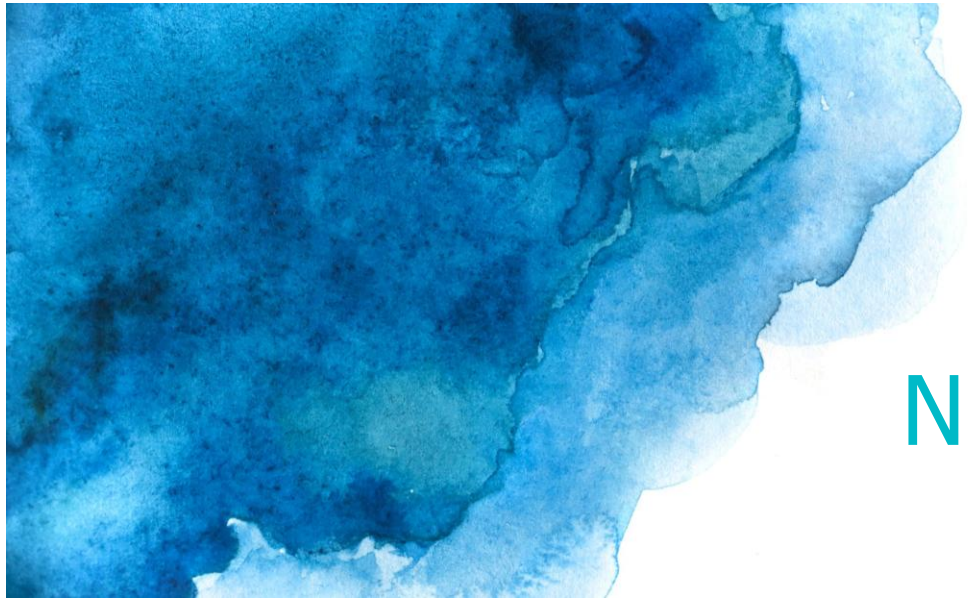

Elements of International Non-proliferation and Disarmament of Weapons of Mass Destruction

Greyfriars April 2025

Johan Rautenbach

UNITED NATIONS

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IOM
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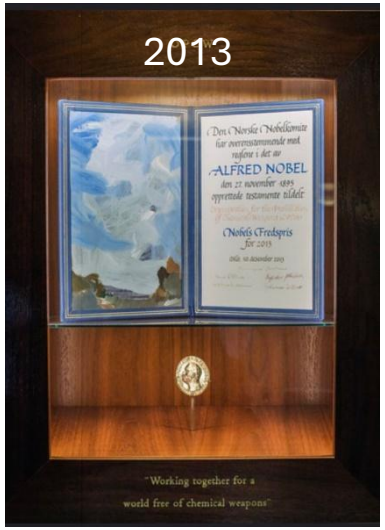
Conference on Disarmament

1991-1993

2013



1993-2002

2005

2002 - 2010

2011 - 2021

2021 - 2025

United Nations | Conference on Disarmament

Agreements Finalized

- Biological Weapons Convention (BWC) (1972)
- Chemical Weapons Convention (CWC) (1993)
- Comprehensive Nuclear-Test-Ban Treaty (CTBT) (1996)
- *Treaty on the Non-Proliferation of Nuclear Weapons (NPT) (1968 by ENCD)*

Topics Discussed (i.a.)

- Nuclear Disarmament
- Radiological Weapons
- Missile Control
- Outer Space Disarmament (Prevention of an Arms Race in Outer Space - PAROS)
- Fissile Material Cut-off Treaty (FMCT)

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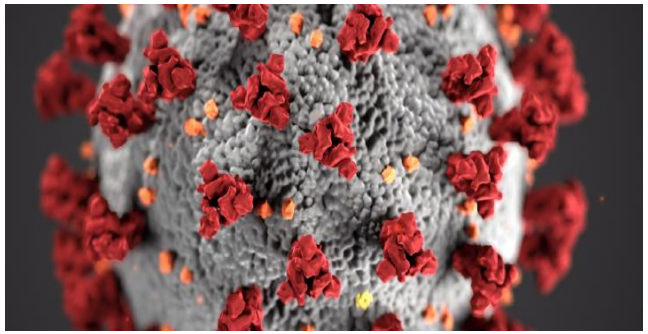
Verification of Nuclear Non-Proliferation

