

Overview of Export Controls



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11 June 2009

This presentation provides an overview of international export control regimes.

Development of international nonproliferation regimes

Nuclear Suppliers Group

- Trigger List
- Dual-Use List

Controlled technology, commodities, and materials

Correlation to US export control laws/regulations

The “*Treaty on the Non-Proliferation of Nuclear Weapons*” (NPT) Became Effective in 1970.

Prompted by China’s 1964 nuclear weapon test

- becoming the 5th nuclear armed nation
 - previous four:
 - United States (1945)
 - Soviet Union (1949)
 - United Kingdom (1952)
 - France (1960)
- worldwide concern over expanding number of nuclear armed nations

The NPT sought to halt the expansion in the number of nuclear armed nations.

Limited which nations could have nuclear weapons

- five official “Weapon States”
 - allowed to retain nuclear weapon programs
 - agreed to *not* assist other nations acquire nuclear weapons
- all other signatory nations deemed to be “Non-weapon States”
 - not allowed to pursue nuclear weapon programs
 - agreed to *not* seek nuclear weapons
 - allowed to pursue peaceful nuclear programs
- eventually signed by all but 3 countries
 - Israel
 - Pakistan
 - India

NPT *(continued)*

Did not provide export controls

- nuclear-related commodities
- nuclear-related technology

Lacked punitive measures for Non-weapon States that pursued nuclear weapons programs

India's 1974 nuclear weapon test

- recognized need to control nuclear equipment

Several nations have proliferated nuclear weapons since India's nuclear weapon test.

- Pakistan (*not an NPT signatory*)
 - 1998 nuclear weapon tests
 - alleged to have nuclear weapons
- Democratic People's Republic of Korea (*withdrew from NPT in 2003*)
 - publicly acknowledged its nuclear weapons program
 - recent “event”
- Israel (*not an NPT signatory*)
 - alleged to have nuclear weapons
- South Africa
 - nuclear weapons program abandoned in 1991
- Iraq
 - clandestine nuclear weapons program discovered in 1991

Nuclear export control regimes started in 1974 with the NPT Exporters' Committee.

a.k.a. “Zangger Committee”

Developed a “Trigger List” of strategic nuclear material and equipment

- controls exports of *“especially designed or prepared equipment or material for the processing, use or production of special fissionable material”*
 - includes weapon-grade fissile material
- exports to Non-weapon States subject to International Atomic Energy Agency (IAEA) safeguards agreement
- illustrative list of equipment
 - descriptive criteria for determinations

The Nuclear Suppliers Group (NSG) publishes guidelines to control nuclear related exports.

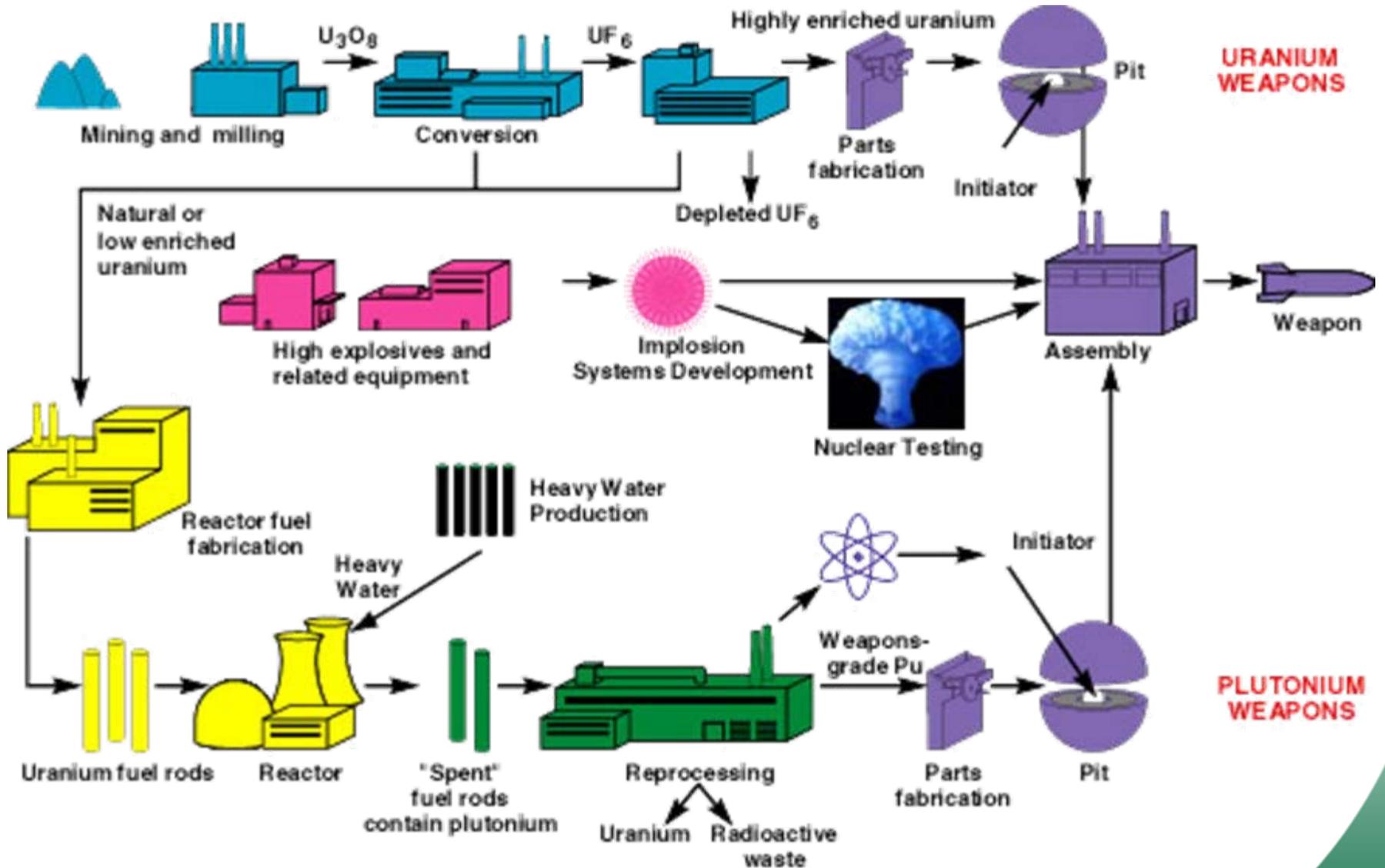
NSG participation

- currently 45 member states
 - includes all five Weapon States

Controls

- focused on the nuclear fuel cycle
 - peaceful end uses
 - useful to weaponization
- not focused on production or use of other radiological materials
 - useful in Radiological Dispersal Devices (RDDs)
 - ^{137}Cs

The nuclear fuel cycle



NSG published its “Trigger List” in 1978.

More comprehensive than the Zangger Committee’s “Trigger List”

- also an illustrative list of equipment
 - expanded to cover heavy water production
- exports to Non-weapon States require “full-scope” IAEA safeguards agreement
- published as an IAEA document
 - INFCIRC/254/Part 1
 - currently in its 9th revision
 - March 2007

NSG Trigger List *(continued)*

- later expansions/modifications
 - added the control of strategic nuclear “technology”
 - restricted retransfers
 - added a “Non-proliferation Principle”
 - allows for subjective denial of export over doubt of recipient's peaceful-use intentions
 - closed an important loophole

NSG Trigger List *(continued)*

Scope of controls

- *production* of special fissionable material
 - creation/production of these
 - including weapon-capable grades
 - encompasses chemical reduction to raw metal
 - necessary for eventual weapon component fabrication
 - no control of subsequent weaponization activities

NSG Trigger List *(continued)*

- two major categories of control
 - Annex A — source and special fissionable material
 - Annex B — equipment and non-nuclear materials
 - reactors
 - fuel reprocessing
 - enrichment
 - heavy water production
 - processing and chemical conversion
 - uranium
 - plutonium

