MULTILATERALIZING THE NUCLEAR FUEL CYCLE: A NEW UNIVERSAL INTERNATIONAL REGIME TO STRENGTHEN NON-PROLIFERATION

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ABSTRACT

The risk of proliferation of nuclear weapons is closely associated with the risk of sensitive technologies proliferation. Due to anticipated nuclear renaissance the threat of sensitive technologies proliferation is of current importance. A new approach has to be found to prevent the spread but at the same time to fulfill the provisions of Article 4 of the Nonproliferation Treaty since compliance with the Treaty is essential to keep the nonproliferation regime stable.

The concept of multilateral nuclear fuel cycle is a response to this challenge. A number of proposals on its practical implementation have been made in recent years; mostly they are uncoordinated and not systemized. For the proposed arrangements to be effective they have to be universal, that is, engage all countries; otherwise they will fail to meet their goal that is to prevent the spread of sensitive technologies.

In the thesis I am addressing the question of whether states would join an arrangement yet even more restrictive than the non-proliferation regime at the beginning was. For this purpose I analyze and classify proposals by five specially invented criteria. On the basis of the analysis a new regulatory regime is introduced that combines elements of compatible proposals into a unified structure. To define whether countries would join the regime I apply two-level game theory. As a result, it was found that generally countries would join the arrangements and, though in some cases the process would be heavily hampered, the universal character of the arrangements is achievable.

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INTRODUCTION

Nuclear non-proliferation issues used to be mostly connected with control over nuclear materials and preventing their spread. Now the focus has shifted to the threat of proliferation of sensitive technologies. This is due to the highly anticipated nuclear renaissance when increasingly more countries have decided to construct an indigenous nuclear fuel cycle to obtain nuclear energy or to increase the capacities they have. There are two reasons for this. First, the existing energy supply is not sufficient to cover power consumption which is due to the increasing rate of economic growth. The growth of China and India, along with other rapidly developing economies has virtually depleted the existing sources of energy, especially hydrocarbons, whose share in the global balance now stands at 80 percent. Total power consumption has increased by almost 95% during the last 35 years (United Nations 2006). Without new sources there are likely to be severe shortages of energy and in some regions perhaps power poverty.

Another reason for increasing interest in nuclear energy is that organic fuel produces the co-called "greenhouse gases" (especially CO2), creating the threat of climate change. Further increase in energy consumption is likely to further exacerbate this situation. In accordance with the Kyoto Protocol[1], 39 industrially developed countries must take measures to restrict or reduce greenhouse gases into the atmosphere emission (United Nations 1998). Achieving this task will hardly be possible without developing alternative sources of energy, especially at the time when energy production must increase. At the moment, at least, solar and wind power does not appear capable of sustaining even the existing demand for power, much less increases required by economic growth. Therefore, large-scale programs of nuclear

[1] *Kyoto Protocol* - is a protocol to the international Framework Convention on Climate Change with the objective of reducing greenhouse gases that cause climate change. It was adopted on 11 December 1997 by the 3rd Conference of the Parties, which was meeting in Kyoto, and it entered into force on 16 February 2005. It is the Global commitment concerning preservation of the environment based on market control mechanisms – "flexible mechanisms", which allow Annex I (developed countries) economies to meet their greenhouse gas emission limitation by purchasing GHG emission reductions from elsewhere. The first commitment period is from January, 1 2008 to December, 31 2012.(United Nations 1998)

power plants (NPP) construction are carried out in the Pacific countries – India, China, Japan and South Korea. Calls to reconsider the earlier negative attitude to the atomic energy and to build new plants can increasingly be heard in Europe (Sweden, Germany and other countries); while Australia, a number of states in Asia and Africa, which have no NPP yet, are planning to develop their own atomic power capability (Nikitin, Andrews and Holt 2010). Realization of these plans will result in the global spread of the technology that might be used for military purposes, that is for the creation of a nuclear weapon. In some cases development of civilian nuclear programs might even serve as a cover for military applications of nuclear power. It poses new challenges for the world community connected with the control over the nuclear materials and technology and verification that it is being used only for peaceful purposes.

To keep the non-proliferation regime stable, it is crucially important for all states to comply with the Non-proliferation Treaty (NPT)[2] and to implement Article 4, according to which non-nuclear states have the right to use nuclear energy for peaceful purposes. "[A]ll the Parties to the Treaty … have the right to participate in the fullest possible exchange of equipment, materials and scientific and technological information for the peaceful uses of nuclear energy" (United Nations 2005). Realization of this provision is essential for the regime existence as it, along with Article 6 of the Treaty, countervails the demand that non-nuclear states do not have, accept or produce nuclear weapons. Without this clause being fulfilled non-nuclear states will not have incentives to stay in and comply with the Treaty and will be free from obligation under Article 2 "not to receive…manufacture or otherwise acquire nuclear weapons or other nuclear explosive devices" which might lead to the wide spread of nuclear weapons (United Nations 2005).

Therefore, it is necessary to fulfil article 4 of the NPT and at the same time to prevent the spread of sensitive technologies. A new approach to implementation of article 4 of the

[2] The Nuclear Nonproliferation Treaty is the multilateral international agreement developed to prevent the spread of nuclear weapons and weapons technology. It was signed in 1968 and came into force in 1970 after the instruments of ratification were deposited.

NPT has to be found so that developing countries could enjoy the benefits of nuclear energy, but simultaneously the risk of proliferation of weapons-related technologies is reduced. A number of proposals have been made in this regard in recent years. The most significant of them are: Global nuclear energy partnership (GNEP), Ensuring Security of Supply in the International Nuclear Fuel Cycle (WNA), six-party proposal (RANF), Japanese proposal on transparency, Nuclear Threat Initiative (NTI), Enrichment Bonds (UK), International Uranium Enrichment Centre (Russia), Multilateral Enrichment Sanctuary Project (Germany) and Multilateralisation of the Nuclear Fuel Cycle (Austria). Generally these are endeavours of different countries to implement the concept of the multilateral nuclear fuel cycle; they are uncoordinated and not systemized, some of them are overlapping and contradict to each other. Therefore implementation of the proposals is hampered.

Most of the research done in the area is focused on the assessment of the existing proposals and their comparison. Some authors attempt to improve the proposals in order to resolve possibly more issues connected to nuclear non-proliferation, while the most important question has been disregarded. To be effective in prevention of sensitive technologies proliferation, most of the proposals require states to forgo development of their indigenous nuclear infrastructure as a condition for joining an arrangement. The only way these proposals might be successful is if all the countries deliberately join them, because otherwise they will fail to meet their goal that is to prevent the spread of sensitive technologies. Therefore, it is very important to define whether states would join an arrangement yet even more restrictive then the non-proliferation regime at the beginning was.

In order to answer this question in this thesis I first analyze the proposals and classify existing proposals by five specially invented criteria. These are sufficiency, realizability, sphere of action, compatibility and effectiveness. On the basis of the analysis I then propose a model of possible realization of the concept of multilateral nuclear fuel cycle, which would

resolve the problem of proliferation of sensitive technologies. This regime is to be realized within the nuclear non-proliferation regime framework. To determine whether countries would be willing to join the regime I divide countries into three categories; these are suppliers (nuclear states and states with developed nuclear fuel cycle), customers (states with limited access to nuclear energy or without any) and problematic states (*de facto* nuclear states). To define whether it is plausible to achieve all countries' consent to join the regime I analyze countries, one from each group, on the likelihood of their participation applying two-level game theory. This theory allows to treat states not as unitary actors but as those which have influential constituents. It helps to determine whether a state would join the regime by defining what interest groups are within the state and how they impact the win set the head of the states has when on the international level. Knowing what interests are present within a country and how influential they are, external incentives to persuade states to join the regime might be found. Thus, using the two-level game theory I analyze the proposed regime and conclude whether states are likely to join the regime and what possibly needs to be done to incline those which initially are not that enthusiastic to be a part of the regime.

CHAPTER 1. PROPOSALS' OVERVIEW

The concept of an international fuel bank is not new – it goes back to the 1946 Baruch Plan, when the United States proposed that all countries should transfer oversight of nuclear materials and activities to a specially established international agency on nuclear energy (UxC 2008). This plan failed because it was not consistent with the post World War II political realities. Yet, the aspect of that plan, which was intended to provide assured supply of nuclear fuel from an impartial source – and an international organization – deserves attention. Half of a century since being first announced the idea of "Nuclear fuel bank" that would reduce the incentives for countries seeking to develop civilian nuclear applications was reintroduced and had been significantly developed since the 2004 G8 Summit in Sea Island (Georgia), where the Iranian nuclear program was one of the central issues under discussion (Holmes 2004).

