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"Nuclear Disarmament:

Challenges, Opportunities and Next Steps"

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I. Scientific and Environmental

A) Scientific

1. What does it take to build a nuclear weapon?

To make a plutonium bomb first you must produce the plutonium. To produce plutonium exploded uranium is needed. It's rarely found in some uranium ores. Plutonium is highly unstable and has a high rate of fission, which causes an explosion. It is safe to use a small amount of the plutonium and crush it until the atoms are tightly packed in the sphere where it starts to begin a chain reaction. [1]

Like coal, oil and natural gas, uranium is an energy resource which must be processed through a series of steps to make an efficient fuel for creating electricity. Each fuel has its own specific fuel cycle: however, the nuclear fuel cycle is more complex. To prepare uranium for use in a nuclear reactor, it has to go through the steps of mining and milling, conversion, enrichment and fuel fabrication. These steps mentioned make up the 'front end' of the nuclear fuel cycle. After uranium has been used in a reactor to create electricity it's known as spent fuel and may undergo another series of steps including temporary storage, reprocessing, and recycling before disposal as waste. Collectively these steps are known as the 'back end' for the fuel cycle.

Mining and Milling- Uranium is most usually mined by either surface or underground mining techniques. After that the mined uranium ore is sent to a mill which is usually located close to the mine. At the mill the ore is crushed and ground to a fine slurry which is leached in sulfuric acid to allow the separation of uranium from the waste rock. It's then recovered from solution and precipitated as uranium oxide concentrate. Also known as 'yellowcake.'

Conversion- Since uranium needs to be in the form of a gas before it can be enriched the U308 is converted into the gas uranium hexafluoride at a conversion plant in Europe, Russia, or North America.

Enrichment- The vast majority of all nuclear power reactors in operation and under construction require enriched uranium fuel in which the proportion of the U-235 isotope has been raised from the natural level of .7% to gaseous uranium hexafluoride into two streams.

Fuel fabrication- Pellets from the transported UF₆ are then inserted into thin tubes, usually of zirconium alloy or stainless steel, to form fuel rods. The rods are then sealed and assembled in clusters to form fuel assemblies for use in the core of the nuclear reactor. Some twenty-five tones of fresh fuel is required each year by a one thousand MWe reactor.

Skilled workers with technical expertise in the fields of nuclear physics, nuclear chemistry, nuclear engineering and even nuclear medicine are needed to develop and support a nuclear weapons program. Workers skilled in these areas are trained in many of the physical sciences including quantitative analysis, calculus, statistics, physical chemistry and also computer languages and many other support areas.

B) Environmental

1. Why are nuclear weapons harmful?

Obviously, nuclear weapons are an extremely large destructive force to reckon with. Nuclear weapons kill by heat, radiation, blast, and shockwave. These weapons don't limit themselves by just killing humans, but all living organisms including the potential to destroy infrastructure.

As worldwide demand for uranium grows, Australia stands to gain. Western Australia has not, until recently electing a new government that overturned the law, allowed open uranium mining. Australia produces only about 19% of the world's yellowcake from 36% of the world's known uranium resources; Australia stands to gain economically if they decide to further develop their uranium resources. This could have both positive and negative environmental consequences depending on the type of mining operation. It is thought that about 66,500 metric tons of uranium ore were needed to power the world's nuclear power plants in 2007. That amount could more than double within 25 years. As the power needs of India and China grow and efforts to reduce carbon emissions become more important a report by the uranium mining consulting firm of Deloitte Touche Tohmatsu states that by adding more nuclear power plants could rise to even more than 253,000 tons of uranium used by 2030 in a time of crisis. The negative environmental impact is a result of Western Australian supply and global demand. Western Australia is currently #2 in yellowcake production to Canada. Southern Australia does not have the uranium mining restrictions that Western Australia does and must still negotiate land questions with native aborigines. Gambling with competition, Australia must face the fact that Namibia already has a well established uranium mining operation in place. [2]