Safety and Security of Nuclear Energy



Nuclear Applications

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Verification of Nuclear Non-Proliferation

Treaty on the Non-Proliferation of Nuclear Weapons, 1970 (191)

- A NW State – device prior to 1 January 1967
- NW States – China, France, Russian Federation, UK, US
- Non-members to NPT – India, Israel, North Korea, Pakistan, South Sudan
- South Africa - 1991
- NW State not transfer/give control/assist NNW State re NWs
- NNW State to accept safeguards from the IAEA – conclude agreement with it
- Comprehensive Safeguards Agreement; Additional Protocol; Small Quantities Agreement

Other Nuclear Non-Proliferation Measures

- Nuclear-Weapon-Free Zones [Tlatelolco; Rarotonga; Pelindaba; Bangkok; Central Asian]
- Comprehensive Nuclear-Test-Ban Treaty (178/187)
- Missile Technology Control Regime (35)
- Wassenaar Arrangement [Dual-use technology] (42)
- Zangger Committee and Nuclear Suppliers Group [Export control] (39)
- Proliferation Security Initiative [Trafficking WMD; searching ships, inspecting cargo, interdicting transfers] (105 excl. RSA)
- UNSCR 1540 [Non-state actors]

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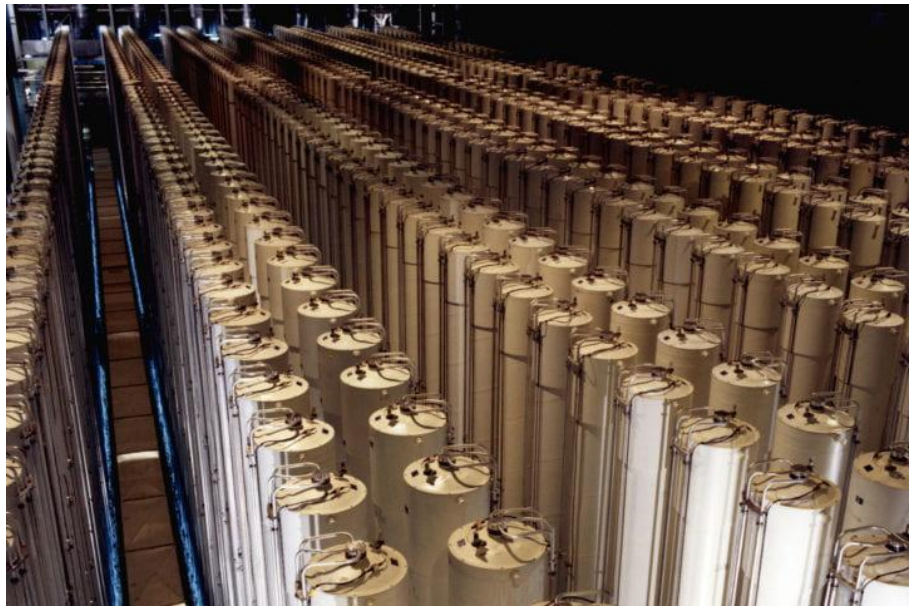
Verification of Nuclear Non-Proliferation

Enrichment



- Natural uranium **99.3% 238** and **0.7% U-235**
- U-235 sustains nuclear chain reaction for both energy and weapons
- Nuclear Power needs **3% to 5% U-235**
- Nuclear Weapons need **90% or more U-235**
- Centrifuge spins at 50,000 to 70,000 RPM
- Spent fuel contains a mix of U-238, U-235, and newly created plutonium Pu-239