NSG Trigger List *(continued)*

Annex A — source material

- natural uranium

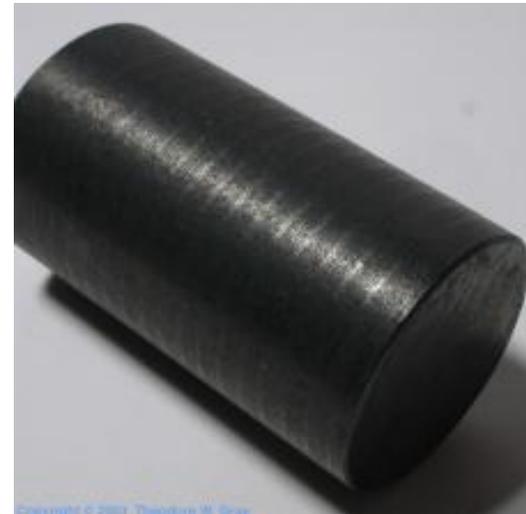


natural uranium
“yellowcake”
(shown in
shipping drum)

- depleted uranium

depleted
uranium
metal

- thorium



NSG Trigger List *(continued)*

Annex A — special fissionable material

- enriched uranium (^{235}U above natural levels)
 - low-enriched
 - reactor grade
 - highly enriched
 - weapon grade



highly
enriched
uranium
metal

- ^{233}U
 - non-natural isotope

NSG Trigger List *(continued)*

Annex A — *more* special fissionable material

- ^{239}Pu
 - exception for high concentrations of ^{238}Pu



plutonium
dioxide
powder

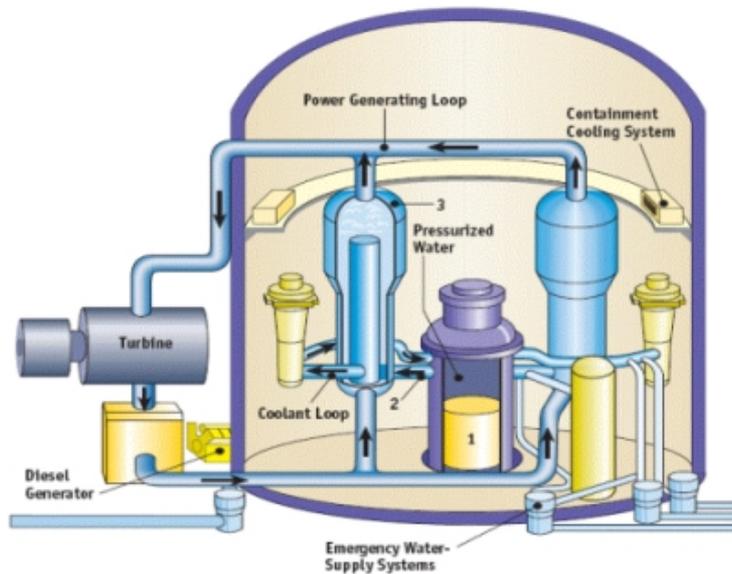


plutonium
metal

NSG Trigger List *(continued)*

Annex B — reactors & related commodities

- complete nuclear reactors



pressurized water
reactor (PWR)



TVA's Sequoyah Nuclear
Plant (PWR)

Soddy-Daisy, TN

NSG Trigger List *(continued)*

Annex B — *more* reactors & related commodities

- reactor vessels



PWR reactor vessel

NSG Trigger List *(continued)*

Annex B — *more* reactors & related commodities

- primary coolant pumps

- heat exchangers

steam generator
(a type of
heat exchanger)



reactor
coolant
pump



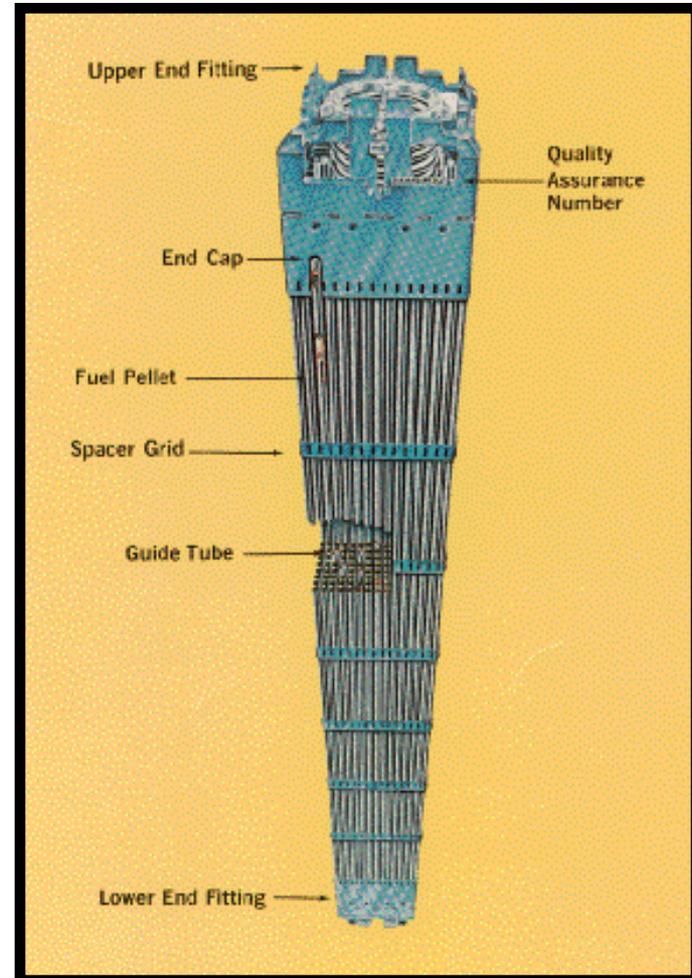
NSG Trigger List *(continued)*

Annex B — *more* reactors & related commodities

- reactor fuel



zirconium
tubes used
for
reactor fuel
cladding



PWR
fuel
assembly

NSG Trigger List *(continued)*

Annex B — non-nuclear reactor materials

- heavy water (deuterium dioxide [D₂O])



stainless steel
drums of
heavy water

NSG Trigger List *(continued)*

Annex B — *more* non-nuclear reactor materials

- nuclear grade graphite

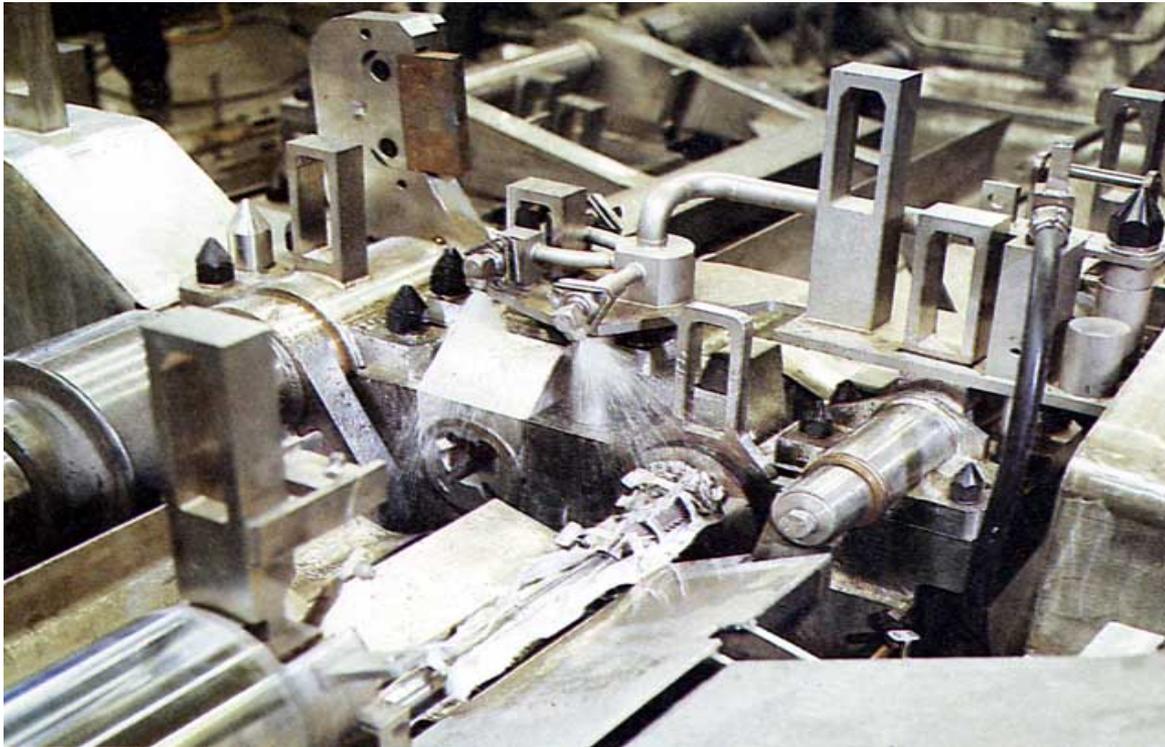


graphite blocks
used in
Manhattan Project
N-reactor,
Hanford, WA

NSG Trigger List *(continued)*

Annex B — fuel reprocessing plants & equipment

- fuel element chopping machines



fuel element
decladding
equipment

NSG Trigger List *(continued)*

Annex B — *more* fuel reprocessing plants & equipment

- fuel dissolvers

internal
dissolver
screw



continuous
fuel
dissolver
(remotely
operated
facility)