2. Where are nuclear weapons stored?

In the United States for example, nuclear weapons are disassembled at Pantex in Texas. Also there is another storage facility in South Africa. South Africa built its facility at the

Circle Facility near Pretoria that was run by the South African Armaments Corporation Armscor. This building contained a high security vault which stored highly enriched uranium awaiting processing into weapon components and the finished nuclear weapons. South Africa had more storage vaults for nuclear weapons, but these vaults weren't used during the height of the program in the 1980's. During the 1980's, South Africa developed nuclear weapons where being separate was the key control philosophy. Each nuclear device was divided into a front and back section. The design minimized the possibility of accidental detonation or unauthorized use. [10] Other countries select their storage programs to fit their own needs, either militarily or privately.

3. Do nuclear weapons require maintenance?

Yes, consider the Nuclear Stockpile Stewardship Program which supports the maintenance of the weapons. [3] People often respond to problematic technology by engaging in repairing activities, like maintenance, or redesign. Since the end of the Cold War, these activities have taken a central role in the United States nuclear weapons program, while stockpiled weapons are no longer continually replaced with new designs. The new Reliable Replacement Warhead (RRW) program states that designers take the lead in repair of the stockpile by redesigning weapon components to optimize them for long term stability in storage, shrinking the need for engineering expertise by designing stability into the weapons themselves. [11]

4. Disasters such as Electromagnetic Pulse

An electromagnetic pulse is a high altitude nuclear detonation that automatically makes a burst of gamma rays from within the device. These photons make high energy free electrons by Compton scattering at altitudes around twenty to forty kilometers. The electrons are now trapped in the Earth's magnetic field, making a radiated electromagnetic field called an Electromagnetic pulse or an EMP. This pulse can very easily cover an area a whole continent in size. The radiation can affect systems on land, in the sea, and also in the air. The first EMP that was recorded was an accident at a high altitude nuclear test over the South Pacific and resulted in system failures as far away as Hawaii. [4]

A) Social and cultural impact of nuclear weapons

1. Why are nuclear weapons important to society?

Nuclear weapons are very important to the global society. Nuclear weapons are important for defensive and offensive reasons and so countries will seem bigger or better since it has them. There are many reasons that cause nations to obtain nuclear weapons. Security concerns about other nations and other nuclear powers make most of the decisions to gain the weapons. Nation states do not currently seem to be deterred by the NPT. [5]

2. What if you don't have nuclear weapons but others do?

If others countries have nuclear weapons and you do not, then you might want to obtain them. If another country acknowledges that a country doesn't have nuclear weapons and that country just happens to be on their "Hit List" then that certain country is in for a radiological problem.

3. Jobs, technology and industrial impact

In the late 1970's Iraq purchased nuclear power plant plans from the French government. Mousaad operatives within the IDF (Israeli Defense Force) followed the development of the facility via American top secret satellites and the French newspaper *La Pointe* reported its completion on 1 June 1981. [7] President Saddam Hussein created jobs for the Iraqi and French people when they bought this technology. This is an example of how technology can create job opportunities within the nuclear industry.

B) Economic impact of nuclear weapons

1. How much does a nuclear weapon cost to build and maintain?

Cost can vary depending on how the material is acquired. America, Japan, Russia, Germany and other countries spent millions of dollars in initial capital outlay during wartime development of nuclear weapons starting in the late 1930's. Rogue nation states (such as North Korea) and non-state actors (terrorists) will pay almost any amount to acquire nuclear weapons. Nuclear materials are sought on black markets around the world. Nuclear weapon design and yield also influence cost.

2. Who can afford nuclear weapons?

Most major countries can afford nuclear weapons. The problem tends to be acquiring nuclear technologies and scientist who can maintain such materials.