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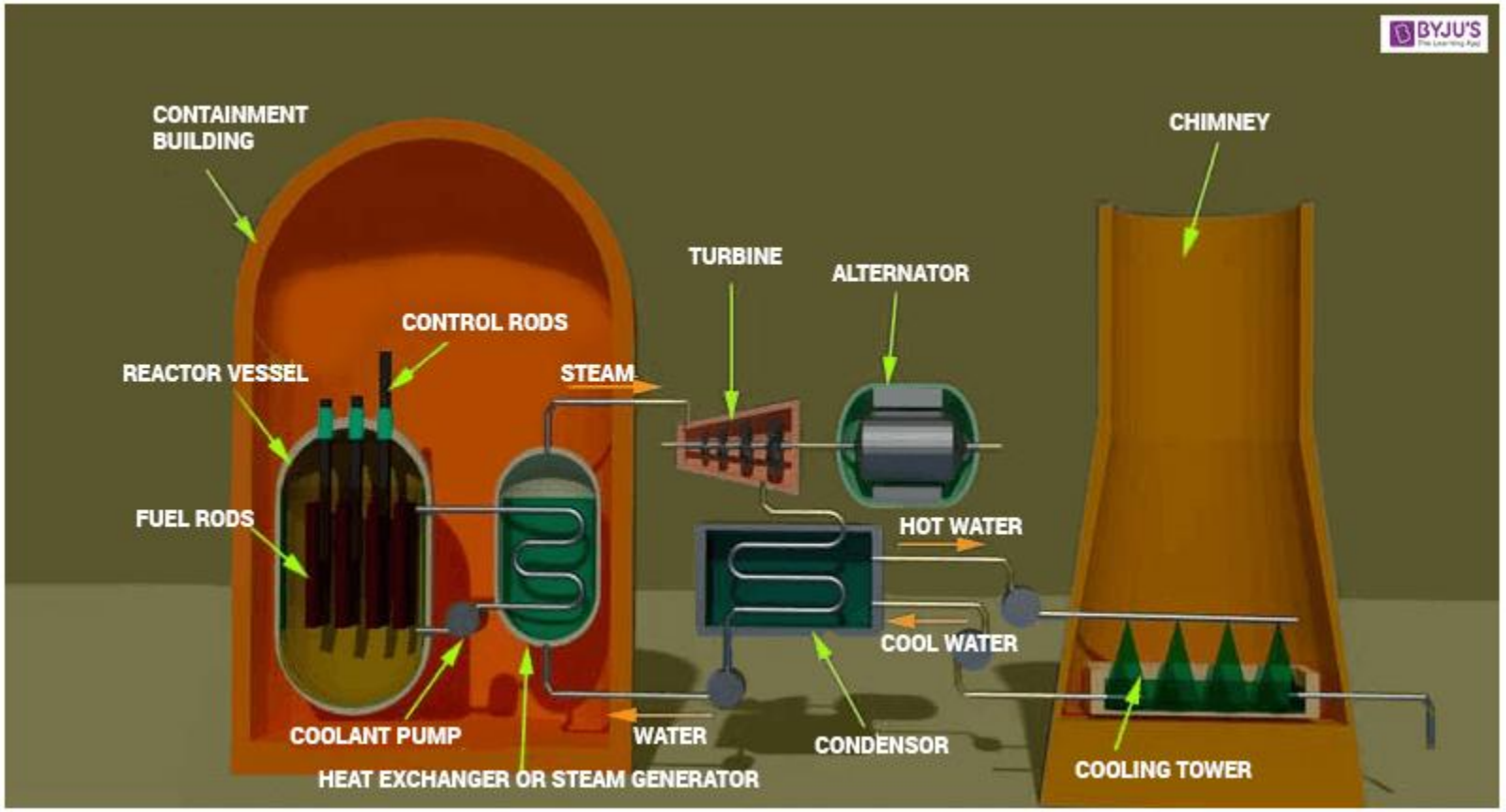