A large number of proposals on multilateral nuclear fuel cycles and/or international fuel bank have emerged since then, many of them on fuel supply assurances. The presumptions underlying the proposals are threefold:

- Indigenous uranium enrichment capabilities are proliferation-sensitive and can be misused;
- It is possible to make alternative fuel supplies to states with civilian nuclear programs sufficiently attractive economically to induce them to forego indigenous enrichment capacity;
- Risks that stem from dependence on external supply of fuel can be mitigated if states have alternative source of fuel in case the main supplier cancels delivery for one or the other reason.

Among the proposals, several are particularly important, such as Global Nuclear Power Infrastructure, Global Nuclear Energy Partnership, Nuclear Threat Initiative,

International Uranium Enrichment Centre and Multilateral Enrichment Sanctuary Project, and further I will discuss them in details.

1.1 Reserve of nuclear fuel

The United States' representatives announced in Vienna in September 2005, at the 49th regular session of the General Conference of the IAEA, that it would allocate up to 17 metric tonnes of high enriched uranium (HEU) "from materials previously declared excess to national security needs" to be down-blended to LEU "to support assurance of reliable fuel supplies for states that forego enrichment and reprocessing" (IAEA 2005, News of politics 2006). A contract for this down-blending was signed in June 2007 between the US Department of Energy and a commercial company. Currently, the process is underway and going to be completed in 2010 (United Nations 2008).

As Dennis Spurgeon, US Assistant Secretary for Nuclear Energy, said at the IAEA Special Event on Assurances of Nuclear Supply and Non-proliferation in September 2006, the LEU stock formed of material produced of down-blended weapon grade uranium could contribute to the effort of establishment of reserves controlled by the IAEA (Meier 2006). However, there is an obstacle to this. Gregory Schulte, the US ambassador to the IAEA, pointed out that due to the US law this LEU reserve would have to be kept under national control because it is required by the US legislature that this kind of materials is under national control. According to the Atomic Energy Act, US-origin material is strictly regulated, and this "may limit the attractiveness of that material for some states". This was confirmed by Schulte who said that "for some countries, that will provide reassurance, but for others, perhaps it won't". Indeed, past experience shows that some consumer countries had difficulties with "transfer and use of US-origin nuclear materials" because of necessity of getting US consent. Therefore, if the LEU reserve "would be under the standard requirements on US-origin

material, it would make a limited contribution, if any, into the creation of a new mechanism to ensure supplies of nuclear fuel" (Yudin 2009).

1.2 Global Nuclear Power Infrastructure

In January 2006, while on a meeting of the Council of the Eurasian Economic Union, Vladimir Putin, President of the Russian Federation, outlined an initiative to establish "a global infrastructure that will give all interested countries equal access to nuclear energy, while stressing reliable compliance with the requirements of the non-proliferation regime", including "the creation of a system of international centres providing uranium enrichment services, including enrichment, on a non-discriminatory basis and under the control of the IAEA" (IAEA 2006a).

Earlier that month Sergei Kiriyenko, head of Russia's State Atomic Energy Corporation "Rosatom", introduced the idea of Russia to be hosting four types of international centres providing nuclear fuel cycle services:

- the first is an International Uranium Enrichment Centre (IUEC). Kiriyenko underlined that the only IUEC would not be sufficient to meat the demand and that besides the IUEC on the Russian territory "from three to five such centres should be present in major regions around the world";
- the second centre would be dealing with spent nuclear fuel reprocessing and storage issues. Creation of such international centres as Russian IUEC raise a whole number of issues regarding storage and reprocessing of the spent fuel originated from these centres. By far spent fuel normally is returned to and has to be handled on the territory and facilities of the country of its origin. In case of IUECs the origin of the fuel is questionable and, therefore, the place of storage and reprocessing of spent fuel becomes ambiguous. International centres for reprocessing and storage, which would

handle spent fuel initially produced by IUECs, would be a good solution. Creation of such centres, as was noted by the head of Rosatom, would require implementation of new technologies to increase the extract of useful materials and possibly minimize the amount of radioactive waste;

- the third would be a centre for "training and certification of personnel, especially for emerging nuclear states". As Kiriyenko noted, personnel training is "one of the most important issues as far as safety is concerned". Common harmonized international standards have to be introduced on every nuclear facility in the world; and while the IAEA is developing the standards to be implemented, joint international centres would educate professionals how to put these standards into practice and stick to them; and
- the fourth centre "would be for research and development on new nuclear energy technologies and for integration of new scientific achievements" (Yudin 2009).

The Global nuclear initiative aims at the creation of centres which would provide all countries with equal access to nuclear services and at the same time secure sensitive technologies from proliferation as it presupposes the sensitive steps of fuel production and reprocessing to be cantered in a limited number of international centres. Primarily, the GNPI offers customer states the front-end services, although there is no shortage of these services on the market. However, it suggests the establishment of international centres for back-end services as well, even though this part of the proposal is more ambiguous. Thereby, the GNPI would provide enrichment services, which is its primary objective, and services of spent fuel storage and reprocessing.

Having back-end services offered along with secured fuel supply services, the GNPI is sure going to be tempting for consumer countries to join. The details of this initiative are yet to be defined, but "Russia already has legislation in place to offer fuel leasing and has such a contract in place with Iran" (Yudin 2009).

Russian initiative on Global nuclear power infrastructure, which "would provide equal access to nuclear power on market terms for all countries under regulation and standards of non-proliferation", could be a good solution for the problem of the spread of nuclear technologies accompanied by the threat of nuclear energy being used for military purposes, that is for creation of nuclear weapon.

1.3 Global Nuclear Energy Partnership (GNEP)

Global Nuclear Energy Partnership was first proposed by the United States in February 2006, when US Secretary of Energy Samuel Bodman announced the initiative which would pursue four basic ends: the first is to reduce dependence of the United States on import of fossil fuel and to stimulate economic growth; the second goal is nuclear fuel reprocessing by means of new, proliferation-resistant technologies to maximize the effective use of nuclear materials and to reduce waste; the third purpose is to contribute to global economic growth and environmental protection; and the fourth goal is to apply new technology to reduce nuclear proliferation risk (Yudin 2009, U.S. Department of Energy 2007).

GNEP has two – domestic and international - components. In its domestic dimension, GNEP focuses on the future of nuclear energy in the United States. It deals with the problems which have been there for a long time and need to be resolved (Yudin 2009). No new reactors have been built in the United States since 1978 (NTI 2009a). Due to the materials deterioration, nuclear power plants have limited service life. It varies for different types of reactors but is in the range of twenty-five to thirty years. Service life of the US nuclear installations has already been prolonged once and soon they will have to be shut down. To satisfy country's energy needs, these reactors should be substituted. Due to constantly rising price for hydrocarbon sources of energy - oil and natural gas – and climate change related concerns the idea to substitute existing nuclear power plants with those working on

hydrocarbon fuel becomes very unattractive. Therefore, interest of United States in nuclear power has been renewed and increased and decision to build new instillations has been made.

This immediately raises two problems. One of them is what kind of reactors to build and another one is what to do with the spent fuel stored up till now and that will have to be stored in the future. GNEP addresses both of these problems by presupposing the development of reactors of new proliferation-resistant type and dealing with issues related to the spent nuclear fuel disposal and reprocessing.

In the international dimension GNEP is "cooperation of those States that share the common vision of the necessity of the expansion of nuclear energy for peaceful purposes worldwide in a safe and secure manner" (GNEP 2010). "Under GNEP, a consortium of nations with advanced nuclear technologies would ensure that countries who agree to forgo their own enrichment and reprocessing technologies will have reliable access to nuclear fuel" (IAEA 2007d). The cooperation is supposed to be realized within the framework of "existing and, where appropriate, new bilateral arrangements as well as existing multilateral arrangements such as the Generation IV international Forum and the International Project on Innovative Nuclear Reactors and Fuel Cycles". The objective of the initiative is accelerated "development and deployment of advanced fuel cycle technologies to encourage clean development and prosperity worldwide, improve the environment, and reduce the risk of nuclear proliferation" (GNEP 2010). The GNEP strategy includes seven elements, and one of them is the establishment of "a fuel services programme to enable nations to acquire nuclear energy economically while minimizing risk of nuclear proliferation". Along with that it suggests to improve nuclear safeguards in order to enhance the proliferation-resistance and safety of expanded nuclear energy (U.S. Department of Energy 2007).

