace Hall. *Deadly Arsenals: Tracking Weapons of Mass Destruction* by Joseph Cirincione *et al* (Carnegie Endowment for International Peace, 2002) is recommended for purchase and will be available at the U-store.

I. **OVERVIEW**

1. **History of the different approaches to protection from WMD**

The U.S. has spent enormous sums acquiring nuclear weapons for "deterrence" and on defenses against them: about $5 trillion on deterrence, $1 trillion on bomber and missile defense, and $20 billion on civil defense as of 1996.[1] **[Footnotes are references not readings.]** Smaller but still huge amounts have been spent on chemical and biological weapons in the past and defenses against them more recently.

In the case of nuclear weapons, the primary emphasis has been on the threat of nuclear retaliation to deter nuclear attack because, for most of the nuclear era, effective defense has been seen as infeasible. During the Cold War, however, the U.S., France and U.K. used nuclear threats to deter massive Soviet conventional attack and, since the Cold War, a weakened Russia has similarly invoked nuclear deterrence against massive conventional attack by NATO, China, Turkey and other neighbors.

Since the U.S. decided to eliminate its chemical and biological weapons, the U.S. DoD has also used the threat of nuclear retaliation to deter chemical and biological as well as nuclear attacks. This policy contradicts U.S. commitments that the it will not use

[1] In 1996 dollars [*Atomic Audit: The Costs and Consequences of U.S. Nuclear Weapons Since 1940,* Stephen Schwartz, ed. (Brookings, 1998)]. For a summary and excerpts, see http://www.thebulletin.org/issues/1998/so98/so98schwartz.html

nuclear weapons against non-nuclear-weapon states unless they attack the U.S., its forces or its allies in concert with a nuclear-weapon state.

Read

- "Global Trends" (pp. 3-23) on the web at http://www.ceip.org/files/Publications/DeadlyArsenals.asp?from=pubauthor) in *Deadly Arsenals: Tracking Weapons of Mass Destruction* by Joseph Cirincione *et al* (Carnegie Endowment for International Peace, 2002)

- *The Spread of Nuclear Weapons: A Debate Renewed* by Scott Sagan and Kenneth Waltz (W.W. Norton, 2002). Read at least the first two chapters: "More may be better" by Waltz, and "More will be worse" by Sagan.

- "National Strategy to Combat Weapons of Mass Destruction," http://www.whitehouse.gov/news/releases/2002/12/WMDStrategy.pdf.

- "Uncooperative America" (pp. 3-14) in *Disarming Strangers: Nuclear Diplomacy with North Korea* by Leon V. Sigal (Princeton University Press, 1998)

2. Nuclear proliferation, "Atoms for Peace," and the NPT

(guest lecture by Daniel Ellsberg[2])

The U.S. conducted its first nuclear test in 1945, Russia in 1949, the U.K. in 1952, France in 1960 and China in 1964. After China's test, the U.S. and Soviet Union discovered a joint interest in nuclear nonproliferation. The Nonproliferation Treaty (NPT) which came into force in 1970, divides countries into two classes: five "nuclear-weapon states" (U.S., Soviet Union, U.K., France, China) that carried out nuclear explosions prior to 1967 and "non-nuclear-weapon states" that committed to carry out their nuclear activities under International Atomic Energy Agency (IAEA) safeguards designed to provide international assurance that no fissile material was being diverted to weapons use. A number of other states stayed outside the treaty because they had nuclear ambitions.

The NPT constitutes a bargain between the nuclear-weapon and non-weapon states. The non-weapon states commit not to acquire nuclear weapons and to allow the IAEA to inspect their nuclear programs in order to verify their compliance. The weapon states commit: i) to "cessation of the nuclear arms race at an early date and to nuclear disarmament," and ii) "exchange…equipment, materials and scientific and technological information for the peaceful uses of nuclear energy…without discrimination."

[2] Ellsberg was a consultant on nuclear-weapons policy to Secretary of Defense Robert McNamara in 1961. In that role, he drafted the Kennedy Administration's revised guidance to the Joint Chiefs of Staff for the operational plans for general nuclear war with the Soviet Union. Ten years later, in 1971, he became famous when he leaked the Pentagon's secret history of the Vietnam War (a.k.a. "the Pentagon Papers") to the *New York Times.* Recently, he published *Secrets: A Memoir of Vietnam and the Pentagon Papers* (Viking, 2002).