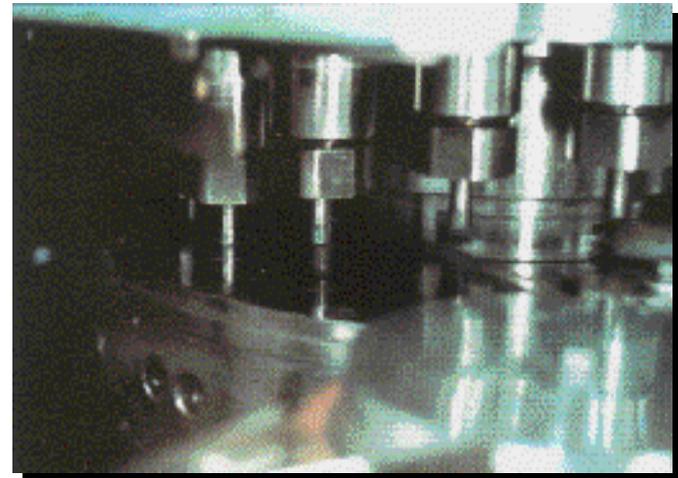


NSG Trigger List *(continued)*

Annex B — fuel fabrication plants & equipment



UO₂ fuel pellets
(low-enriched)
for
civilian power
reactor



fuel
pellet
press

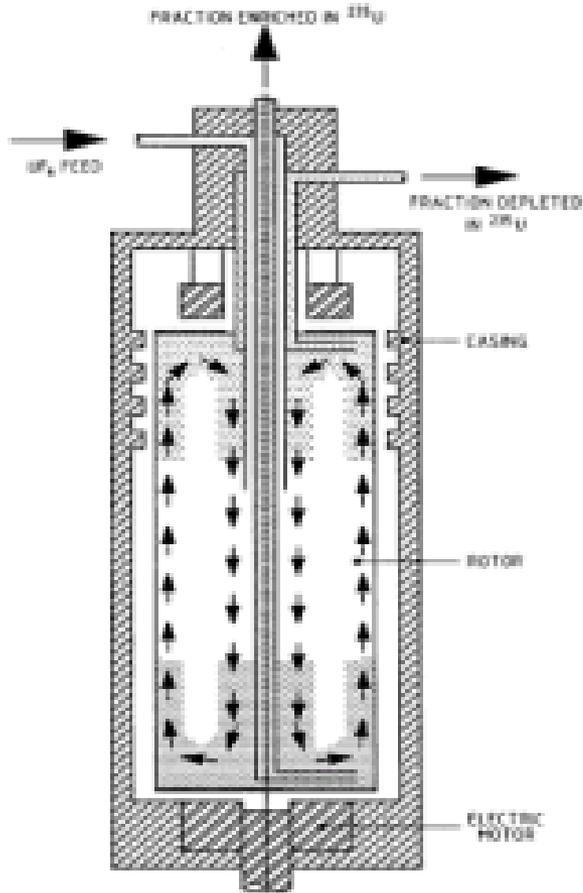
NSG Trigger List *(continued)*

Annex B — uranium enrichment plants & equipment

- gas centrifuge
- gaseous diffusion
- electromagnetic
- aerodynamic
- other types
 - laser-based
 - atomic vapor laser (AVLIS) or molecular laser (MLIS)
 - plasma separation
 - chemical or ion exchange
- some auxiliary systems
 - uranium feed/withdrawal systems, process piping & control systems, vacuum systems, analytical instrumentation

