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Nuclear Energy, Renewable Energy and Peace

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Nuclear Energy, Renewable Energy and Peace

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1. Introduction

This conference primarily addresses renewable energy and its use in Asia. The widespread use of renewable energy will certainly pave the way to a safe, sustainable energy supply. However, this path will have consequences that go far beyond energy supply, as we quickly realize when we consider the second topic of this conference: peace.

If we want to see how renewable energy and peace are interrelated, we also have to take a look at the alternatives to renewable energy. Many view nuclear energy as the best alternative for a future energy supply. I would like to discuss whether nuclear energy is really the best path, or whether there are other aspects concerning peace issues to consider in addition to mere energy supply.

My study focuses on three issues:

- The direct connection of nuclear energy with military applications
- Nuclear installations and renewable energy installations in the event of war
- Dependency in supplies

I will then summarize the conclusions I draw from these issues.

2. The direct connection of nuclear energy with military applications

Technical background

If a country wants to use nuclear technology, it has to have nuclear materials, installations, and expertise. This applies equally to civilian and military applications.

Nuclear weapons consist of 1) a core of fissile material that releases energy upon ignition and 2) technical equipment needed for processes before and during the ignition of the bomb or warhead.

Generally, two nuclear materials can be used for the core of nuclear weapons:

- Highly enriched uranium (HEU) and

- Plutonium (Pu).

Highly enriched uranium mainly consists of the 93% enriched isotope uranium 235, the rest being mostly uranium 238. Some 20 to 25 kg of highly enriched uranium are needed to make one atomic bomb. This HEU is used to operate research reactors in many countries and is also used directly for military purposes.

HEU is easier to handle as a fission material for weapons than plutonium, with more simple ignition mechanism – and hence more simpler design of the entire bomb. The radiation is lower during handling than in the case of plutonium.

Enriched uranium is made in enrichment facilities; the physical principles they are based on vary. But regardless of which principle is applied, relatively simple changes to the equipment and operation can make any enrichment facility for reactor uranium (3-5% U-235) into a production plant for military applications (93% U-235). Therefore, enrichment plants are very sensitive facilities.

Plutonium consists of a mixture of mainly the isotopes Pu-239, Pu-240, and Pu-241, it contains also lower amounts of Pu-238 and Pu-242. The specific composition of the isotope mixture varies according to the operating history of the reactor in which the plutonium was created. Those reactors can be power reactors or research reactors. For nuclear weapons, caused by nuclear physics, a share of Pu-239 as high as possible is the most convenient. However, it has been demonstrated that all usual mixtures of plutonium isotopes can be used in nuclear weapons. The only drawback is that other mixtures make the equipment more complicated. Several kg of plutonium are required for one nuclear weapon.

The amount of uranium or plutonium needed to make weapons is thus much smaller than the amount needed to operate a reactor. The cores of power reactors contain several tons of the nuclear fuel; the cores of research reactors often contain several dozen to hundreds of kg of nuclear fuel. A comparison of these figures clearly shows that only a small part of the material used in research or power plants is needed to make nuclear weapons. Large amounts of fissile material are only needed if a country wants to have a great number of atomic bombs.

Many countries have nuclear facilities today. Some of them are research and laboratory facilities, in which nuclear material can be handled in a great variety of ways. If a country has nuclear energy facilities, it can also use them to make weapons.

Plutonium can be made in research or power reactors and separated for use as military or civilian fissile material. Reactors whose fuel assemblies can be exchanged during operation offer special advantages as the composition of the isotopes can be controlled very exactly in the plutonium mixture created.

Plutonium can be separated in facilities for the chemical treatment of nuclear fuel, be they small laboratory facilities or large reprocessing plants.

Highly enriched uranium can be made in enrichment facilities. Only a few countries operate such complicated facilities on an industrial scale. The key technology underlying the nuclear weapon programmes of South Africa, Brazil, and Iraq was the use of enrichment facilities to make the fissile material for nuclear weapons.