On September, 16 2007 heads of Atomic Department of 16 countries, including France, China, Russia, Australia, Kazakhstan and Ukraine signed the Global Nuclear Energy

Partnership Declaration in IAEA head office in Vienna (News of politics 2006). According to the GNEP official web page (2010), to date

> "the partnership consists of twenty-five (25) partners, three (3) permanent international nongovernment observers; and a 31 observer countries. The partners are: Armenia, Australia, Bulgaria, Canada, China, Estonia, France, Ghana, Hungary, Italy, Japan, Jordan, Kenya, Kazakhstan, Republic of Korea, Lithuania, Mongolia, Morocco, Oman, Poland, Romania, the Russian Federation, Senegal, Slovenia, Uganda, Ukraine, United Kingdom and the United States. The three permanent international nongovernment observers are: the International Atomic Agency, the Generation IV International Forum and Euratom".

The Partnership is functioning according to the Statement of Principles as its policy framework. To become a partner of the GNEP a country has first to be invited by already existing partners; it also has to affirm and sign the GNEP Statement of Principles. Once countries have been invited to the Partnership they have an access to "meetings as Candidate Partners to better understand the partnership" and decide on whether they willing to join (GNEP 2010).

The Partnership has a three-level organization. The direction of the Partnership development on the high-level is defined by "the GNEP Executive Committee comprised of Ministerial-level officials." The decisions of the Executive Committee are fulfilled by the Steering Group, "whose members are designated by the Executive Committee." At the meeting of the Executive Committee in September 2007 "two working groups were established to address matters concerning reliable nuclear fuel services and infrastructure development" (GNEP 2010).

On October 1, 2008, at the meeting of the GNEP Executive Committee in France, a necessity for the GNEP transformation "to provide a broader scope with wider participation" has been recognized and the Steering Group Chair reported on Partnership's readiness to cooperate with "external entities, including industry and academic institutions" (GNEP 2010). Revision of the GNEP operational structure in order to adjust it to a new cooperation approach was assigned to the Steering Group; its finalized proposal is supposed to be

submitted to the Executive Committee by April 2010. While the details of the GNEP realization including its future operational structure is not clear, the important aspect of the proposal is that "industry, universities and other external entities" are to be deeply engaged. When a precise procedure of countries engagement and operating system/organization is established, the GNEP could prospectively become a universal proposal enveloping other initiatives.

1.4 Ensuring Security of Supply in the International Nuclear Fuel Cycle

This proposal was made by the World Nuclear Association (WNA) back in May 2006. A working group, including representatives of the four principal enrichment companies, proposed a three-level mechanism to assure enrichment services: (1) basic supply security provided by the existing world market; (2) collective guarantees by enrichers supported by governmental and IAEA commitments; and (3) government stocks of enriched uranium product (IAEA 2007d).

1.5 Concept for a Multilateral Mechanism for Reliable Access to Nuclear Fuel

Concept for a Multilateral Mechanism for Reliable Access to Nuclear Fuel (RANF) was proposed by the six enrichment services supplier states in June 2006 (IAEA 2006b). France, the Federal Republic of Germany, the Netherlands, Russian Federation, United Kingdom and United States of America proposed essentially two levels of enrichment assurance beyond the normally operating market. At the "basic assurances" level suppliers of enriched uranium would agree to substitute for each other to cover certain supply interruptions to customers in States that had "chosen to obtain supplies on the international market and not to pursue sensitive fuel cycle activities". At the "reserves" level, participating

governments could provide physical or virtual reserves of LEU that would be made available if the "basic assurances" were to fail (IAEA 2007d).

1.6 IAEA Standby Arrangements System for the Assurance of Nuclear Fuel Supply

In September 2006 Japan proposed IAEA Standby Arrangements System for the Assurance of Nuclear Fuel Supply (IAEA 2006c). The proposal is a complementary one to the concept of reliable access to nuclear fuel as proposed by the six countries. Japan proposed an information system to help prevent interruptions in nuclear fuel supplies. The system, which will be managed by the IAEA, would disseminate information, which is voluntarily supplied by Member States, on their national capacities for uranium ore, uranium reserves, uranium conversion, uranium enrichment and fuel fabrication, as well as the availability of these services (UxC 2008). Three levels of availability are suggested in the proposal:

- Level 1 – a capacity has already stated commercial activities, but is limited to domestic services. Therefore the quantity of uranium or fuel that state can supply may be limited and the beginning of supply will require considerable lead time.
- Level 2 – the country exports products/services to foreign countries on commercial basis. Therefore, response to emergency request for supply it can respond quickly within the range of available capacity.
- Level 3 – existing capacity has reserves that can be exported at a short-term notice.

For the purpose of assuring supply it is also suggested to add spare enrichment capacity of domestic producers to the six-supplier capacity. According to this proposal, states collaboration is based on their voluntary declaration of their existing unused capacity. The proposal incorporates a certain level of uncertainty because it heavily relies on voluntary contribution and the readiness of states to step in the case another fuel-producing state interrupts supply.

1.7 The Nuclear Threat Initiative

In September 2006 Nuclear Threat Initiative3 (NTI) launched private initiative by Ted Turner and former U.S. senator Sam Nunn. NTI offered to contribute $50 million to the IAEA to help create an LEU stockpile owned and managed by the Agency that could be made available to interested states should usual fuel supply arrangements be disrupted.

"The offer is contingent on the following two conditions being met within two years from when the offer was made: (1) that the Agency takes the necessary actions to approve the establishment of the reserve; and (2) that one or more Member States contribute an additional $100 million in funding or an equivalent value of LEU. Every other element of the arrangement — the structure, its location, the conditions for access — would be up to the Agency and the Member States to decide" (IAEA 2007d). "One option under discussion includes a stockpile of 50-60 MT of 4.9% enriched LEU in the form of UF6, either enriched from natural uranium or downblended HEU, located in one of the countries outside the major supplier states with existing nuclear infrastructure and a good non-proliferation, safety and security record." Possible candidates include Kazakhstan, Switzerland, Sweden, and South Africa. U.S. Congress has appropriated $50 million to contribute to the IAEA for the LEU stockpile. In February 2008 Norway made a $5 million contribution and $10 million more were assigned by United Arab Emirates in August 2008. In March 2009, with Kuwait's contribution of $10 million the NTI matching requirement was met (NTI 2009b).

The NTI is a funding proposal and none of the details regarding Nuclear Fuel Bank arrangement have ever been worked out (NTI 2009b). Therefore, now, when all the requirements are met, all elements of the proposal, including in particular, a concept of how

[3] The Nuclear Threat Initiative – NTI – is a non-profit organization with a mission to strengthen global security by reducing the risk of use and preventing the spread of nuclear, biological and chemical weapons, and to work to build the trust, transparency and security which are preconditions to the ultimate fulfillment of the Non-Proliferation Treaty's goals and ambitions (NTI 2009a).

exactly the reserve will be operated and how it will be replenished once it has been used have to be thoroughly thought through before the initiative is on the stage of implementation.

1.8 Enrichment Bonds

The proposal was made by the United Kingdom. This is a "'bonding' principle that would, in the event that the Agency determines that specified conditions have been met: (1) guarantee that national enrichment providers would not be prevented from supplying enrichment services; and (2) provide prior consent for export assurances" (IAEA 2007d). This proposal is meant to be a path for implementation of the RANF proposal; it outlines a way that enables countries in need of nuclear fuel to participate through existing enrichment providers (UxC 2008). The implementation of the proposal would require "an agreement between supplier states, the recipient states, and the IAEA, in which the supplier government would guarantee that, subject to compliance with international law and to meeting the non-proliferation commitments to be assessed by the IAEA, national enrichment providers will not be prevented from supplying the recipient state with enrichment services in the event that the guarantee is invoked" (IAEA 2007e). Germany and the Netherlands are cooperating with the UK in the development of the enrichment bonds concept.