NSG Trigger List *(continued)*

Annex B — gas centrifuge enrichment



NSG Trigger List *(continued)*

Annex B — *more* gas centrifuge enrichment



US Gas
Centrifuge
Enrichment
Program

Oak Ridge, TN



Urenco Enrichment
Company, Ltd
Almelo, Netherlands

NSG Trigger List *(continued)*

Annex B — *more* gas centrifuge enrichment

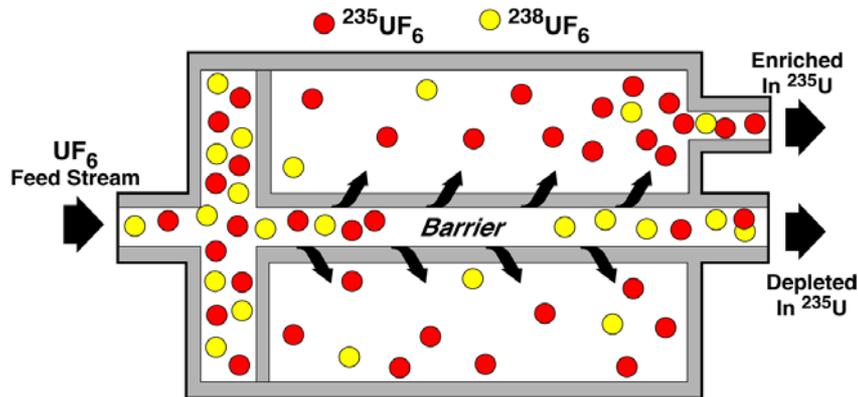


Pakistani gas
centrifuge equipment

Press conference,
Oak Ridge, TN

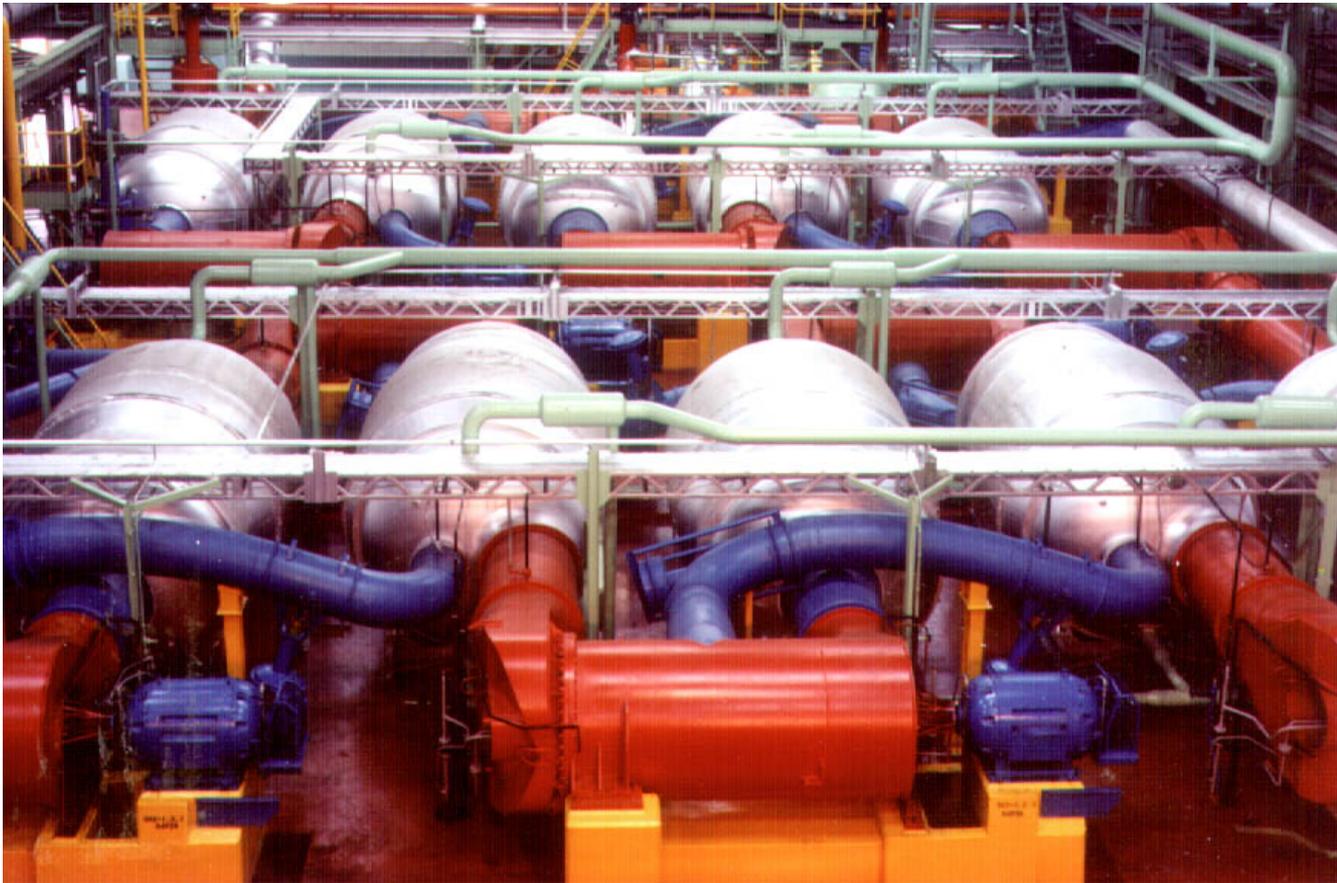
NSG Trigger List *(continued)*

Annex B — gaseous diffusion enrichment



NSG Trigger List *(continued)*

Annex B — *more* gaseous diffusion enrichment



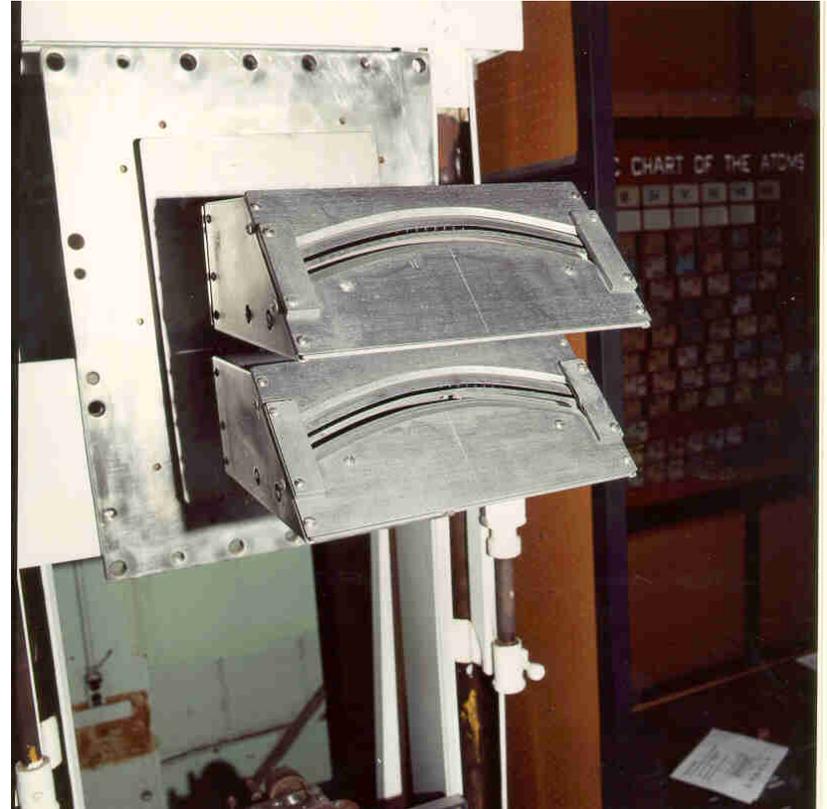
NSG Trigger List *(continued)*

Annex B — electromagnetic enrichment



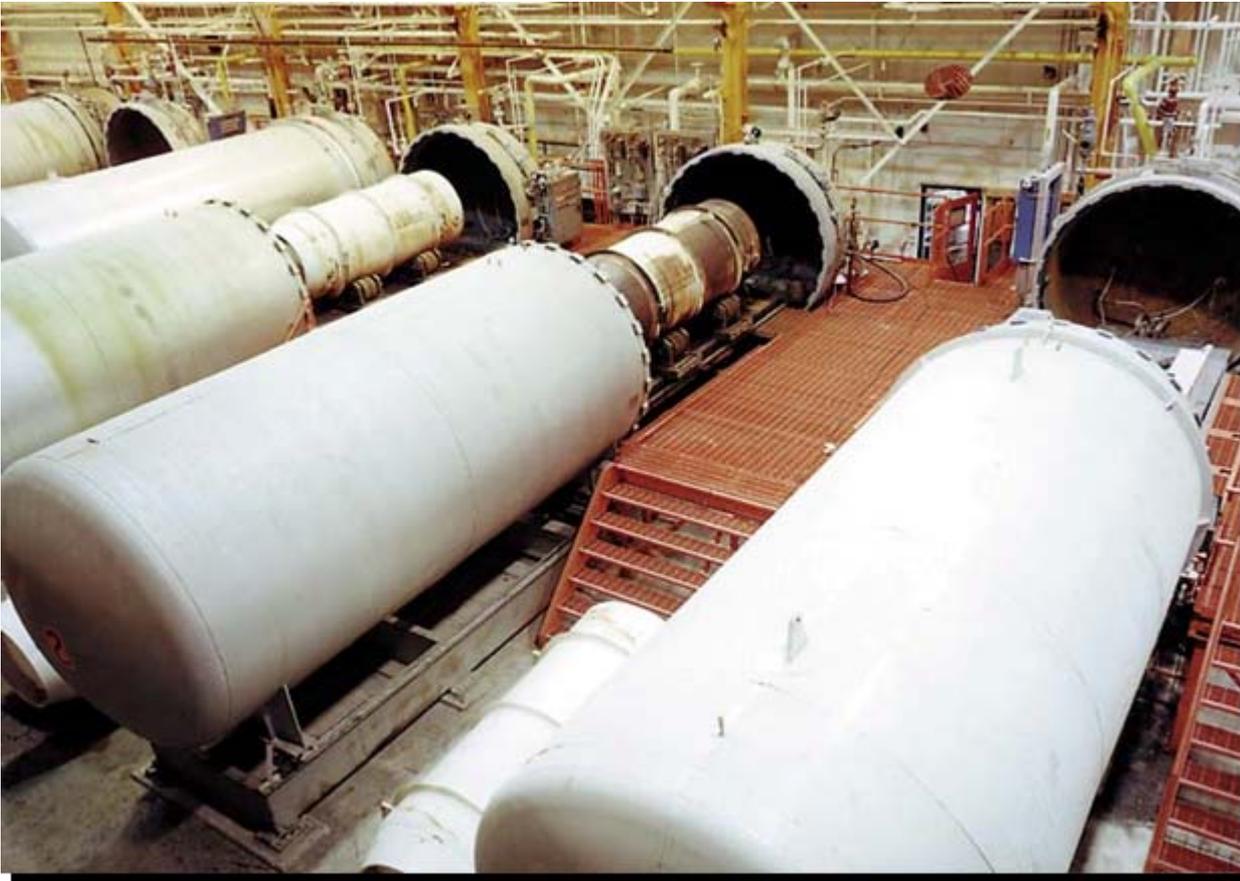
NSG Trigger List *(continued)*

Annex B — *more* electromagnetic enrichment



NSG Trigger List *(continued)*

Annex B — auxiliary systems (enrichment)



uranium (UF_6)
feed system

gaseous
diffusion
enrichment plant

NSG Trigger List *(continued)*

Annex B — *more* auxiliary systems (enrichment)