Many countries have the technical expertise in nuclear technology today. Numerous scientific and technical issues are closely related between military and civilian applications. For instance:

- Expertise in handling nuclear fissile material and nuclear materials,
- Calculation of fission processes,
- Handling of neutron sources.

The operation of a civilian nuclear energy programme requires a great number of experts. Many of these experts will also have expertise in the fields mentioned. They could thus use this knowledge to take part in the development of nuclear weapons. Even in a country that just has nuclear research programmes, the experts involved have knowledge that can be used for both civilian and military purposes.

History

Nuclear energy was born of nuclear bombs, which were first dropped exactly 59 years ago. A decade after these first bombs were dropped, the development of civilian applications was stepped up. Back then, any country that aimed to develop nuclear energy was basically thought to be pursuing both military and civilian applications. A number of countries that nowadays are only thought of in connection with civilian nuclear energy (such as Switzerland and Sweden) also conducted research in preparation for military applications in the 1950s and 1960s.

This did not change until the Non-Proliferation Treaty (NPT) was signed, dividing since 1970 the world into ‘nuclear weapon states’ and ‘non-nuclear-weapon states’. For many years, this treaty limited the number of official nuclear powers. Nevertheless, the situation remained life-threatening for many people all over the world. I come from a

country that was divided until 1990. Many nuclear weapons were stationed on both sides of the border. In the event of war, they would have been used on our territory.

In the 1990s, people all over the world realized that some countries not included in the five designated nuclear powers had also developed nuclear weapons – or were trying to. In the 1970s and 1980s, South Africa developed the technology for nuclear weapons and ultimately built several such weapons, which were dismantled after the end of apartheid during the ensuing political changes. Brazil ended its research and development on nuclear armament after a political change. In Asia, India and Pakistan have announced that they have nuclear weapons, proved by the test explosions in May 1998. Israel has also has nuclear weapons, though it does not formally confirm this fact. Iraq was also developing nuclear weapons before 1991. The development was stopped due to the international situation, at least there is no evidence that this development continued.

The current situation

Today, being a signatory of the Non-Proliferation Treaty is of limited import in political disputes. Two factors are more decisive for the political actions of other states: Do they consider that

- the state in question is capable of developing nuclear weapons based on its knowledge of nuclear technology?
- it is willing to do so?

A few examples from Asia:

- In dealing with Iran, western countries are led since several years by the suspicion that the country's civilian use of nuclear energy is actually driven by military intentions. For several years, Iran is being completing its civilian power reactors after work on them was interrupted in the political upheaval in 1979. Iran also aims to establish an enrichment facility for its civilian programme. This intent has repeatedly created tension in world politics due to the sensitivity of enrichment. Opinions vary as to whether the Iranian programme actually serves military purposes. Whatever the case, the plans in Iran are a constant bone of contention in international relations.
- For many years, people everywhere assumed that the nuclear programmes in India and Pakistan primarily aimed to provide electricity. Nonetheless, several countries seemed to fear military use of these programmes. In the 1970s and 1980s, American and Canadian companies therefore abandoned their technical support for

these programmes in both countries. In the end, the demonstrative tests of atomic bombs in both countries confirmed everyone's worst fears: the civilian programmes are also being used for military purposes.

- Public perception of the situation leading up to the last Iraq war depended greatly on the potential military use of nuclear energy. An analysis of the issue not only has to take into consideration whether Iraq was actually working to make nuclear weapons – of which there is no proof to this day. Rather, what is important is that the mere suspicion led to the political dynamics that provided the justification for consent to the war in the US and several other countries.
- The discussions about North Korea's nuclear programme and its announced military use have repeatedly led to great tension. It is dealt with this matter in greater detail elsewhere in this conference, so I will not deal with this issue any further here.