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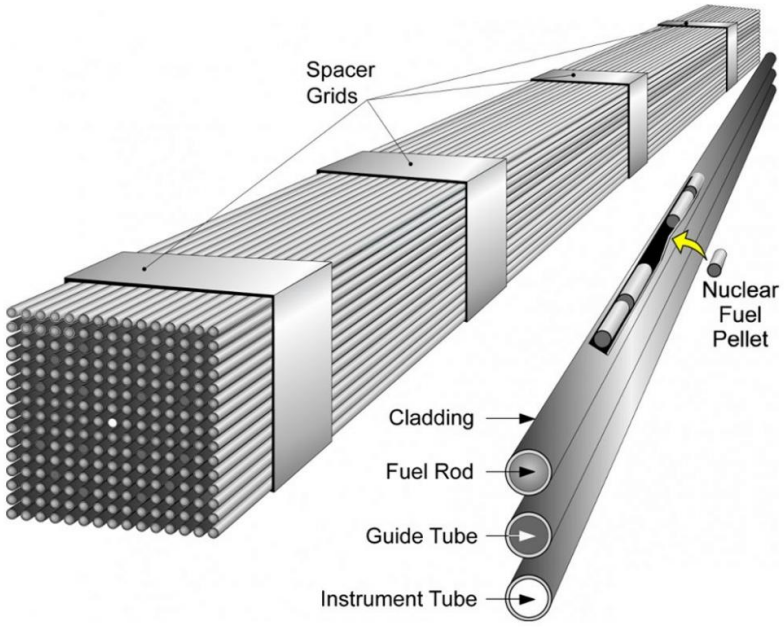

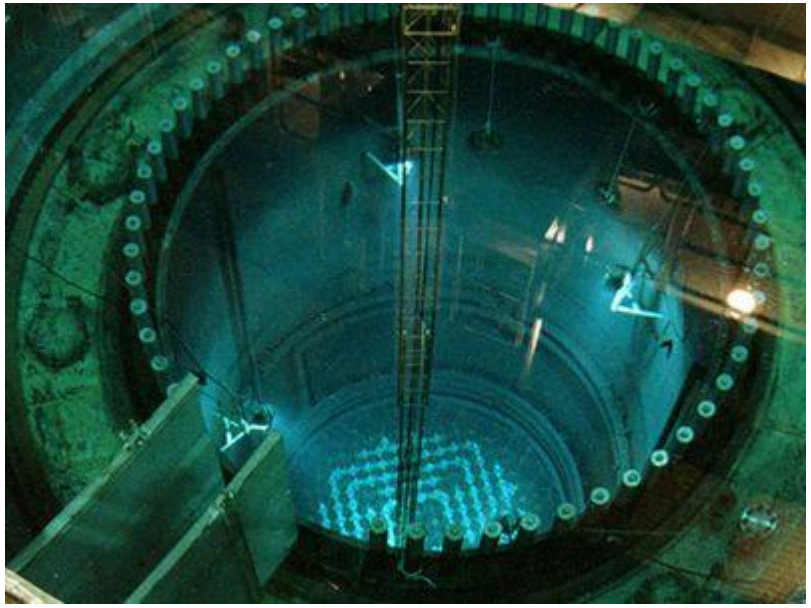

Treaties Nuclear Safety

- Convention on Nuclear Safety - land-based civil nuclear power plants has a peer review process (78)
- Joint Convention on the Safety of Spent Fuel Management and on the Safety of Radioactive Waste Management - has a peer review process (83)
- Convention on Early Notification of a Nuclear Accident - notification system for nuclear accidents with possible international transboundary release (127)
- Convention on Assistance in the Case of a Nuclear Accident or Radiological Emergency - cooperation among States for assistance and support in case of accidents or emergencies (122)
- Codes of Conduct, Guidelines, Joint meetings