Read:

- "Pakistan (pp. 207-219), "North Korea" (pp. 241-254), "Iran" (pp.255-269); and "Nuclear supplier organizations" (pp. 413-420) in *Deadly Arsenals.*

- "Argentina and Brazil: rivals, not enemies" (pp. 45-71); and "The former Soviet Union: managing the inheritance;" (pp. 89-128) in *Bridled ambition: why countries constrain their nuclear capabilities* by Mitchell Reiss (Johns Hopkins University Press, 1995).

- "The nuclear nonproliferation treaty: history and current problems" by George Bunn, *Arms Control Today*, December 2003, pp. 4-10, http://www.armscontrol.org/act/2003_12/Bunn.asp

- "Nuclear-weapon states and the grand bargain" by Leonard Weiss, *Arms Control Today*, December 2003, http://www.armscontrol.org/act/2003_12/Weiss.asp

"North Korea and Iran: Test cases for an improved nonproliferation regime?" by Joseph Cirincione and Jon. B. Wolfshtal, *Arms Control Today*, December 2003, http://www.armscontrol.org/act/2003_12/CirincioneandWolfsthal.asp

II. **THE WEAPONS**

3. **Nuclear weapons**

The essential material for the production of nuclear weapons is fissile material (material that can sustain an explosive fission chain reaction). The two fissile materials that have been used in the production of nuclear weapons thus far are uranium enriched to about 90% U-235 (from the natural level of 0.7%) and the artificial element, plutonium.

Uranium is enriched by technologies that use the weight difference of the chemically identical isotopes.

To produce a nuclear explosion, one must assemble a super-critical mass of fissile material so that a large enough fraction of the approximately 3 neutrons produced by each fission is absorbed by fissile material that each fission will cause more than one fission, resulting in an exponentially growing fission chain-reaction. All nuclear weapons contain fission triggers ("primaries"). In advanced designs, the yield of these fission triggers is "boosted" by neutrons from the fusion of deuterium-tritium gas inside the fission "primary." There may also be a thermonuclear "secondary" compressed and heated to fusion temperatures by X-rays from the primary.

Tutorial: N. Korea's plutonium-production reactors and the gas-centrifuge technology acquired by Pakistan to produce highly-enriched uranium. Design of the Hiroshima and Nagasaki bombs.

[**Film: "**Trinity And Beyond: The Atomic Bomb Movie"

Read

- *Hiroshima* by John Hersey (1946).

- *The U.S. Nuclear War Plan: A Time for Change* (NRDC, 2001) (scan) http://www.nrdc.org/nuclear/warplan.

4. **Biological and chemical weapons**

Approaches to defense against both chemical and biological weapons are generally well known: gas masks and suits, filters on the air intakes of buildings, and antidotes.

Biological. We have recently learned more than we wanted to about anthrax. Because of the durability of its spore form, this has been the prototypical BW agent since WWII. Both the U.S. and Russia developed huge production capacities for anthrax and several other biological agents during the Cold War.[3] Iraq produced a considerable amount.

In 1969, President Nixon decided to unilaterally end the U.S. BW program. This led to the negotiation of the Biological Weapons Convention. Unlike other arms control treaties, however, the BWC has no arrangements for verification.

Tutorials. Biological agents (Kahn). How to estimate casualties, based on quantities released, toxicity, weather conditions and population density (von Hippel).

Read

- "The Great Terror: In northern Iraq, there is new evidence of Saddam Hussein's genocidal war on the Kurds—and of his possible ties to Al Qaeda" by Jeffrey Goldberg, *New Yorker*, March 25, 2002 http://newyorker.com/fact/content/?020325fa_FACT1

- "Biological and chemical weapons, agents and proliferation" (pp. 45-68), *Deadly Arsenals*

- "The Cult" (pp. 151-164) and "Evil Empire" (pp. 165-182) in *Germs: biological weapons and America's secret war* by Judith Miller, Stephen Engelberg, and William Broad (Simon & Schuster, 2001).

[3] For popular accounts, see: J. Miller, S. Engelberg and W. Broad, *Germs: Biological Weapons and America's Secret War* (Simon and Schuster, 2001); *The Biology of Doom: The History of America's Secret Germ Warfare Project* by Ed Regis, (Henry Holt, 1999); and *Biohazard: The Chilling True Story of the Largest Covert Biological Weapons in the World [that of the Soviet Union] Told from inside by the Man Who ran It* by Ken Alibek with Stephen Handelman (Random House, 1999).