3. Are they all the same, same size and cost the same

There is an assundry types and sizes of nuclear weapons scattered across the world. Not too long ago Los Alamos National Lab scientists Dowler and Howard described four types of nukes. A 10-ton-yield penetrating "micro-nuke" to destroy bunkers. A 100-ton-yield "mini-nukes" to counter ballistic missiles, a 1,000-ton-yield "tiny-nukes" for a lot of battlefield use, and finally a high power microwave and electromagnetic pulse generating nuke. [6]

III. Political importance and consequences of nuclear weapons

a) Political and geopolitical impact of nuclear weapons

1. Reason for state and non-state actors to acquire nuclear weapons

One reason state actors as countries may wish to have nuclear weapons is for defense either perceived or real. Non-State Actors (NSA) may seek nuclear weapons as instruments of terror. Terrorists who act with or without state support may not wish to kill their targets. Iran, whom many Americans consider a nuclear threat "will probably in a year or so have enough low enriched uranium to convert into highly enriched uranium, and if they have the know-how to weaponize it and deliver it, then they can have one nuclear weapon." [8] Iran has sworn to wipe Israel off the map if they acquire nuclear weapons. Iran may supply nuclear weapons that they produce to NSA for this purpose. If this happens, the world may not be able to hold Iran responsible.

2. What is the role of Non-State Actors such as terrorist use of WMD's?

Nuclear weapons are just one kind of WMD and all WMD's are not nuclear weapons. Nuclear weapons are extremely expensive and difficult for NSA to acquire. Terrorist's purpose may not be to kill but to terrorize. The use of a nuclear weapon would kill many people and therefore may not be the best choice for many purposes. Any country or terrorist group who uses any nuclear weapon in anger will certainly suffer worldwide consequences.

3. What is a nation state willing to do to afford or get nuclear weapons?

According to a CNN News report, ““In 1974, Prime Minister Zulfikar Ali Bhutt vows Pakistan will "eat grass" if necessary to develop nuclear weapons after India explodes its first nuclear device.”” “As early as 1972 Pakistan sets up first nuclear power station with Canadian help.” This supports the lengths that a country will go to, to acquire a nuclear defense program for her people. In 1979, Pakistan risked losing American military and economic aid to develop her nuclear program. [9]

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1. Definitions of proliferation, nonproliferation, and deterrence. A partial list of frequently used vocabulary terms.

Proliferation is the spread of nuclear weapon materials and or technologies. [1]

Nonproliferation is the prevention of something increasing or spreading, but mostly especially the prevention of an increase in the number of countries possessing nuclear weapons. [2]

Deterrence is the act or process of discouraging actions or preventing occurrences by instilling fear or doubt anxiety. [3]

2. Effects of the nuclear weapons on Hiroshima and Nagasaki

Hiroshima

August 6, 1945, at 9:15 AM Tokyo time, a B-29 plane, named the Enola Gay piloted by Paul W. Tibbets, dropped a uranium atomic bomb, code named "Little Boy" on Hiroshima, one of Japan's top ten largest cities. In just minutes, half of Hiroshima vanished completely. According to the United States 60,000 to 70,000 people were killed or missing, 140,000 were injured, and many more were homeless because of the devastating bomb. Deadly radiation reached over 100,000 people. Just the blast killed thousands instantly [4] and lingering radiation from fallout kept killing people for years.

3. Effects of nuclear weapons testing.

Iran has carried out missile tests for what could be a plan for a nuclear strike on the United States, the head of a national security panel has warned. [10]

On Wednesday, 25 February 2009, Robert Tait of the British newspaper *The Guardian* reported claims by Iran that their nuclear reactor at Bushehr had had its first test run. The test run was facilitated with virtual fuel consisting of lead representing enriched uranium. A tentative date later this year is when the 1000-megawatt reactor is expected to become operational.

Developments at Bushehr came when the West was focusing their attention at Iran's Natanz uranium enrichment plant. This presents a direct threat to the safety of many countries.