1.9 International Uranium Enrichment Centre

The International Uranium Enrichment Centre (the IUEC) is an initiative of Russian Federation made in 2007 (IAEA 2007a). This is a first step in creation of Global Nuclear Infrastructure. The Centre was established on the basis of Angarsk Electrolysis Chemical Complex, Angarsk, which is approximately 5,000km east from Moscow (Yudin 2009). In total 4 projects have been realized on a basis of Angarsk enterprise and the IUEC and the LEU stockpile are two the most significant of them from the non-proliferation point of view.

The IUEC is "to provide guaranteed access to uranium enrichment capabilities to the Centre's participating organizations" (IAEA 2007a). Initially, the idea was developed as solution to the Iranian crisis. It was aimed at creation of an incentive for Iran to forego indigenous enrichment capacity. Worth mentioning that after rather lengthy negotiations, Iran, nevertheless, refused to join the uranium enrichment centre, but the project continues without it. The IUEC is a commercial venture with a clear marketing focus. Being founded as all open joint-stock company, it is open for other countries organizations without any political conditions (UxC 2008). The IUEC operates on the basis of five fundamental principles. These are:

- "equal and non-discriminatory membership;
- guaranteed access to uranium enrichment services for IUEC participant states;
- transparency of IUEC activities guaranteed by placement of its nuclear materials under IAEA safeguards;
- the IUEC would be a "black box", as participant states would not have access to Russian enrichment technologies;
- political and economic advantages from membership in the IUEC would discourage its participant states from developing indigenous enrichment technologies" (Yudin 2009).

The commercial model of the Centre has two levels. The upper level is intergovernmental agreement, which determines the rights and obligations of the centre countries-parties, and the lower level is a joint enterprise specially established by the parties; the uranium enrichment services consumers are supposed to rule the centre and take part in determination of its market strategy and profit distribution through the mentioned enterprise (Interfax-Ukraine 2007).

The way the Centre was established, Russia's share in the enterprise can not be less than 51% and the interest of other participants is approximately equal to 10% each (UxC 2008). "On 10 May 2007 the first agreement in the framework of the IUEC was signed by the Russian Federation and the Republic of Kazakhstan" (IAEA 2007d). There are no political conditions for joining the IUEC and so far, Armenia has become a partner and Ukraine has expressed an interest and might join the centre in the future.

The fact that participation in this initiative is not stipulated by political conditions is an advantage. This makes the joining process much easier and brings to the front benefits of the cooperation not shadowing them with the necessity to scarify with any of sovereign rights. Therefore, absence of political conditions for joining the Centre sure makes the IUEC very attractive to prospective partners. However, from the other side, this means that nothing prevents partners of the IUEC from developing indigenous uranium enrichment capabilities on their own territory. This undermines the idea of the IUEC as an endeavour aimed at decrease of a threat of nuclear proliferation. Therefore, though the IUEC is a good incentive for countries to forgo the development of full nuclear fuel cycle (including steps of uranium enrichment) on their territory, its contribution into prevention of a spread of sensitive technologies and strengthening of the non-proliferation regime is quit limited, because it leaves a room for countries been developing indigenous nuclear infrastructure while being a partner of the Centre.

The second proposal under realization on the base of Angarsk plant is a mechanism to set aside a stockpile of LEU, which could be contributed to a broader supply assurance mechanism, and "a regulatory basis will be developed in the sphere of export control such that the shipment of material out of the country at the request of the Agency is guaranteed" (IAEA 2007a). In September 2007, Russia announced it intended to create a guaranteed reserve of 120 MT of LEU worth $300 million and equivalent of two reloads for a 1000 MWe reactor

(UxC 2008). It was declared by the current head of Rosatom S. Kiriyenko on the 51st session of the IAEA General Conference. This stockpile is supposed to be the part of the IAEA nuclear fuel bank and to be under the IAEA control (Russian Business 2007). An Agreement between the Agency and the IUEC is expected to be signed soon; the discussion in both Russia and the IAEA are currently underway (UxC 2008).

1.10 Multilateral Enrichment Sanctuary Project

In May 2007 Germany proposed the creation of a multilateral uranium enrichment centre operating on a commercial basis as a new supplier in the market, under IAEA control, providing enrichment services without any technology sharing (IAEA 2007b, IAEA 2007d). The facility is to be built and operated by the international enrichment consortium on the international property donated by the host country to the IAEA (IAEA 2007b). The Agency will have sovereign rights over the territory, and control the LEU supply from the facility, and the potential fuel reserve. From this plant, potential users could then obtain nuclear fuel for civilian use under strict supervision. Eligibility criteria are to be defined by the IAEA (UxC 2008). Such a plant could also help assure the supply of enriched uranium to qualifying States since it resolves the possible challenges arising from locating the fuel reserve on the national territories and associated with national politics and national regulations (IAEA 2007d). One potential drawback of this proposal is the simple fact that even if the territory for the enrichment facility is donated to the IAEA, access to it remains under control of the donor state. The weak point is, fundamentally, the same as with the NTI proposal - even if the stockpile is owned by and is under control of the IAEA, it is still necessary to transfer the materials through one or more national territories. Thus, to secure access to the reserve one would need to get the permission of the state hosting the Centre on materials' transit, which could be impossible or laboured due to political reasons.

1.11 Multilateralisation of the Nuclear Fuel Cycle

Multilateralisation of the Nuclear Fuel Cycle is a two-track multilateral mechanism proposed by Austria (IAEA 2007c). The first track of the mechanism would "optimiz[e] international transparency going beyond current IAEA safeguards obligations". The second track would place all nuclear fuel transactions under the auspices of a "nuclear fuel bank" to "enable equal access to and control of most sensitive nuclear technologies, particularly enrichment and reprocessing" (IAEA 2007d).

1.12 The EU Non-Paper

Nuclear Fuel Cycle, the EU non-paper of June 2007, noted that flexibility would be appropriate in considering an approach to fuel supply options and proposed criteria for assessment of a multilateral mechanism for reliability of fuel supply. These criteria included, *inter alia*: (1) proliferation resistance — minimization of the risk of unintended transfer of sensitive nuclear technology; (2) assurance of supply —reliability of long term supply arrangements; (3) consistency with equal rights and obligations— obligations of suppliers, companies, consumer States and the IAEA; and (4) market neutrality — avoiding any unnecessary disturbance or interference in the functioning of the existing market (IAEA 2007d).

All the proposals been listed above are to reduce the risk of horizontal proliferation of sensitive technology; they pursue one and the same goal, that is, to ensure developing countries to abandon indigenous full nuclear cycle including uranium enrichment and spent fuel reprocessing, which are the most sensitive from the nuclear non-proliferation viewpoint. These proposals are mostly focused on the establishment of fuel backup supply mechanism

and “reserves”, which if necessary are to provide countries in need with low enriched uranium.

CHAPTER 2. THE PROPOSALS' CLASSIFICATION

Due to the fact that the proposals have been made by different countries, or sometimes groups of countries, at different times, often regardless to what was proposed before, they are very uncoordinated, aimed on dealing with different causes of fuel supply disruption and sometimes controversial. To systemize existing proposals and assess the plausibility and effectiveness of their implementation I have invented five criteria to classify them. These are sufficiency, realizability, sphere of action, compatibility and effectiveness. According to the criterion of sufficiency proposals are divided depending on whether they are original or additional. This division is based on the way these proposals are supposed to be implemented, whether they are stand-alone, self-sufficient programs or just complementary to other proposals. The criterion of realizability is a binding one. It defines whether proposals are meant to act with respect to the existing world nuclear market that is of crucial importance because the market-based mechanisms of fuel supply can be unwittingly destroyed when non-market alternatives are implemented. None of the proposals listed above (no matter if they deal with technical or political issues) can address all the issues connected with realization of the concept of multilateral nuclear fuel cycle. That is why it is reasonable to foresee an implementation of combination of several proposals. In this regard proposals' compatibility is of great importance. The final criterion is effectiveness; it defines whether an effective solution is suggested and evaluates the ability of the projects to operate in a long-term prospective and keep the non-proliferation regime stable.

2.1 Sufficiency

All the proposals can be divided into two groups: original proposals and supplementary ones. This division is based on the way these proposals are supposed to be implemented: part of them can be stand-alone, self-sufficient programs while the other group

can be considered only as an enhancement to the original initiatives. Thus, the Japanese Proposal about the IAEA standby arrangements system for the assurances of nuclear fuel supply and UK Proposal of enrichment "bonds" fall into the category of supplementary because they are considered complementary to the Six-Party proposal and can be implemented only if that proposal is implemented. In contrast, the German proposal as well as the Russian one in Angarsk is original one and can be implemented regardless of whether there are other initiatives to support it.