large gate valve
gaseous diffusion
enrichment plant



NSG Trigger List *(continued)*

Annex B — heavy water production plants



Bruce
Heavy Water
Plant
Lake Huron
Canada

NSG Trigger List *(continued)*

Annex B — uranium and plutonium processing and chemical conversion

Uranium processing and conversion

Uranium ore to UO_3

UO_3 to UF_6 , UO_2

UO_2 to UF_4 , UCl_4

UF_4 to UF_6 , metal

UF_6 to UO_2 , UF_4

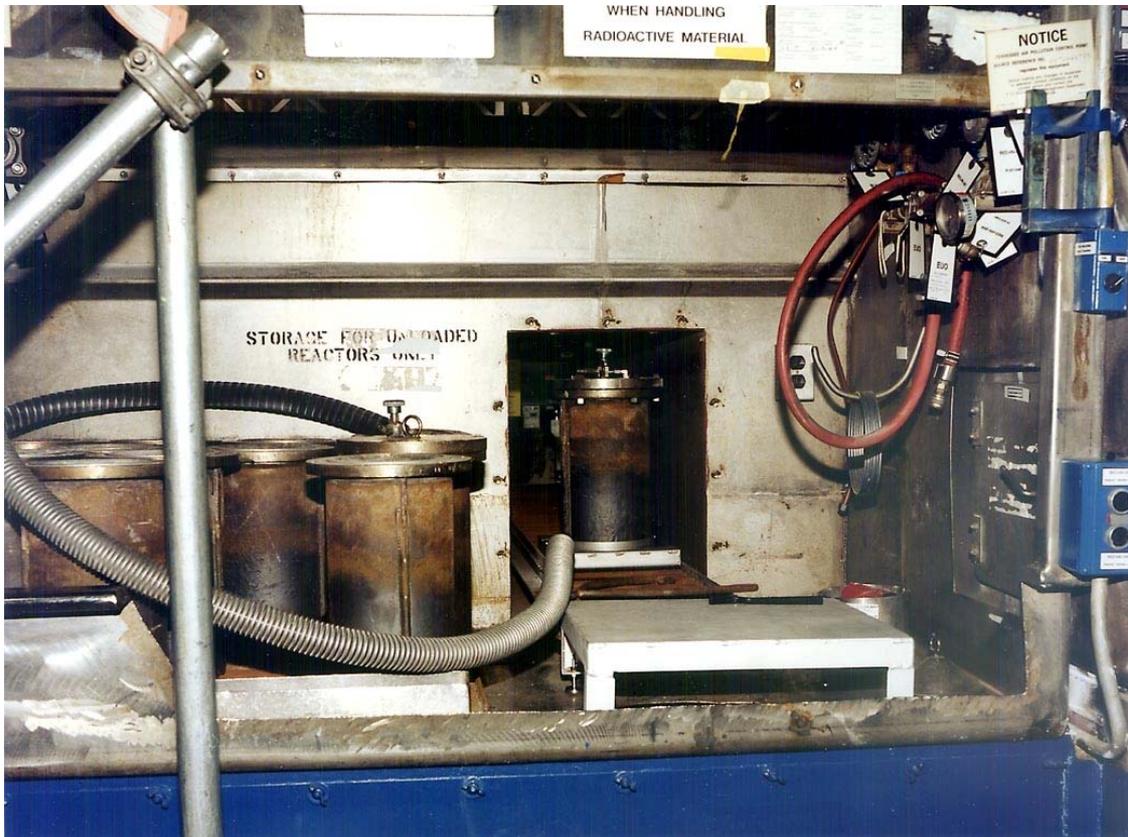
Plutonium processing and conversion

Plutonium nitrate to oxide

Plutonium metal production

NSG Trigger List *(continued)*

Annex B — *more* uranium and plutonium processing and chemical conversion



Stainless steel reactor vessels for reduction of highly enriched UF_4 to U metal

Two Federal agencies license the export of Trigger List materials, components, equipment, facilities, and technology.

US Nuclear Regulatory Commission (NRC)

- equipment, material, and embedded technology
 - 10 CFR PART 110, *Export and Import of Nuclear Equipment and Material*

US Department of Energy (DOE)

- stand-alone nuclear technology
 - 10 CFR Part 810, *Assistance to Foreign Atomic Energy Activities*

Most of 10 CFR Part 110 regulations are closely based on the NSG Trigger List.

Trigger List entry for valves for use in gaseous diffusion*

Especially designed or prepared manual or automated shut-off and control bellows valves made of UF6 -resistant materials with a diameter of 40 to 1500 mm (1.5 to 59 in.) for installation in main and auxiliary systems of gaseous diffusion enrichment plants.

Corresponding export control language in 10 CFR Part 110*

Especially designed or prepared manual or automated shut-off and control bellows valves made of UF6 -resistant materials with a diameter of 4 cm to 1.5 m for installation in main and auxiliary systems of gaseous diffusion enrichment plants.

- * The differences between the Trigger List and 10 CFR Part 110 entries are highlighted in red.

The N-stamp is an international designation of Trigger List commodities.



N-stamps on nameplates
affixed to pumps
controlled by the
NSG Trigger List

N-stamp (continued)

American Society of Mechanical Engineers (ASME)

- authorizing entity in the United States

NUCLEAR COMPONENTS
(N-type Certificates)

- **Stamps**

	Nuclear vessels, pumps, valves, piping systems, storage tanks, core support structures, concrete containments, and transport packaging
	Field installation and shop assembly
	Fabrication, with or without design responsibility, for nuclear appurtenances and supports
	Pressure relief valves

ASME C&S Training Module B9

(cont'd)
.....→
Slide 67



N-stamp (continued)

- <http://cstools.asme.org/holdersearch/>

**NUCLEAR COMPONENTS
(N-type Certificates)**

- **Stamps (cont'd)**

	Nuclear supports
	Containments for spent nuclear fuel and high level radioactive waste

ASME C&S Training Module B9 Slide 68



The IAEA and NSG recently granted an exception on U.S. nuclear transfers to India.

“U.S.-India Agreement for Cooperation Concerning Peaceful Uses of Nuclear Energy (123 Agreement)”

- executed on 10 October 2008
- allows U.S. nuclear transfers
 - to India’s civilian nuclear programs and facilities
 - still restricts certain equipment and technology
 - uranium enrichment
 - fuel reprocessing
 - contingent upon IAEA Safeguards at these same civilian facilities
 - 1 August 2008 of IAEA Safeguards agreement
 - does not apply to India’s nuclear weapon facilities
- no direct changes to NPT or NSG Trigger List

The NSG published the Dual-Use List in 1992 after events in Iraq and South Africa.

Controls exports of dual-use equipment, material, software, and technology which could make a significant contribution to unsafeguarded nuclear fuel cycle or nuclear explosive activities

- specific list of controlled items
 - exacting technical criteria for determinations
- no export to certain activities in “Non-weapon States”
 - nuclear explosives
 - unsafeguarded nuclear fuel cycle facilities
- published as an IAEA document
 - INFCIRC/254/Part 2
 - currently in its 7th revision
 - March 2006

NSG Dual-Use List *(continued)*

Scope of controls

- nuclear fuel cycle
 - some items or materials-of-construction used in Trigger List equipment/facilities
- nuclear weaponization

NSG Dual-Use List *(continued)*

- six broad categories
 - 1) industrial equipment
 - 2) materials
 - 3) uranium isotope separation equipment
 - 4) heavy water production equipment
 - 5) test and measurement equipment for the development of nuclear explosive devices (NEDs)
 - 6) components for NEDs