- “A farewell to germs: the U.S. renunciation of biological and toxin warfare, 1969-70” by Jonathan B. Tucker, *International Security 27,* Summer 2002, pp. 107-148.

- ”Anthrax powder: state of the art?” by Gary Matsurmoto, *Science 302*, November 28, 2003, pp. 1492-7.

III. DEFENSE

5. Defense against biological weapons

(Nelson, Kahn and von Hippel)

The response to the anthrax letters demonstrated how poorly prepared the U.S. was for a even a small biological attack. One reason was that the "first responders" to a biological attack would be doctors, hospitals and public health departments, not the police, fire departments, national guard, and the military.

Since the fall of 2001, the U.S. Government has begun to pour billions of dollars into biodefense and biodefense R&D.

Tutorials. The determinants of disease spread (R. Nelson). Defending against smallpox (Kahn).

Read

- "Bioterror: What Can Be Done?" by Matthew Meselson in *The New York Review of Books*, December 20, 2001, http://www.nybooks.com/articles/14971

- "The Looming Threat of Bioterrorism" by Donald A. Henderson, *Science 283, 5406,* Feb 26 1999: 1279-1282.

- "The Future" (pp. 287-314) in *Germs: biological weapons and America's secret war* by Judith Miller, Stephen Engelberg, and William Broad (Simon & Schuster, 2001).

- "Executive Summary," *Biotechnology Research in an Age of Terrorism,* http://www.nap.edu/books/0309089778/html/

6. Deterrence and/or Preemption?

In the 1950s, the U.S. threatened "massive [nuclear] retaliation" in response to fears of a Soviet invasion of Western Europe. This would have meant the total destruction of Soviet and Chinese cities and the deaths of hundreds of millions. However, as U.S. intelligence concerning Soviet military-related facilities improved and the number of U.S. nuclear weapons multiplied, the emphasis shifted to "counterforce" and counter-industrial targeting. Many tens of millions of civilians would still have been killed as a result of "collateral damage" but total destruction of Soviet cities would have been a threat held in reserve as long as U.S. cities were spared. As missile warheads became more accurate, the land-based missiles became each-others' highest priority targets, which made them "time-urgent" targets and put them in a hair trigger, launch-on-warning status.

Tutorials:; Stable/unstable nuclear balances (von Hippel); early-warning systems (Nelson)

Films (optional): *Dr Strangelove; 13 Days* (2000, 147 minutes);

Read:

- "Taking nuclear weapons off hair-trigger alert" by Bruce Blair, Harold Feiveson and Frank von Hippel, *Scientific American,* November 1997, pp. 74-81. For the reaction of the then Commander in Chief of the U.S. Strategic Command, see "General Eugene E. Habiger, Commander in Chief, US Strategic Command, Interview with Defense Writer's Group, Wash DC 31 March 1998, fourth question: http://www.fas.org/news/usa/1998/03/980331-dwg.htm

- "The next Nuclear Posture Review?" (pp. 243-283) in *The Nuclear Turning Point,* Harold Feiveson, ed. (Brookings, 1999).

- TO BE ADDED

- A.H. Nayyar and M.V. Ramana, "India, Pakistan and the Bomb," *Scientific American,* December 2001.

- "Indian and Pakistani nuclear weapons: for better or worse?" (pp. 88-124) in *The Spread of Nuclear Weapons: A Debate Renewed* by Scott Sagan and Kenneth Waltz (W.W. Norton, 2003).

- "Preemptive posturing: What happened to deterrence?" by Hans Kristensen, *Bulletin of the Atomic Scientists,* Sept.-Oct. 2002, http://www.thebulletin.org/issues/2002/so02/so02kristensen.html

- "Contemporary cases" in *Valleys of vulnerability: Instability in asymmetric nuclear rivalries"* by Lyle J. Goldstein (PhD thesis, 2001), pp. 196-219.

7. Missile Proliferation and Defense

Aerial warfare in World War II was dominated by mass-bomber attacks. After the Allies won dominance of the air in the Battle of Britain, however, Germany began to attack Britain with unmanned V-1 and V-2 missiles. These missiles were respectively the forbearers of modern cruise and ballistic missiles. Indeed, the V-2 is still with us in the form of the Scud missile which the Soviet Union produced and exported in great numbers and which North Korea, Iraq, Iran and other countries have learned how to produce.