2.2 Realizability

Trying to solve certain proliferation issues through the establishment of an assured-supply system with effective mechanism of back-up supply, we need to take into account the status of the existing market and industry interests because without their involvement and collaboration, it is hardly feasible to imagine successful implementation of any of the proposals outlined above. Furthermore, there is also risk of unwittingly destroying market-based mechanisms of fuel supply by offering a non-market alternative. To the extent that proposals above take into account the interests and the tools of industry, they can be classified as realizable or not realizable, at least until the industry issue has been included. Practically none of these proposals addresses this issue so far, except those that envision the creation of a new market actor (GNEP, IUEC at Angarsk, Germany's proposal) and those that consider market as a part of the concept of fuel supply assurances (WNA proposal, RANF).

2.3 Sphere of action

While some of the proposals deal with technical issues and market failure as a cause of supply disruption, others seek to solve political issues. For example, the Japanese transparency proposal, while being complementary to the six-party proposal, suggests,

basically, to substitute one supplier with another in case of an emergency. This mechanism of back-up supply solves only technical reasons for supply interruption and it is far from obvious that it can address interruptions caused by political motives. In contrast, the NTI proposal purposefully addresses political issues by suggesting the establishment of a "politically neutral" stockpile of LEU under IAE A supervision.

2.4 Compatibility

To cover the most of issues it could be reasonable to combine two or more proposals. From this point of view, their compatibility is a very important criterion. Some of the proposals initially have been made as a supplement to others, so they can be easily implemented together. A good example is the six-party proposal, the Japanese transparency proposal and the UK "enrichment bonds"; each of them meant to manage different aspects of supply assurances. Their combination allows recovering each other shortcomings. Since there are proposals which are not detailed enough it is difficult to say whether they are compatible or not, as in case Russia's IUEC and US GNEP.

2.5 Effectiveness

To be effective a proposal should be a precisely detailed long-term project, so that it could operate for a long time and keep the non-proliferation regime stable. Some of proposals mentioned above, such as the NTI proposal, GNEP, IUEC, Germany's Multilateralizing the Nuclear Fuel Cycle do not provide such a perspective for several reasons:

- First – these proposals are not sufficiently detailed and the scheme of their realization is not clear.
- Second – these proposals are based on current political situation and might not be sufficiently flexible to operate if its changes;

- Third – they do not include a mechanism of flexibility to respond on the nuclear market changes, including fluctuation of nuclear fuel prices;
- Fourth – the proposals doesn't take into account a shortage of recourses.

This analysis revealed both advantages and disadvantages of the proposals, showed which of them are compatible and can be implemented without destroying of existing nuclear market. This gave a good basis for creation of improved model of multilateral nuclear fuel cycle implementation which combines the best features of existing compatible proposals.

CHAPTER 3. UNDERSTANDING THE INTERNATIONAL REGULATORY REGIME[4]

The general definition of a regime might be given as a social institution "governing the actions of those interested in specifiable activities (or accepted sets of activities)." Being a social institution a regime is a pattern of well-established practices and expected behaviour (Young 1983). It "may be more or less formally articulated" or "accompanied by explicit organizational arrangements" (Young 1980). International regimes define activities and behaviour of "members of the international system" (Young 1983). The most essential purpose of any international regime is to enhance "the ability of states to cooperate in the issue - area" (Hasenclever, Mayer and Rittberger 1997).

There are a large number of international regimes; they are highly diverse and determine the behaviour of interested actors in different issue areas. They "vary greatly in terms of functional scope, areal domain, and membership." Being created to regulate different areas of interest, regimes vary in the range of functioning from dealing with a very concrete issue as, for example, the polar bear agreement to the treaties of "the broad concerns" as, for instance, the treaty on outer space. Territorially regimes are also very diverse. They may cover small or limited areas as Nuclear Free Zone Treaties do, or be enforced globally, as the Comprehensive Nuclear Test Ban Treaty (CTBT) is supposed to be. There is the same variety of regimes with regard to membership. They can involve from two (or three) members, as in the case of the bilateral US-Russia Arms reduction Treaty, to over a hundred of participants, as in the case of the almost universal Nuclear Non-proliferation Treaty (Young 1980).

Every international regime to be recognized as such has to include several components, namely, "the substantive component", "the procedural component", and "implementation".

[4] If not mentioned otherwise, this chapter is based on the work of Young (1980)

3.1 The substantive component

"[A] collection of rights and rules" is in the essence of any international regime. The right is what actor is entitled to "by virtue of occupying a recognized role." Different roles imply different rights. Thus, for example, the role of a human being presupposes a right to life, being a citizen in a country with democratic political system means to have "the right to vote in elections, the right to speak freely, and the right to move about at will." Many roles contain not one but a whole set of rights. These rights "may be more or less extensive" and are "a subject to change over time."

Several conspicuous categories of rights can be distinguished that are inherent in international regimes. These are such rights as property rights, "the right to protection against certain forms of aggression, the right to receive specified benefits from international transactions or productive operations, the right to trade on favourable terms with other members of the international community, and the right to participate in making collective decisions under the terms of a given regime." Within the property rights category private and common property rights may be distinguished. An example of the private property right, as Young adduced in his article "International Regimes: Problems and formation", may be rights for the international trade by commodities, and rights to use airspace can be an example of common property rights. At the international level the common property arrangements are prevailing. Therefore, "international regimes often emphasize the development of use-and-enjoyment rights." These rights are usually explicitly defined, and they may or may not be exclusive. Regardless of whether these rights are exclusive, they all are all designed to assure that the key resources are accessible to actors "under conditions in which private ownership is infeasible."

Rules, as opposed to rights, are "well-defined guides to action or standards" defining what actions members of the "subject group" (regime participants) may and may not perform

under specified circumstances. Rules of any given regime contain "an indication of the relevant subject group", "a behavioural prescription" and "a specification of the circumstances under which the rule is operative." Thus, any rule specifies the group the rule is applied to. Moreover, any rule features explicit guidelines to follow for members of the group indicated in the rule, which indicate what actions are allowed and expected, and what actions are forbidden. And, finally, any rule contains some indication of under what circumstances it is applied.

With regard to international regimes, three general categories of rules can be distinguished which are significantly prominent. These are "use rules", "liability rules" and "procedural rules". Depending on a particular regime, use rules might specify certain safety standards, which have to be met, or procedures, which have to be followed. Often, use rules are formulated as limitations "on the exercise of right" restricting the freedom by reducing the range of possible actions to the set of permissible options. Liability rules are the second category of rules that are generally present in international regimes. They define responsibilities of parties entitled to them with accordance to their role within the regime. And, finally, procedural rules that define the way of disputes resolution if those occur, organizational structure of an arrangement and patterns of communication and decision making within the regime.

An international regime to be complete, the collection of rules and rights it comprises are generally "supplemented by extensive sets of regulations and incentives system." Regulations are used to "translate rights and rules formulated in general terms" into applicable "managerial arrangements" applicable to practice. Incentive system is "penalties and rewards" used to persuade actors to alter their behaviour and follow the regulations while in the regime, or, in case of positive incentives, that is, rewards and benefits, to convince actors to join the regime if they do not participate yet. To be effective regulations and

incentive system require explicit organizational structure in place that is not always present in international regimes.

3.2 The Procedural Component

A procedural component of a regime comprises mechanisms of collective choice. In a situation when there is a decision to be made, which would affect all members of a regime, it is important to have special arrangements recognized by all members of the regime. These arrangements are mechanisms of aggregation of dissimilar preferences of regime participants. They facilitate group choice and ease the decision making process, defining fixed procedures which are to be followed whenever there is a necessity to make a collective decision.

In an operative international regime, there are several types of issues which would require a group choice to decide on. One of these issues is "the allocation of factors of production" that is especially difficult to handle, since common property is prevailing on the international level. Other types of issues whose solution would require a group choice include problems connected with "explicit distributive implications" and disputes resolution, which "arise from efforts to apply general rights and rules to the complexities of the real-world situations."