Nuclear Security Instruments

- Convention on the Physical Protection of Nuclear Material - protection measures and criminalizes offences related to illicit trafficking and sabotage (157)
- International Convention for the Suppression of Acts of Nuclear Terrorism - sharing of information and assistance for investigations and extraditions (124)
- Convention on Civil Liability for Nuclear Damage (40)
- Code of Conduct for the Safety and Security of Radioactive Sources (130)
- UNSC Res 1373 (2001) and 1540 (2004) Non-state Actors

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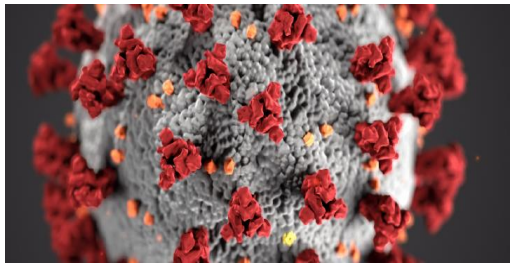


Nuclear Applications

Stable isotopes used in **scientific research, environmental studies, medicine, and industry** - no radiation.

Oxygen-18 (^{18}O) & Hydrogen-2 (^{2}H, Deuterium) reconstruct past climate conditions

Oxygen-18 (^{18}O) trace water sources

Carbon-13 (^{13}C) track carbon cycles in ecosystems, breath tests to detect bacterial infections

Carbon-13 (^{13}C) & Nitrogen-15 (^{15}N) verify food authenticity organic vs. synthetic fertilizers in plants

Radioactive isotopes are used in **medical treatments, dating techniques, industrial applications, and space exploration** - emit radiation.

Iodine-131 (^{131}I) treat thyroid disorders and cancer

Cobalt-60 (^{60}Co) radiation therapy for cancer

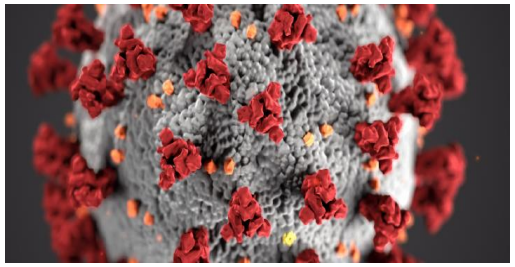
Technetium-99m (^{99m}Tc) medical imaging e.g., bone scans, heart scans

Carbon-14 (^{14}C) radiocarbon dating

Potassium-40 (^{40}K) & Uranium-238 (^{238}U) dating rocks and minerals

Americium-241 (^{241}Am) smoke detectors

Plutonium-238 (^{238}Pu) powering spacecraft e.g., Mars rovers



Nuclear Applications

IAEA Laboratories

Nuclear Application Laboratories - Seibersdorf (Austria)

- **Nuclear Science and Instrumentation Laboratory** – develops and tests nuclear instruments
- **Food and Environmental Protection Laboratory** – food safety and traceability using isotopic techniques
- **Animal Production and Health Laboratory** – disease control and livestock production
- **Soil and Water Management & Crop Nutrition Laboratory** – improved agricultural practices
- **Plant Breeding and Genetics Laboratory** – radiation-induced variations for improved crops
- **Dosimetry Laboratory** – Supports quality assurance in radiation therapy and dosimetry

Monaco Marine Environment Laboratories - impact of pollutants on the marine environment

Nuclear Safeguards Laboratories Seibersdorf (Austria) - support nuclear safeguards by analyzing nuclear material samples to detect illicit nuclear activities

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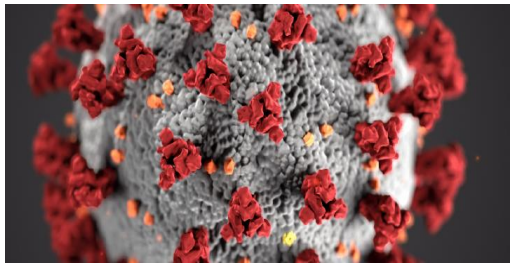

Nuclear Applications

Health

Technic development (isotopes, radiopharma)