NSG Dual-Use List examples

Category 1 — industrial equipment

- machine tools

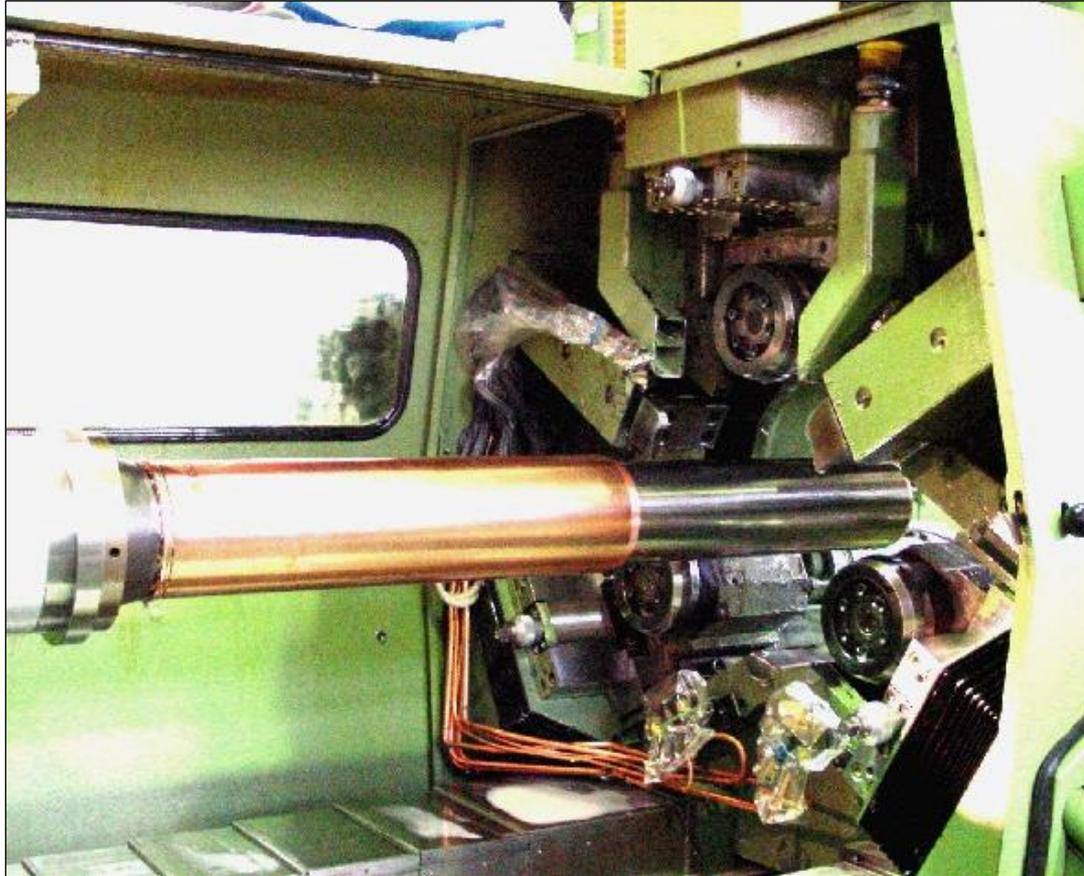
High accuracy,
multiple axes
machine tool



NSG Dual-Use List examples *(continued)*

Category 1 — *more* industrial equipment

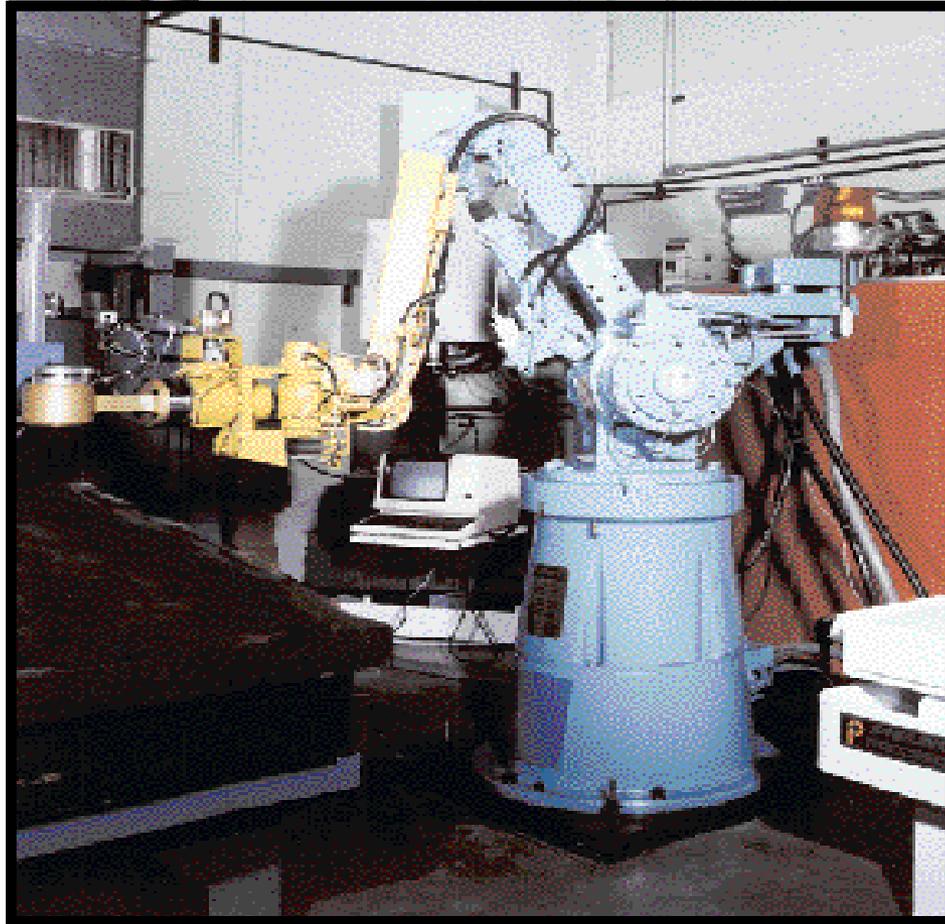
- flow- and spin-forming machines



NSG Dual-Use List examples *(continued)*

Category 1 — *more* industrial equipment

- robots



NSG Dual-Use List examples *(continued)*

Category 1 — *more* industrial equipment

- radiation shielding windows



NSG Dual-Use List examples *(continued)*

Category 1 — *more* industrial equipment

- remote manipulators



NSG Dual-Use List examples *(continued)*

Category 1 — *more* industrial equipment

- vacuum induction furnaces



NSG Dual-Use List examples *(continued)*

Category 2 — materials

- high strength aluminum (round stock, solid or hollow)



NSG Dual-Use List examples (continued)

Category 2 — *more* materials

- maraging steel



NSG Dual-Use List examples (continued)

Category 2 — *more* materials

- fibrous or filamentary materials, and prepregs



NSG Dual-Use List examples (continued)

Category 2 — *more* materials

- composite structures (tubular)



NSG Dual-Use List examples (continued)

Category 2 — *more* materials

- crucibles made of materials resistant to liquid actinide metals



various crucibles

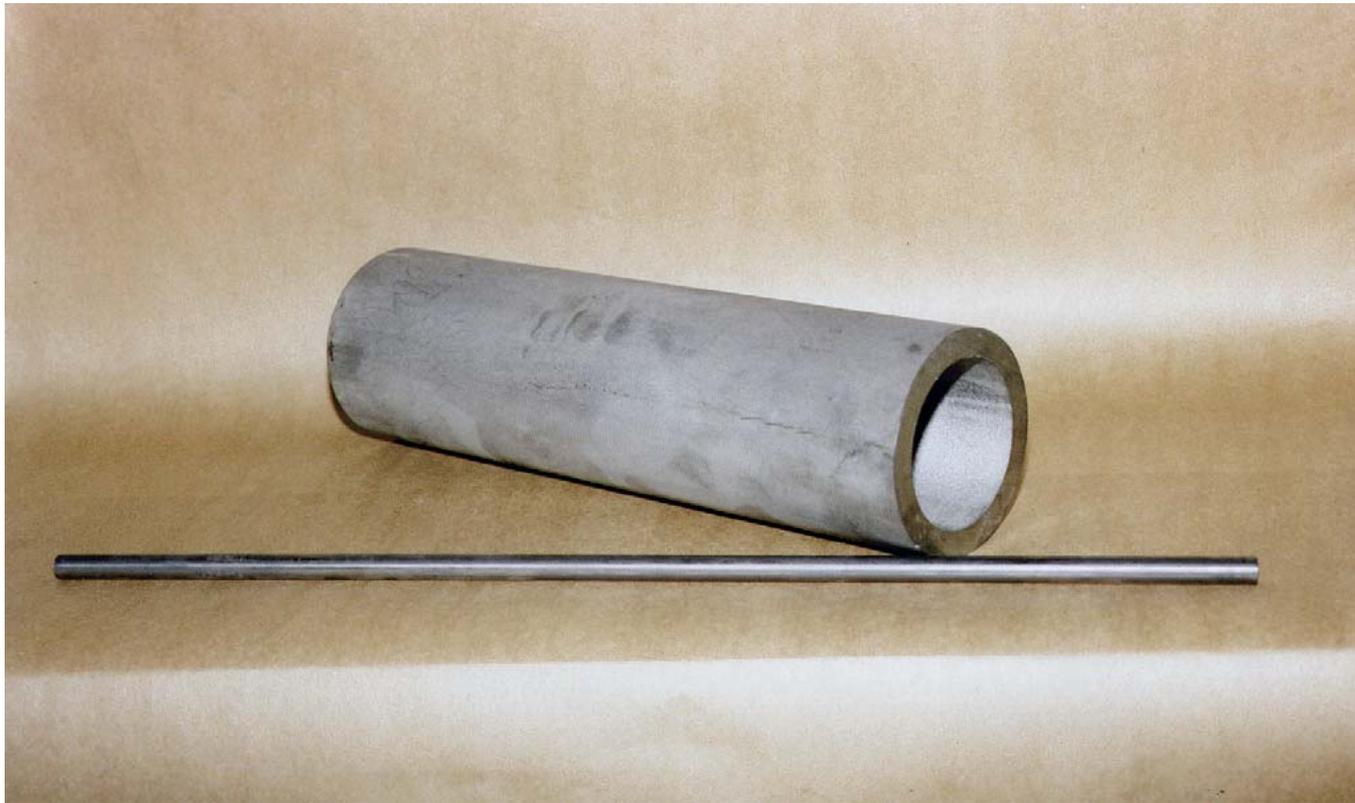


MgO
crucible

NSG Dual-Use List examples *(continued)*

Category 2 — *more materials*

- zirconium having low concentrations of hafnium



NSG Dual-Use List examples (continued)