Mechanisms and arrangements that constitute the procedural component of regimes "may be more or less formalized." Frequently, not one but several mechanisms are applied at the same time. In the wide range of these devices those which are particularly characteristic of international regimes as systems with "a relatively small number of formal members" and "high level of decentralization" are the "law of capture", bargaining, different sorts of coercion, and markets. Not all regimes include these "social choice mechanisms"; some of them operate using "institutional arrangements of larger social structures" or "share mechanisms with other regimes." A good example of this might be the United Nations

arrangements and procedures which sometimes get fully involved into the resolution of a problem initially arisen "under specific international regime", as it happened when the problem of the Iranian nuclear program was escalated to the UN Security Council level.

3.3 Implementation (Compliance mechanisms)

For a regime to operate smoothly, the rights must be respected, rules must be followed and obligations must be fulfilled. However, sometimes parties may disagree with the results of a group choice rand refuse to comply with the decision. Therefore, for a regime to be effective there need to be a compliance mechanism of some sort.

Being essential for a proper work of the regime a compliance mechanism is primarily based on incentives. It is generally accepted that an actor would prefer to comply with the regime if it goes along with his self-interest considerations. Incentives, independently from whether they are positive (benefits) or negative (penalties), are to adjust a given regime to what would be acceptable for its acting or perspective members.

Compliance and non-compliance are the ground for adjudication of benefits and penalties, respectively. Therefore, compliance mechanisms often include verification systems. For example, the compliance mechanism of the non-proliferation regime includes annual reporting, inspections on the ground etc. – everything that the IAEA safeguards provide for. This is extremely expensive. Thus, to develop and exercise compliance mechanism it needs to be invested in. This raises the question of "opportunity costs", that is whether it is wise to put so much effort and finances into compliance mechanisms when they could be spent on something that might be yet even more valuable at the moment. Another question is how big the investments if any should be. Usually, equilibrium "with respect to these investments decisions depends on the assumptions made about the members of international regime."

"Compliance can be handled in a centralized fashion through the operation of a transnational agency like the IAEA or in a decentralized fashion through the operation of responsible agencies within individual member states." Moreover, compliance mechanisms can be established as procedures to be followed on either a voluntary or mandatory basis "in terms of responsibilities of individual regime members." For example, the IAEA compliance mechanism is a "centralized but voluntary system", which, however, allows the Agency to verify the member-states' compliance with the regime by sending inspection groups to check everything right at place (Young 1989).

Although a regime guides the international activity in an area, establishing standards and putting in place some restrictions on what may and may not be done, it does not mean that the regime will lead to the achievement of "well-defined substantive goals such as enduring peace, economic efficiency, or maximum sustained yields from renewable resources." The concept itself is empty; it has "no intrinsic metaphysical or teleological orientation." However, when creating a new regime or reforming an existing one, actors involved in the process tend to keep in mind certain goals they are trying to achieve (Young 1980).

As any other social institutions international regimes "may be more or less effective" and "more or less robust (or resilient)." According to Powell (1994), effectiveness implies a "static perspective" meaning that it can be defined at any single moment in time. Resilience (robustness) is, by contrast, a "dynamic measure of the significance of regimes" which implies that being realized and operating steadily they positively affect their environment (Hasenclever, Mayer and Rittberger 1997).

"Regime effectiveness comprises two overlapping ideas": "regime strength" and "staying power." Regime strength defines effectiveness as the extent to which members comply with the regime and follow its rules and norms. The better participants comply with

the regime and the more they are devoted to it, the more effective this regime is. Staying power is the second idea which constitutes regime effectiveness. It defines regime effectiveness as the extent to which the regime "achieves certain objectives or fulfils certain purposes."

Regime robustness (resilience), in contrast, refers to the ability of an international institution to maintain through time "in the face of exogenous challenges." It is defined by the fact of whether present behaviour and decisions of members of the regime are constrained by the "prior institutional choices", that is, whether "institutional history matters" (Powell 1994). To put in other words, a resilient regime would not change should the power distribution shift or prevailing interests of the most powerful participants change. Change here is understood as a drastic fundamental modification of the "regime's normative content." Thus, a regime, though reasonably flexible, should be robust and not alter whenever some of its members decide that "their interests are no longer optimally served" (Powell 1994).

CAPTER 4. THE NEW ARRANGEMENT

The Model is a system of multilateral crosscutting agreements among governments, industry and the IAEA, which establishes the framework for actions of the member-states within the area of nuclear supply, development and non-proliferation. It is a global international regulatory regime operating within the non-proliferation regime framework. The main objective of the regime is the strengthening of the non-proliferation regime by preventing the wide spread of sensitive technologies, that is, uranium enrichment and reprocessing of spent fuel. Their sensitivity is explained by the fact, that on these stages of nuclear fuel cycle the weapon grade materials can be produced or extracted. Therefore, the proliferation of sensitive technologies is directly linked to the proliferation of nuclear weapons, and by preventing the spread of these technologies the risk of horizontal proliferation of nuclear weapons will be diminished. For this purpose a system of nuclear fuel supply is in the main focus of the regime. It seems that the only possibility to restrain countries interested in using nuclear energy from launching their nuclear programs is to provide them with a secured supply of nuclear fuel for a reasonable price. Therefore, the mechanisms of fuel supply, including the backup supply system are articulated in the regime.

Due to the particularities of the non-proliferation regime and issues it deals with, successful and effective operation of the new regime requires participation of all countries in it. First and foremost, this requirement descends from the purpose of the regime to be established - to prevent proliferation of sensitive nuclear technologies. If the regime does not involve all countries, there still would be those which prefer to develop indigenous nuclear infrastructure and proliferation of sensitive technologies will continue that will make the whole effort meaningless.

One of the main reasons why countries may refuse participation in the regime is that they would be in a potentially disadvantaged situation when they are dependant on nuclear

fuel supply through the regime's mechanisms and obliged not to develop nuclear fuel cycle on their territory, while their neighbours would have indigenous nuclear capacities and, therefore are independent in their energy supply. Therefore, the regime needs to be a universal arrangement, so there is no excuse for countries not to join such as the lack of trust or anxiety of what a neighbour may do once it has obtained the technology that enables it to produce nuclear weapons. Moreover, the universal character of the arrangement will ease the tension with regard to the legitimate right of the states to develop indigenous nuclear capacities. This right is provided by article 4 of the Non-proliferation Treaty, which together with article 3 of the Treaty balances rights and obligations of non-nuclear weapons states within the regime. According to what is required by the new arrangement's rules, countries have to abandon this right to be allowed to join. There is no doubt this requirement is going to be an obstacle on the way to regime development, however, once more countries have joined the easier the process will be. Political reasons, such as prestige of a state, and economic reasons, such as benefits of the trade within the framework of the arrangement, will be incentives enough to override the issue.

Within the regime two subject groups may be distinguished. One group is a group of countries- suppliers. It comprises states with developed indigenous nuclear power infrastructure, which possess technology of a full nuclear fuel cycle, meaning that they have uranium enrichment and fuel reprocessing steps of the cycle recreated on their territory. This group consists of all nuclear weapons states (NWS) and those non-nuclear weapons states (NNWS) that have already developed a nuclear infrastructure. These countries are members of the Nuclear Supplier Group (NSG) and do not include de-facto nuclear states, since due to the NSG rules the cooperation and trade with countries out of the nuclear non-proliferation regime is prohibited. However, there are ongoing negotiations on the matter of India being allowed cooperation and the situation can change. Then de-facto nuclear states would be

included in the group of countries-suppliers, though most probably their non-proliferation status would still be vague. Another group of countries is a group of customers (consumers). These countries are those which do not possess any or have very little developed nuclear infrastructure. However, this does not mean that they do not use nuclear energy and do not have any nuclear power instillations on their territory. In contrast, though some of these countries indeed do not have an access to nuclear energy yet, some of them do have nuclear power installations built for them on their territory and enjoy benefits of peaceful use of nuclear energy.

The regime offers mechanism for mutually beneficial cooperation of both sides: suppliers and customers. Suppliers get to trade nuclear fuel services on favourable but yet reasonable terms, while customers get an access to the benefits of peaceful use of nuclear energy as it has been provided by article 3 of the NPT. Countries-customers will be able to have nuclear power installations on their territory, built by one of the suppliers, and a steady supply of proper nuclear fuel. Thus, countries-customers will not have to launch very expensive, time consuming and science intensive nuclear program and recreate all stages of full nuclear fuel cycle including enrichment (and, in case of closed nuclear fuel cycle, reprocessing) to get access to nuclear energy. Therefore, being members of the regime, countries-customers get an access to the benefits of nuclear fuel without bearing all the burdens and costs of development of extensive nuclear power infrastructure.