Staging, i.e. jettisoning structural weight as fuel is consumed, made it possible to

develop ballistic missiles of intercontinental range. The U.S. and Soviet Union ultimately each deployed about 2000 long-range land-based ballistic missiles, equipped with an average of 3-4 warheads each.

Tutorials: Rocket range/payload (FvH) Radar and infrared detection and discrimination (Nelson)

Read

- "Missile proliferation" (pp. 69-99) and "The Missile Technology Control Regime" (pp. 403-409) in *Deadly Arsenals.*

- "Missile defense: The untold story" by Bill Keller, *New York Times,* Dec. 29, 2001, A33.

- "The Continuing Debate on National Missile Defenses," Lisbeth Gronlund, George N. Lewis, and David C. Wright, *Physics Today*, December 2000, p. 36, www.physicstoday.com/pt/vol-53/iss-12/p36.html.

IV. DIPLOMACY

8. **Multilateral nuclear arms control**

(Nelson, von Hippel)

Aside from the 1970 Nonproliferation Treaty, multilateral negotiations on nuclear weapons control have focused on steps toward a Comprehensive [nuclear weapons] Test Ban Treaty and a Fissile Cutoff Treaty that would ban the production of more fissile materials for nuclear weapons.

Tutorials: The nuclear earth-penetrating warhead (Nelson). Verifying a the moratorium on fissile-material production (FvH)

Read

- "The Comprehensive Test Ban Treaty" by Jeremiah D. Sullivan, *Physics Today*, March 1998 [URL TO BE PROVIDED]

- "The Death of a Treaty" by Terry L.Deibel, *Foreign Affairs*, Sept.-Oct. 2002, 142-161.

- "Nuclear weapons in the 21st Century" by Stephen Younger, Associate Lab Director for Nuclear Weapons, Los Alamos National Laboratory, LAUR—002850, June 27, 2000, http://www.fcnl.org/issues/arm/sup/nukwpns21stcent.pdf

- "Nuclear Bunker Busters, Mini-Nukes, and the US Nuclear Stockpile," Robert Nelson, *Physics Today,* November 2003, http://www.physicstoday.org/vol-56/iss-11/p32.html

- ***"****Nuclear disarmament, nuclear terrorism and fissile materials, Frank von Hippel,* Briefing to the Latin American and Caribbean Delegates to the Preparatory Meeting for the 2005 NPT Review Conference, U.N., March 14, 2002

9. **Dealing with the legacy of Cold War: Arms control**

(FvH, Josh Handler?[4])

In1946, the U.S. offered to eliminate its nuclear weapons if other countries first opened themselves to international verification that they were not pursuing nuclear weapons. Negotiations quickly reached an impasse with the USSR insisting that the U.S. eliminate its nuclear stockpile before the Soviet Union opened itself to international inspection. However, starting in 1972, the two countries did begin to sign treaties to at first limit their arms buildup and then later to reduce their nuclear weapons.

Tutorials: Using satellite images for verification, Josh Handler?
Dismantling the Doomsday Machine, Frank von Hippel

Read:

- Alan Krass, "Cold War Arms Control" (pp. 9-25) and "The Arms Control Revolution" (pp. 29-64) in *The United States and Arms Control: The Challenge of Leadership* (Praeger, 1997).

- "Nuclear arms control at a crossroads" (pp. 3-14) and "A strategy of staged reductions and de-alerting of nuclear forces" (pp. 15-27) in *The Nuclear Turning Point,* Harold Feiveson, ed. (Brookings, 1999).

- "The Moscow Treaty: making matters worse" by Christopher Paine, *Bulletin of the Atomic Scientists,* November/December 2002, p. 19.

- "The 1991-1992 [Presidential Nuclear Initiatives] and the elimination, storage, and security of tactical nuclear weapons" by Joshua Handler (pp. 20-41) in *Tatical Nuclear Weapons,* Brian Alexander and Alistair Millar, eds, (Brasseys, 2003).

10. Cooperative Threat Reduction

[4] Josh Handler received his PhD from the WWS in 2002 and is currently in the State Department's Nonproliferation Bureau.