Category 3 — uranium enrichment equipment

- frequency changers



NSG Dual-Use List examples *(continued)*

Category 3 — *more* uranium enrichment equipment

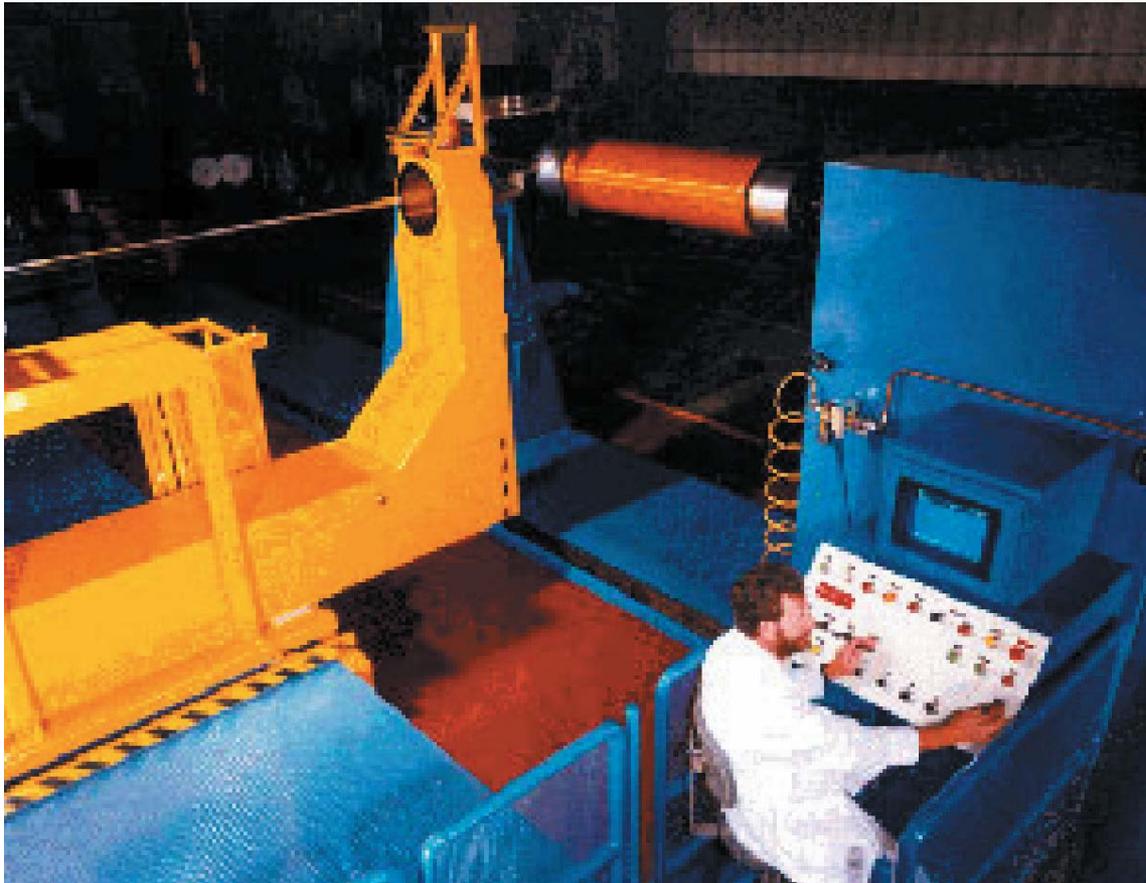
- corrosion resistant valves, with a bellows seal



NSG Dual-Use List examples *(continued)*

Category 3 — *more* uranium enrichment equipment

- filament winding machines



NSG Dual-Use List examples *(continued)*

Category 3 — *more* uranium enrichment equipment

- electrolytic cells for fluorine production



NSG Dual-Use List examples *(continued)*

Category 4 — heavy water production plant equipment

- ammonia synthesis converters
- specialized packings



NSG Dual-Use List examples *(continued)*

Category 5 — test and measurement equipment (for development of NEDs)

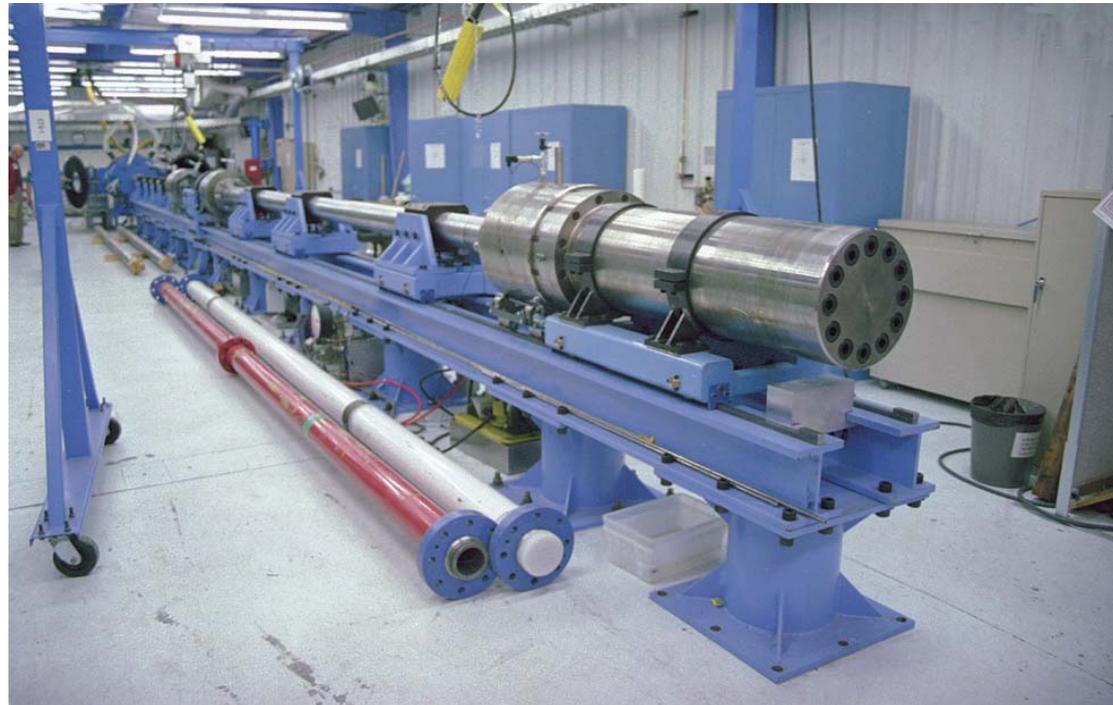
- photomultiplier tubes



NSG Dual-Use List examples *(continued)*

Category 5 — *more* test and measurement equipment (for development of NEDs)

- multistage light gas guns or other high-velocity gun systems



NSG Dual-Use List examples (continued)

Category 5 — *more* test and measurement equipment (for development of NEDs)

- mechanical rotating mirror cameras



NSG Dual-Use List examples (continued)

Category 5 — *more* test and measurement equipment (for development of NEDs)