Safety standards

Diagnostics and treatment (cancer, Covid-19 RT-PCR, Ebola, Zika)

Disease control (malaria, tsetse fly)

Nutrition (infant and child feeding maternal nutrition, ageing)

Industry

Food and Agriculture

Environment

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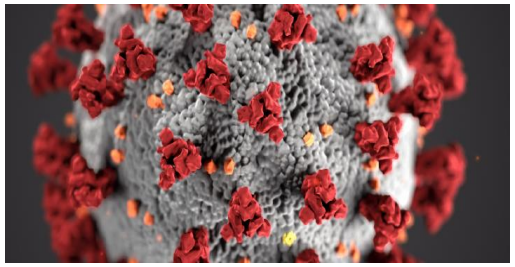

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Industry

Industrial radiography (non-destructive testing to inspect e.g., concrete and welds in gas/water pipelines, storage tanks etc. to identify invisible cracks/flaws.

Nucleonic gauges (for static or continuous measuring applications)

Medical sterilization (cost-effective method for sterilizing medical devices)

Radiotracers (measuring flow rate of liquids, gases and solids, process optimization/troubleshooting)

Material modification (crosslinking of polymer chains for producing e.g., wire and cable insulations, car tires or natural rubber latex)

Food and Agriculture

Environment

IAEA
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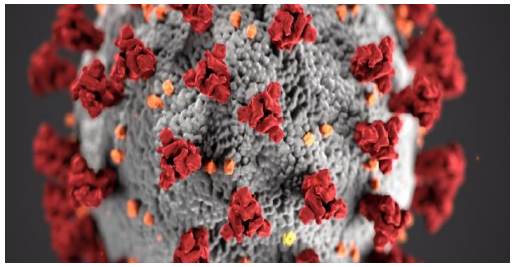

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Industry

Food and Agriculture

Livestock (diagnose diseases, monitor vaccination – Rinderpest, animal movement)

Food standards Codex Alimentarius Commission, harmonized international food standards, food irradiation, verify food authenticity, measure agrochemical levels (pesticides and veterinary drug residues) in food.

Plant breeding Irradiation used to induce variation in plants for improved quality

Pest control - sterile insect technique fruit fly, tsetse fly, screwworm, codling moth mosquitoes

Environment

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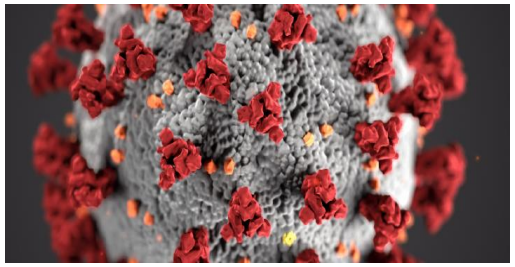

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Industry

Food and Agriculture

Environment

Air (isotope pollutant measurement/movement)

Land (isotopes identify pollutants)

Oceans (isotopes monitor contaminants and biotoxins in seafood e.g., red tide)

Water (movement of pollutants in water and to measure water quality)

Forests (geographical origin of imported wood)

OPCW

Chemical Weapons

OPCW

Chemical Weapons

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Chemical Weapons
Historic Use

- 423 BCE – Peloponnesian War - Spartans used burning sulphur against Athenians at Delium
- 256 CE – Roman-Persian Wars – Persians used bitumen and sulphur at Dura-Europos
- 22 April 1915 – First Large-Scale Chemical Attack (Second Battle of Ypres) when Germany used 168t of chlorine gas against French and Algerian troops
- 1 million affected 90,000 dead in WW1
- Iran-Iraq War (1980-1988) – mustard gas and sarin against Iran and Kurds in Halabja
- Syrian Civil War (2010s-Present) - sarin and chlorine gas attacks against civilians
- ISIL – mustard gas