(Ken Luongo[5])

With the end of the Cold War, a new danger emerged: that the oversized WMD complexes that Russia could no longer support could potentially become a sources of weapons materials or expertise for terrorists or radical states. The U.S. therefore launched a number of programs to assist Russia in downsizing its production complexes and, converting excess personnel and disposing of the materials.

Tutorial: Corralling highly-enriched uranium, the nuclear terrorist's choice (FvH)

Read

- "Potatoes were guarded better…" by Oleg Bukharin and William Potter, *Bulletin of the Atomic Scientists*, May-June 1995 http://www.thebulletin.org/issues/1995/mj95/mj95.bukharin.html

- "The Mystery of the Sunken Gyros" by Vladimir Orlov and William Potter, *Bulletin of the Atomic Scientists, November-December 1998,* http://www.thebulletin.org/issues/1998/nd98/nd98orlovpotter.html

- "U.S. Nonproliferation Assistance Programs" (chapter 3) in *Nuclear Status Report: Nuclear Weapons, Fissile Material, and Export Controls in the Former Soviet Union* (Carnegie Endowment for International Peace, 2001), http://www.ceip.org/files/Publications/StatusReport.asp

- "The Next Steps in U.S. Nonproliferation Policy" by Senator Richard Lugar, *Arms Control Today*, December 2002, pp. 3-7, http://www.armscontrol.org/act/2002_12/lugar_dec02.asp

- "Reform and expansion of coopertive threat reduction" by Ken Luongo and William Hoehn III, *Arms Control Today* June 2003, http://www.armscontrol.org/act/2003_06/luongohoehn_june03.asp

V. THE HARD QUESTIONS

11. **The goal of WMD policy: abolition or not?**

(Guest lecture: Jonathan Schell?)

The Chemical Weapons Convention attempts to ban chemical weapons. The Biological Weapons Convention attempts to ban biological weapons. The

[5] Ken Luongo is Director of the Russian-American Nuclear Security Advisory Council (RANSAC). During 1994-7, while he was Director of the Department of Energy's Office of Nonproliferation and Arms Control, he built up the U.S. program that assists former Soviet countries to increase the security of their fissile materials.

Nonproliferation Treaty commits the nuclear-weapon states to pursue nuclear disarmament in good faith.

Some are profoundly sceptical, however, about the goal of eliminating WMD. They believe that the existence of nuclear weapons prevented World War III. They do not believe that the elimination of WMD is verifiable or that a zero-WMD world would be stable to a breakout. In short, they believe that WMD abolition is neither feasible nor desirable.

Some who are not comfortable with the idea of living with WMD indefinitely and who do not see how nations can remain indefinitely divided between a few WMD haves and the rest WMD have-not countries have postponed engaging in the debate because they think that, whether we are aiming for small or zero stockpiles makes little difference today. Others worry about fudging what they see as a profoundly moral issue.

Tutorial. Can we verify zero?

Read

- "Statement on nuclear weapons by international generals and admirals." http://prop1.org/2000/genint.htm

- "Its dangerous to disarm" by Richard Haas (subsequently head of the State Department's Policy Planning office and now President of the Council on Foreign Relations), *New York Times,* Dec. 11, 1996.

- " The Gift of Time" by Jonathan Schell, (Metropolitan Books, 1998), pages to be selected

- "The road to abolition: how far can we go?" (pp. 287-301) in *The Nuclear Turning Point.*

- "Why Do We Have to Keep the Bomb?" by Kathleen Bailey, *Bulletin of the Atomic Scientists,* January/February 1995, http://www.thebulletin.org/issues/1995/jf95/jf95Bailey.html

- "Zero Tolerance" by Lee Butler (former Commander in Chief of the U.S. Strategic Command), *Bulletin of the Atomic Scientists*, January/February 2000, pp. 20-21, http://www.thebulletin.org/issues/2000/jf00/jf00butler.html

- "Remember your Humanity," Nobel Prize acceptance speech by Joseph Rotblat, *Bulletin of the Atomic Scientists,* March/April 1996, http://www.thebulletin.org/issues/1996/ma96/ma96rotblat.html

12. **The Future of U.S. Nonproliferation Policy**

(discussion with George Perkovich, Vice President for Research, Carnegie Endowment for Peace)

Read

- "Bush's Nuclear Revolution" by George Perkovich, *Foreign Affairs 82*, March/April 2003, pp. 2-8.