The regime is a two-level arrangement. The First level is multilateral cross-cutting agreements between member-states, industry and the IAEA. These agreements establish rights of states-parties of the regime and articulate rules with accordance to which the regime is to operate. Rights and responsibilities of the regime members are defined by the goals the regime pursues. Depending on the subject group countries belong to, their rights, responsibilities and obligations vary, though all countries are unconditionally obliged to

comply with the Non-proliferation Treaty. Countries-suppliers retain the right to have and use their indigenous nuclear capacities and trade nuclear fuel cycle services on the market terms to the countries-customers. But in addition to this they are responsible for fuel supply being regular and reliable. They have to assure steady supply of nuclear fuel in the necessary amount regardless any complications that might occur if these complications are not proliferation related. This means that whatever happens, fuel supply should not be disrupted. The only legitimate reason for fuel supply to be stopped is when a country-customer failed to comply with the non-proliferation regime and there are concerns that it violates the Non-proliferation Treaty. Countries-customers, have right to obtain and use nuclear power installations. They also have a right to reliable nuclear fuel supply, however, in turn, they are obliged to forego their national nuclear programs and not develop indigenous nuclear power infrastructure.

The Second level of the arrangement is a threefold system which consists of (1) indigenous capacities on nuclear fuel cycle; (2) multinational enterprises of nuclear fuel cycle; and (3) international backup supply system. Multinational enterprises, such as Uranium Enrichment Centres (Russian and German proposals), Fuel Fabrication Centres and Centres of spent fuel reprocessing, are regular independent nuclear market players with an exception of the fact that they are founded on the basis of multilateral agreements between regime states-members and operate as their joint ventures. They may be placed either on the national territory of a state or on a territory donated by a state to the international community in common property. Together with industry the Centres are to provide nuclear fuel cycle services to those countries which have joined the regime. However, there is a significant difference between the two. The Centres are international multilateral arrangements. This status allows for impartiality and contributes to the non-discriminatory policy of the Centres. Besides, it resolves a number of political issues that hamper the cooperation between the

states nowadays and provoke countries to develop their own nuclear infrastructure not to be dependant on the political will of other states. A good example for this may be the situation around the Iranian nuclear program. Cooperation of Iran first with Germany (German company) and then with Russia (Russian company) on the construction of the nuclear power plant in Busher has been hampered for years due to political reasons. The situation was hard to resolve and, though now it seems the project will be finished, it took a lot of time and finances. What is even more important is that it showed how fragile the bilateral arrangements could be, especially with the meddling of the third party, which in case of Iran was US. International status of the Centres annihilates these issues; it helps to overcome political reasons and tensions that hamper states' cooperation. Due to the fact that the Centres are multilateral arrangements, it is no longer the situation when one state has a certain policy towards the other country. In contrary, the attitude towards Centres' customers is neutral and does not depend on current policy of any single state. Therefore, the multilateral character of the arrangements contributes to flexibility of the system and impacts overall resilience of the regime to alterations of international politics.

In order to guarantee reliable nuclear fuel supply and assure countries-customers that nuclear fuel supply will not be disrupted either due to technical or political reasons, a backup supply system has been invented. It is developed on the basis of principles stated in the Six-party proposal, Japanese proposal on transparency and "Enrichment Bonds" proposal. In the core of the backup supply system is the multilateral agreements between the countries-suppliers according to which states substitute for one another and take over fuel supply to a given country once a situation occurred when the initial supplier can not fulfil its duty. The only legitimate reason for fuel supply interruption is when there are concerns based on sound evidences that a country-customer does not comply with the non-proliferation regime or violates the international law. In other cases suppliers substitute one another on the basis of

their nuclear capacities availability meaning that a country which takes over a give nuclear fuel supply is the one that has enough capacities available at the time to produce necessary amount of appropriate fuel. This is realized through the international information system which contains the data on countries' current nuclear capacities availability. The database is compiled on the basis of countries' annual reports. These reports are made voluntarily but, though it creates a certain level of uncertainty, economical benefits of the cooperation are good enough to persuade states to report on a regular basis.

In addition to the mechanism of substitution, backup supply system comprises an international system of "reserves" of low enriched uranium. This is an extra insurance. When all the mechanisms of the fuel supply fail to provide a given country with the nuclear fuel it needs, there are the LEU stockpiles to be used in the last resort. These stockpiles are in the common property and under the IAEA supervision. They can be placed on either national or donated territory. The access to these "reserves" can be granted only by the IAEA and only when the given country has good non-proliferation records meaning that the country fully complies with the non-proliferation regime. Once a stockpile has been accessed and the LEU has been taken, the reserve has to be replenished. To ease the procedure of LEU replenishment once it has been used reserves closely cooperate with uranium enrichment Centres. The system of reserves is to be established on the basis of the NTI proposal and Russian proposal; both are on the stage of realization.

The whole arrangement is meant to function under IAEA control. The Agency is a guarantee of parties' compliance with the regime and a key player in the creation and sustaining of the international information system. It also plays a role of the mediator between customers and suppliers when a fuel supply disruption occurs and there is a necessity to use the LEU stockpile to take over the supply, provide fuel and prevent shutdown of the nuclear power plant of the country in question.

The regime is a stable in a long run system which combines compatible proposals and respects the existing nuclear market. The industry is included in the arrangement and international centres providing nuclear fuel cycle services, though established on the basis of multilateral agreements between countries-suppliers, are introduced to the existing market system as regular players. Therefore, the regime's mechanisms do not violate but go along with the existing nuclear market's rules and can be implemented without damaging it.

The main objective of the regime is to strengthen the non-proliferation regime and prevent the wide spread of sensitive technologies. It creates the environment for mutually beneficial cooperation of countries within the nuclear field and manages materials' and technologies' flows. The regime suggests a system of backup supply to guarantee countries that the fuel they need will be delivered under any circumstances and persuade them to forgo development of indigenous nuclear fuel cycle on their territory. Being introduced it will resolve a number of issues. However, due to particularities of the non-proliferation regime and specificity of the issue the new arrangement is addressing, to be effective it needs all countries to be engaged in the regime. This is an essential requirement, which has to be met; otherwise the regime will not be efficient in counteracting proliferation of sensitive technologies, which is its primary goal.

To define whether the universal character of the arrangement can be achieved it needs to be defined whether countries would join the regime. To approach this question, in order to make a complex issue less complicated, the two-level game theory can be applied.

CHAPTER 5. THE TWO-LEVEL GAME THEORY

The politics of international negotiations and bargaining often can be explained applying a two-level game theory (Putnam 1988). Knowing "strategies and tactics at each" level, highly intricate at first developments become understandable (Carment and James 1996). At the national level, "domestic pressure groups pursue their interests by pressuring the government to adopt favourable policies, and politicians seek power by constructing coalitions among those groups." At the same time, "at the international level, national governments seek to maximize their own ability to satisfy domestic pressures, while minimizing the adverse consequences of foreign developments" (Putnam 1988). Thus, there are two "bargaining tables": domestic politics and international negotiations, and a head of a state or political leader coordinates actions at both of them. (Carment and James 1996). When at the international table, the leader confronts "his foreign counterparts, and at his elbows sit diplomats and other international advisors," while behind him at the domestic table "sit party and parliamentary figures, spokespersons for domestic agencies, representatives of key interest groups, and the leader's own political advisors," This disposition put the head of a state in situation, when "any player at the international table who is dissatisfied with the outcome may upset the game board, and conversely, any leader who fails to satisfy his fellow players at the domestic table risks being evicted from his seat" (Putnam 1988). Therefore, following assumptions can be made:

- decision maker (a head of a state or a political leader) have to consider interests of his constituents, when negotiating at the international level, and know how power is distributed among these interests;
- the consensus achieved at the international table "can not be successful if it contradicts the preferences of a decision maker's constituency;" and

- a head of the state "must retain some minimal degree of support among the constituency" to be able to fulfil promises given at the international table and keep his seat staying in power (Carment and James 1996).