Delays on the Russian side are thought to be from delinquent payments by Iran for the 700 million Lira project. Successful and productive completion of the Bushehr facility has the Western world extremely anxious. All this is at the mere possibility that Iran could produce a nuclear weapon of mass destruction. [5]

This symbolic gesture of Middle East weapons flexing reflects Iran's attitude which seems to threaten Israel the most. With offensive technology capable of delivering a nuclear nightmare to nearby states the region would probably continue to suffer unrest.

In his comment in *The Guardian*, Hans Blix suggests further inspections are pointless, there are better ways to dissuade the Iranians from developing a nuclear bomb and that we should be worried. Mr. Blix further states that the IAEA cannot ignore the possibility that even if Iran says Bushehr is to be used as a dedicated civilian power development site there is no reason it could not be converted into or used for an industrial-scale uranium enrichment program in the future. [6]

4. The nuclear fuel cycle. Relate the cycle to how nuclear weapons are produced.

http://www.fas.org/programs/ssp/nukes/nuclear_power_and_fuel_cycle/index.html

The Nuclear fuel cycle is the process that involves the production of electricity* from uranium in nuclear power reactors. Uranium, a relatively common element that is found throughout the world, is mined in a number of countries and must be processed before it can be used as fuel for a nuclear reactor. Uranium is also a slightly radioactive metal that occurs throughout the Earth's crust. It is about 500 times more abundant than gold and about as common as tin. Electricity is created by using the heat that is generated in a nuclear reactor to produce steam and drive a turbine connected to a generator. Fuel removed from the reactor, after it reached the end of its useful life, can be processed again to produce even more new fuel. [7]

* During the act of creating electricity, some energy or power source has to be used to develop steam to drive turbines or pistons that cause friction that is captured and channeled for the production of electricity. Nuclear fuel is an option that is becoming more economically favorable. However, many environmentalists' sensibilities are offended to think that such a dangerous power source is used simply to heat water, this is also the position of this research team.

Water has an extremely high heat capacity compared to other objects. The heat capacity of an object is the amount of heat required to raise its temperature by 1 Kelvin (or 1 degree Celsius). The heat capacity of an object is called its Specific Heat. The specific heat for pure water is 4.18 Joules/grams per Kilogram compared to the specific heat of iron is 0.45 Joules/grams per Kilogram. This is a comparative example of how much greater the specific heat for water is compared to common iron. [8] The fundamental question of this point being that nuclear energy is a more efficient fuel for heating water.

5. Sciences and technologies involved in nuclear weapons and how these scientific domains and technologies are used.

Nuclear Fusion-

Nuclear energy can be released by the high energy fusion of two light elements. Nuclear fusion is the power that fuels the sun and the stars. In a hydrogen bomb, two isotopes of hydrogen, deuterium and tritium are fused to form a nucleus of helium and a neutron. This fusion releases 17.6 MeV of energy. Unlike nuclear fission, there is no limit on the amount of the fusion that can occur. An example of nuclear fusion can be found at <http://www.atomicarchive.com/Fusion/Fusion1.shtml> This site is made up of five separate pages. The first page of this site shows a nuclear fusion reaction. The second page shows the basics of the hydrogen bomb with the production of tritium from lithium deuteride. The third page describes the shock wave and intensity of a thermonuclear detonation with an example using high energy gamma ray radiation. For extra fun for everyone to enjoy a schematic of The Hydrogen Bomb is shown on page four and explains how the multiple parts and fissionable material interact to produce the most desirable resultant fallout. This archival information culminates with a short explanation of a “small hydrogen bomb” called “The Neutron Bomb.” The Neutron Bomb differs from a conventional hydrogen bomb in that its lethal effect is primarily a display of enhanced-radiation. NATO selected this type of weapon because densely populated areas may be their targets thus reducing the loss of non-combatative civilians and property. [9]

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1. Why did the earliest nuclear powers developed nuclear weapons, (United States and Russia).

In the beginning America, Russia, Japan, and Germany competed to develop nuclear capabilities. The mother of all inventions is necessity and or fear; therefore, just prior to WWII the nuclear arms race began. Serendipitous events propelled America’s success ahead of Germany with Japan’s nuclear program quietly being swept under the radar.