Consequences

In the final analysis, the purely civilian use of nuclear energy plainly cannot be separated from military use in international relations between states. There are a number of consequences:

- Every state that has nuclear energy also has the potential to use it militarily. At any point now or later, unless it is prevented from doing so by other states, a state can decide to use nuclear energy militarily.
- Every state that has nuclear energy can be accused of secretly working to use it for military purposes.
- The use of nuclear energy thus increases the potential for tension between states.
- Such tension can worsen international relations, lead to destabilization, and – in extreme cases – even lead to armed conflicts.

Comparison with renewable energy

Renewable energy does not suffer from any usefulness for direct military applications the way nuclear energy does. No type of renewable energy can be used as a weapon of mass destruction. This is one essential difference between these two energy sources.

Of course, like any other energy source, renewable energy can also be used in military operations. In this respect, there is no difference.

3. Nuclear installations and renewable energy installations in the event of war

Nuclear facilities play a role in armed conflict and can hardly be kept immune from such conflict. Various scenarios can be imagined:

- The nuclear facility (such as a nuclear power plant) supplies power to the opposing state. There is thus a need to put it out of operation. Disenabling the enemy's crucial central energy supply units is a common military tactic. If the central power plant is just a conventional thermal power plant, the only result would be a power outage.

  This is not so with nuclear power plants. In all probability, the destruction of a nuclear plant would release the radioactive material in the plant, for instance when the reactor or the fuel assembly storage is directly hit. Even if this is not the case, it is very probable that radiation will be released indirectly. After all, nuclear power plants require a feed of cooling water and electric power to maintain a safe operating status. If a military attack greatly damages these systems, a core meltdown will occur, releasing large amounts of radioactive matter.

  In the conflicts after the collapse of the former Yugoslavia, the Yugoslavian army openly threatened to attack the nuclear power plant in the Slovenian town of Krsko, the main power generator in Slovenia.

- Nuclear facilities (research facilities, research reactors, etc.) play a role in the enemy's (assumed) nuclear armament. Here, the military goal can be to destroy such facilities as quickly as possible to ensure that the enemy cannot develop military applications.

  Examples of this can be found in the history of Iraq over the past 25 years, for instance, beginning with a bombing attack to an Iraqian research reactor by unidentified aircrafts (assumed Israelian).

- Nuclear facilities can also be accidentally attacked or their media feeds (electricity and cooling water) destroyed. In armed conflicts, this scenario is not improbable. Such "unplanned" safety disturbances can release large amounts of radioactive material from the nuclear facility. In such cases, it does not help if the combatants agree not to directly attack a nuclear facility.

- Nuclear facilities can be used as stationary "dirty bombs". The destruction of nuclear facilities and their media feeds can release tremendous amounts of radiation. In armed conflicts, large areas can thus be intentionally contaminated with radiation. Depending on the direction of the wind, the intention might be to

contaminate the enemy's land or to practice a scorched-earth policy in the area around the nuclear facility.

In scenarios produced in the 1970s and 1980s, such issues were discussed for the divided Germany as many of our nuclear facilities are near the former border between the two Germanies.

- Under the current international conditions, there is a real risk that non-governmental and terrorist organizations might resort to one or more of the aforementioned scenarios.

If the potential of renewable energy is compared to the various scenarios studied for nuclear energy, the outcome is very different:

- Most applications for renewable energy and distributed or, if central, in smaller units relative to the overall energy demand. It thus makes little sense to attack one single renewable energy unit as the loss would not detrimentally affect the enemy's power supply. In other words, most renewable energy units are not valuable as military targets.
- One exception is the large storage dams that provide hydropower. Here, the destruction of the dam could cause a tremendous flood wave, causing considerable damage downstream. In addition, the hydropower plant would be out of commission for a long period.

  In the Second World War, for instance, storage dams were destroyed for military purposes.
- An accidental attack on a renewable energy unit would destroy it. No other effects in the direct surroundings can be expected aside from possible fires and debris impacts. Again, large hydropower dams are the exception; the damage from a flood wave would be considerable.
- As renewable energy systems do not contain large amounts of contaminants, attacking them to release such contaminants would not make military sense.