OPCW

Chemical Weapons

OPCW

Chemical Weapons

Implements Chemical Weapons Convention

193 Member States

98% of the global population lives under its protection

100% declared stockpiles verifiably destroyed

2013 Nobel Peace Prize recipient

Designated Laboratory Network

Robust Verification regime

Maintains readiness to respond

OPCW

Chemical Weapons

cont. 6 of 16

OPCW

The Convention

- Convention on the Prohibition of the Development, Production, Stockpiling and Use of Chemical Weapons and on their Destruction (193)
- Comprehensive single purpose Convention – the only non-proliferation and disarmament – 179 pages
- Prohibition and destruction of existing chemical weapons
- Old (<1925/1946) and Abandoned (>1925)
- Buried (<1977) and Sea dumped (<1985)
- Establishes organisation for verification of destruction and non-diversion by commercial chemical industry
- Investigation of alleged use
- Challenge inspection
- National legislation, including extraterritorial for nationals
- Economic and technical development

OPCW

What is a chemical weapon

- General purpose criterion
- All toxic chemicals and their precursors, except for purposes not prohibited
- Munitions and devices, specifically designed for use of toxic chemicals
- Any equipment specifically designed for use directly with such munitions and devices
- Riot control agents not as a method of warfare

Except for:

- Industrial, agricultural, research, medical, pharmaceutical or other peaceful purposes
- Protective purposes against toxic chemicals and chemical weapons;
- Military purposes not dependent on the use of the toxic properties of chemicals
- Law enforcement including domestic riot control purposes

OPCW cont. 9 of 16

Declaration and Destruction

- Chemical Weapons
- CW Production Facilities
- Abandoned CW

OPCW

Declaration and Destruction

Verification regime

- Self declaration back to 1946 and verification
- Destruction of chemical weapons and all facilities
- Non-diversion by commercial industry
- Balance - declaration and routine inspections for key chemicals
- Schedule 1 – Was used as a CW and poses a high risk
- Schedule 2 – Was used as precursor and poses a significant risk
- Schedule 3 – Was used as CW, poses a risk but produced in large commercial quantities
- OCPF - Discrete organic chemicals and with phosphorus, sulphur or fluorine
- OPCW laboratory and network of designated laboratories

Verification regime

- Destruction of CWs: systematic and continuous verification
- Different regulatory sub-regimes
- Schedule 1: restrictions, transfer notifications, systematic verification
- Schedule 2: transfer restrictions to SnP, risk-based verification approach
- Schedule 3: verification based on weighted random selection
- OCPF (DOC/PSF): verification based on weighted random selection
- ACW – Abandoned Chemical Weapons

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Other Chemical Weapons Regimes

- The 1899 Hague Declaration banned use of poisonous gases, but it was not widely enforced
- Geneva Protocol (1925) – **Use** of Asphyxiating, Poisonous or Other Gases, and Bacteriological Methods of Warfare
- Australia Group (1985) – 42 countries limiting dual-use chemicals
- UN Security Council Resolutions - UNSCR 1373 (2001), 1540 (2004), and UNSCR 2118 (2013)

Selected Issues and Problems

Biotoxins

- **Naturally occurring** toxic biologically produced substances from living organisms - bacteria, fungi, plants, animals
- **Extreme toxicity** - lethal in milligram doses (e.g., botulinum toxin, ricin, saxitoxin)
- **Difficult detection** – Colorless, odorless, tasteless, no universal detector or analysis
- **Multiple delivery methods** – Aerosols, contaminated food/water, or injection
- **Non-volatile** – Do not readily evaporate, making them persistent
- **Deniability** – Because they occur naturally, biotoxin attacks can be harder to trace
- **Limited verification** – Only ricin (castor beans) and saxitoxin (shellfish)

Selected Issues and Problems

Artificial Intelligence

- CWC lists about 200 chemicals
- > 200 million new chemical substances since 1993
- AI - new formulas and pathways in days not years
- AI enabled mobile laboratories
- AI operated cloud laboratories - conduct experiments on-demand any time any location, with only computer interface
- Perform sample preparation, storage and handling, all from a remote setting
- Improved CW delivery capacity


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