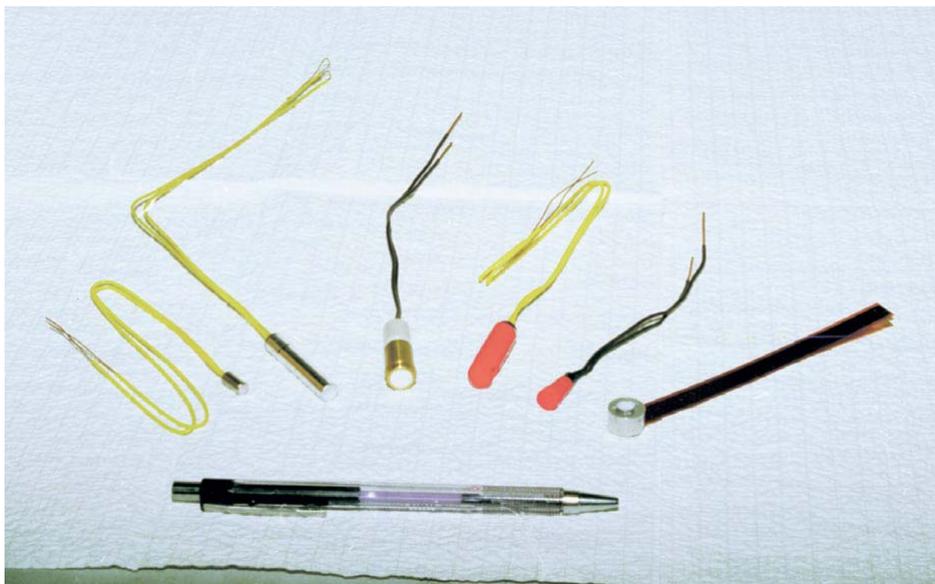
- pulse generators



NSG Dual-Use List examples (continued)

Category 6 — components for NEDs

- detonators and multipoint initiation systems

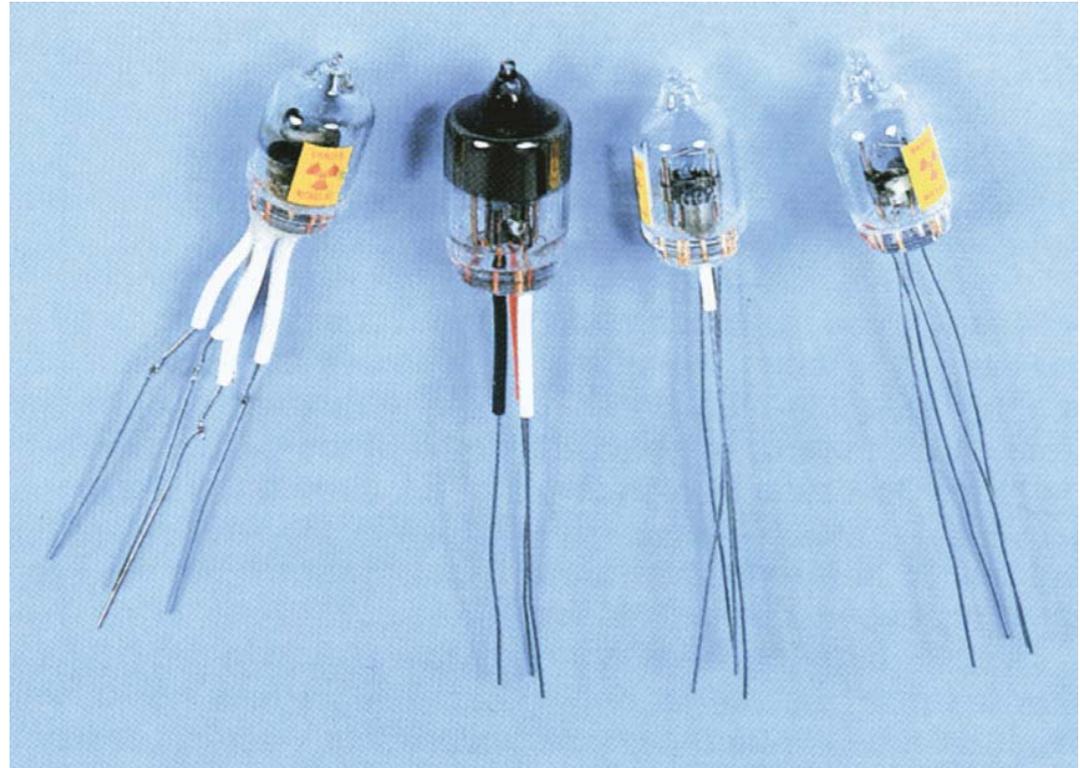


NSG Dual-Use List examples *(continued)*

Category 6 — *more* components for NEDs

- switching devices

three Krytrons
and one Sprytron
(2nd from left)



NSG Dual-Use List examples (continued)

Category 6 — more components for NEDs

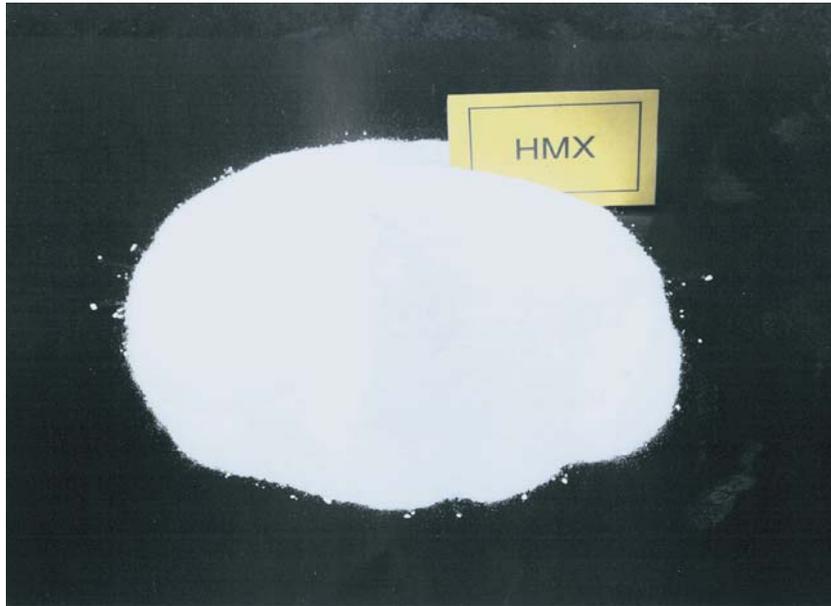
- capacitors



NSG Dual-Use List examples (continued)

Category 6 — *more* components for NEDs

- high explosive substances



HMX



TATB

The US Department of Commerce (DOC) licenses the export of dual-use equipment, material, software, and technology.

15 CFR Parts 730 – 774, *Export Administration Regulations (EAR)*

- listing of export control items
 - Commerce Control List (CCL)
 - Supplement No. 1 to 15 CFR 774
- jurisdiction authority over items on the CCL
 - DOC's Bureau of Industry and Security (BIS)

How do Trigger List definitions differ from Dual-Use definitions?

Trigger List's illustrative definitions

- Plants and equipment “*especially designed or prepared systems for the conversion of UF_4 to UF_6* ”
 - NSG Trigger List Annex B, Section 7.1.5
 - Controls such equipment, regardless of size, capacity, chemical process involved, or quality of product

Dual-Use List's specific definitions

- “*Magnesium containing less than 200 parts per million by weight of metallic impurities other than calcium, and containing less than 10 parts per million by weight of boron.*”
 - NSG Dual-Use List, Section 2.C.10
 - Controls precisely this type of high-purity magnesium, *not* to other types of high-purity magnesium

Here is a list of useful internet links.

NPT

- <http://disarmament2.un.org/wmd/npt/index.html>

NSG

- <http://www.nuclearsuppliersgroup.org/default.htm>

IAEA

- <http://www.iaea.org/>

Useful Internet Links *(continued)*

U.S. Nuclear Regulatory Commission

- <http://www.nrc.gov/>

U.S. Department of Commerce

- <http://www.commerce.gov/>

U.S. Department of Energy

- <http://www.energy.gov/>

U.S. National Nuclear Security Administration (NNSA)

- <http://www.nnsa.doe.gov/>

NNSA NA-24 Nuclear Supply and Transfers Team

- <http://www.nnsa.doe.gov/na-20/nstt.shtml>