The number of nuclear weapons in the world and the ability of national leaders to prevent the use of them have been massive measures of global security since 1945. Early on, if any country that could develop nuclear weapons did so, but varied influences like economic trade offs, security guarantees from nuclear weapon states, and political factors caused many nuclear capable states to give up nuclear weapon programs and others to not start making nuclear weapons in the first place. [1]

What it comes down to is that nuclear weapons were developed out of fear for national security. After countries discovered the ability to produce nuclear weapons, nuclear weapons became the offensive and defensive deterrent of choice.

The nuclear arms race that developed between Russia and America ultimately led to the start of the Cold War in the early 1960's. It's with the onset of the Cold War that Russia and America started the ultimate Arms Race. This lasted until the fall of the Berlin Wall in 1989.

2. Why did more recent nuclear powers developed these weapons (India and Pakistan).

When it seemed that the Indo-Pakistani military standoff had begun to slow down, tensions have flared up once more. In response the terror attacks (on April and May of 2002) by Pakistan based insurgent groups in Indian controlled Kashmir, India's Vajpayee government has threatened to prosecute a limited conventional war against Pakistan to punish Islamabad for what New Delhi describes as "cross-border terrorism." Pakistan denied culpability in the terror attacks. Pakistan's President, Pervez Musharraf says that his government lends only moral and political support to disaffected Kashmiri militants fighting Indian security forces in Kashmir. New Delhi, however, has threatened to strike militant camps and related infrastructure in Pakistan controlled Kashmir.

Pakistan, in turn, expressed alarm at the threat of war and warned India of a horrid response. In late May, Musharraf threatened that if attacked, Pakistan would take the war into Indian Territory. Pakistan would not hesitate to use its nuclear arsenal in self-defense. To restate this position, Pakistan made a succession of ballistic missile tests in the last week of May. Even though the tests were aimed primarily at a domestic place, they once again highlighted the dangers of a larger conventional war in South Asia and how a war like such could easily take a tragic nuclear turn.

Military tensions that peaked in the last week of May, however, now appeared to be winding down. International pressure has forced Pakistan to back down in the crisis.

3. Why do some nations currently might want to become nuclear weapons powers (Iran and North Korea)?

Some argue that North Korea wants nuclear weapons for the same reason India and Pakistan wanted them, and that is as a deterrent against hostile action from other states. Walter Pincus of *The Washington Post* traces North Korea's initial interest in nuclear weapons to the threats made by United States presidents Harry Truman and Dwight Eisenhower to use nuclear weapons against North Korea during the Korean War. In 1950, when a reporter asked Truman whether he would use atomic bombs at a time when the war was going badly, the president said, "That includes every weapon we have." Three years following that, Eisenhower made a veiled threat, saying he would "remove all restraints in our use of weapons" if the North Korean government did not negotiate in good faith an ending to that bloody war. In 1957, the United States placed nuclear tipped Matador missiles in South Korea, to be followed in later years, under both Republican

and Democratic administrations, by nuclear artillery, most of which was placed within miles of the demilitarized zone.[3]

Iran and North Korea might want to become nuclear weapons powers so they can puff out their chest to make them look bigger. They don't want to feel inferior to the United States and or Russia. So obtaining nuclear weapons will make Iran and or North Korea feel more superior or confident in themselves.

4. Why did some countries decide not to have nuclear weapons?

The conference on Trident, in Edinburgh yesterday, underlined our commitment to make the world a much safer place by getting rid of weapons of mass destruction. The majority opinion in Scotland is opposed to the Trident weapons system that is based on the Clyde. Other countries, including Russia and the U.S., have made significant signals that will help reduce nuclear tensions. Moscow has halted the stationing of missiles around Kaliningrad and President Barack Obama has launched a review of the Pentagon's controversial missile defense shield in Central Europe. [4]

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