4. Dependency in supplies

Energy use often entails a dependency on other countries. Dependency can occur with respect to raw energy sources that can only be provided, or only in sufficient quantities, from other countries, or with respect to the technical plant equipment made in other countries.

Energy dependency can be used to put pressure on countries. In the worst case, the economic development of a country can be severely damaged if its energy supply is hampered. These dependencies can lead to conflicts, possibly even armed combat in the worst-case scenario.

The profile of dependency differs from one type of energy use to another.

Dependencies in nuclear technology

Most countries are critically dependent on imports for supplies of nuclear fuel. There are two bottlenecks:

- The first is in the extraction of uranium ore and "raw uranium" (yellow cake). The natural deposits are not at all equally distributed across the globe. In addition, only a few corporations that operate mines in a number of countries divide up the market between themselves.
- The second bottleneck concerns enrichment. Light-water reactors – the most common kind worldwide – require 3-5 % enriched uranium as fuel. Countries with nuclear weapons have the most enrichment capacity. The only exceptions are in the European Union and Japan. Other countries that wish to set up or have already set up their own enrichment capacity either have also tried to use this capacity for military purposes (South Africa, Brazil) or are immediately accused today of wanting to do so (Iran).

Heavy-water reactors can also run on uranium that has not been enriched. Thus, countries with such reactors are less dependent on imports of uranium as they can use their own supplies or buy uranium more easily elsewhere as it does not need to be enriched. However, countries that operate heavy-water reactors sooner or later run the risk of being suspected of wanting to use this technology to produce weapons-grade plutonium. Other countries can then be expected to impose sanctions or apply pressure.

What goes for the supply of nuclear fuel also goes for the supply of parts for nuclear power plants. Here, a large number of highly specialized components are necessary, and they are usually only made in leading industrialized countries. Hence, countries that use nuclear energy are automatically dependent on these industrialized countries.

In future developments of international relations, it is always possible that supplies of nuclear fuel and reactor components might be instrumentalized in conflicts. Only time

will tell to what extent this will lead to situations that endanger peace between countries.

Dependencies with renewable energy

Dependencies on supplies of raw energy sources and equipment also play a role with renewable energy.

Enough energy resources are generally available in all countries for solar power, windpower and biomass. Other countries cannot truly influence their availability. With hydropower, the situation is different, at least when large rivers are used. Under certain geographic conditions, conflicts can occur with countries upstream and downstream as a storage dam that generates electricity depends on a sufficient supply of water upstream, and simultaneously – and often negatively – affects the flow of water downstream.

Renewable energy systems are often not so demanding as to entail long-term dependency on a few supplier countries. Here, photovoltaics is an exception as the production of the basic materials used is concentrated in a few areas.

5. Conclusion

One main difference between the use of nuclear energy and renewable energy is the direct connection of nuclear energy with the military use of weapons of mass destruction. Because there can be no strict separation in international relations between purely civilian use and military use of nuclear energy, the use of nuclear energy increases the potential for tension between countries. Such tension can worsen international relations, lead to destabilization, and – in extreme cases – even lead to armed conflicts.

In contrast, renewable energy is not directly useful for weapons of mass destruction.

The comparison of nuclear facilities and renewable facilities in the event of war shows that intentional or unintentional military impacts on nuclear facilities could release massive amounts of radioactive material, while renewable facilities do not pose such a danger.

The dependencies on the supply of nuclear fuel and nuclear facility components play an especially large role in the use of nuclear energy. They, too, can lead to tension in various ways, possibly even to situations that endanger peace. In contrast, the dependencies with most forms of renewable energy are very much smaller.

Overall, the comparison of nuclear energy with renewable energy shows that nuclear energy's technical and military linkages lead to situations that can increase tension between countries, thus endangering peace. With a few rare exceptions, there are no such problems with renewable energy.

I would therefore like to encourage you to step up the promotion of renewable energy, as this clearly promotes peace in many parts of the world.