"The requirement that decision-makers satisfy both domestic constituents and international opponents is the component in this conceptual approach that produces constraints on international behaviour." The mechanisms of a two-level game "are straightforward and should be broadly applicable to states across regime types" (Trumbore and Boyer 2000). Negotiators are restricted in their options by both "the domestic and international implications of their actions". They have to make a policy choice on the basis of both what they expect to be other international players' positions on a subject and what would be acceptable by constituency of each of the players (his own constituency being a first priority). There can be distinguished four types of actors who define what the domestic game would be. These are "the military, the mass public, mass media and political opposition" (Boukhars 2001).

5.1 The Military

The military plays an important role in any political system. Depending on a type and particularities of a given political regime, influence of the military may vary. However, it always strives to affect "the outcome of decision or policy-making." Military officers "use whatever political skills and resources they can muster," including personal ascendancy, in order to pursue their interests and assure implementation of a desirable or the most preferable policy. In countries with authoritarian political regime military influence on conducted policy is particularly significant. A good example for it can be Algeria where Army is "the decisive player" and heavily impact the national politics of the country. Institutionalised and highly influential, it controls domestic politics in Algeria "by imposing a high cost on politicians

who fail to take sufficient account" of its interests and purposes (Boukhars 2001). Army plays a significant role during presidential elections. Regardless the political regime in the country Army support is extremely important and may be decisive as it were during the constitutional crisis in Russia in 1993, for instance, when light tanks were brought into Moscow and the White House was bombarded. Back then army support was on Yeltsin's side. He used military to get to power and eventually became a President. (Reddaway and Glinski 2001). This example, as many others, shows that the Army is the force that can bring a leader to the power and help to retain the position (Boukhars 2001). Political leaders are always seeking for army support and, therefore, usually conduct policies that reflect its interests.

5.2 The Mass Public

As well as the Military, the mass public plays a significant role in decision-making process. There are a lot of theories elaborated on the topic. Authors argue n "the role of the electorate in limiting leaders options" when on the international level. The most significant influence on the foreign policy of a state the mass media has in democracies. Chief executives (Presidents or Prime Ministers) are dependent on the public because it is up to the public to decide whether they will be re-elected for the next term (if re-election is allowed by the law). Therefore, they can not disregard public opinion while conducting a policy. They are bounded to respect and possibly satisfy public demands because "their continuation in power is contingent upon the way the public gauges their performance while in office." Leaders are accountable to their "constituents for the success or failure" of the foreign policy they implement. Therefore, they have to be concerned about possible consequences of their choices and actions.

In countries with non-democratic regimes, the mass public plays an important role too. Regardless the absence of developed democratic mechanisms the public in non-democracies

still “has a say in leaders continuation in power.” Citizenry extremely dissatisfied with the policy conducted by the government “might revolt against the blunders of repressive rulers” (Boukhars 2001). This can lead to destabilization of political situation within a state and give political opposition an opportunity to replace current government

5.3 Mass Media

The Media is a great power. It can influence public opinion or form the way of thinking on a specific issue. The Media can be a tool used by a government in order to achieve certain goals, but it can also be an independent player able to influence political authorities, and for the purposes of this research the later is of a particular interest.

By manipulation with frequency and “duration of attention” to certain affairs, the Media controls “[t]he public's familiarity with political matters.” To get a deeper understanding of how the Media constrains the range of options a leader has while negotiating on the international level it is important to understand that the information the public receives about international events is previously selected and formed by the Media. The Media heavily “impacts the public’s level of concern over foreign policy or events in the international arena.” By varying the frequency and duration of coverage of different issues in the news, the Media creates an impression of what is “the most important problem” the country is currently facing (Boukhars 2001).Thus the Media plays an important role as a domestic level constrain heavily affecting the win-set a leader has at the end of the day.

5.4 Political Opposition

Political opposition is an important political actor. It chooses when and whether to support government in a policy it implements. During the crises its support “can lend additional credibility to a government's foreign policy,” as it shows that there is a sufficient

ground for a certain policy choice (Boukhars 2001). However, if the opposition is strong, it also can seriously hamper implementation of a certain policy, if this policy does not go along with what the opposition considers to be right.

All four types of actors are highly influential and depending on the actual context can heavily impact the outcome of international negotiations by imposing restrictions on what can be acceptable on domestic level. Due to the fact, that the military usually supports either government or political opposition, and the influence of the Media can be reduced to the public opinion, since its main influencee is the public, these four actors can be reduced to two: public opinion and political opposition. Therefore, analysing countries on the subject of whether they would join the regime, I will primarily look at these two players.

CHAPTER 6. COUNTRIES PARTICIPATION

The new arrangement been described in details in chapter 4 is aimed at prevention of global spread of sensitive technologies. To achieve this goal the regime has to engage all countries. Due to the specificity of the issue this is an essential requirement for the regime to be successful. Efficient work of the regime should result in maintenance of the status quo meaning that the number of countries with developed nuclear energy infrastructure will remain the same. In period of anticipating nuclear renaissance, when increasingly more countries become interested in using nuclear energy, this is possible only if the new arrangement is a sound alternative to the development of indigenous nuclear fuel cycle, a regime which countries would prefer to join, rather than invest in development of indigenous nuclear fuel cycle. If the regime does not reach its universal status there still will be countries outside the regime that have preferred to develop full nuclear fuel cycle on their territory. This will lead to further proliferation of sensitive technologies; status quo will not be maintained, which means that the regime will fail to meet its primary goal.

To define whether the universal status of the regime is achievable it is necessary to determine whether countries would be willing to join it. Since foreign policy decisions countries make usually depend on what interests prevail within these countries, to answer the question of whether countries would join the regime it is appropriate to apply the two-level game theory. By analysing the domestic situation within a given country a win-set on the issue can be aggregated that comprises what would be acceptable within the country. When the domestic preferences are defined, the win-set is compared to what is suggested by the regime. If the regime requirements fall into the win-set area, then the country most probably will join. If the win-set and the regime requirements do not match, then there should be found those incentives that would persuade the country to join the regime.

In order to conduct the analysis and define whether the universal status of the regime is achievable and countries will join, all the states have to be divided into groups with accordance to criterion of whether given country possesses any nuclear technology and if it does then to which extent.

On the basis of how developed nuclear energy is within a country, two large groups of countries can be distinguished. The first group is a group of countries which have developed nuclear infrastructure. This group comprises countries-parties of Nuclear Suppliers Group, that is, nuclear weapon states and non-nuclear weapon states that have full nuclear fuel cycle recreated on their territory. Moreover, it potentially includes *de-facto* nuclear states. The second group comprises those countries, which have an access to the nuclear energy but do not have indigenous nuclear fuel cycle, and those, which currently do not have access to nuclear energy at all.

On the basis of a status countries have within the non-proliferation regime, the first group of states can be further divided into three groups: (1) nuclear states, (2) *de-facto* nuclear states, and (3) non-nuclear states with developed nuclear fuel cycle. Although all of these countries have extensive nuclear infrastructures including stages of uranium enrichment, they have to be treated differently. Since the new regime is meant to operate within the non-proliferation regime framework, the non-proliferation status of states is relevant and should be considered.

This is especially applicable to the *de-facto* nuclear states: India, Israel, Pakistan and North Korea. According to the Nuclear Non-Proliferation Treaty there can be only five nuclear weapon states. Therefore, nuclear status of these four *de-facto* nuclear states can not be officially recognized. This puts some additional restrictions on these countries participation in the regime and makes their joining more difficult. For this reason India, Israel, Pakistan and

North Korea constitute a separate group of countries to which I will further refer as problematic states.

As for the nuclear states and non-nuclear states with developed nuclear energy infrastructure, these countries can be considered as one category. Regardless the difference in their status within the non-proliferation regime for the purposes of this research these countries can be treated the same way. This is due to the fact that these states comply with the regime and possess somewhat the same technology. Further I will refer to these states as suppliers.

The third group of countries comprises those which are not included neither in the group of suppliers nor in the group of problematic states. This is a group of countries-customers. There are three potential types of customers:

- those countries that do not have an access to benefits of nuclear energy meaning that they neither have any Nuclear Power Plant built on their territory nor scientific base to launch nuclear program but do not have the whole infrastructure;
- those countries that have limited access to nuclear energy meaning that they have one or more nuclear power installations on their territory, but do not have the whole infrastructure and do not have sufficient scientific base to launch full-scale nuclear program; and
- those countries that either do not have any or have limited access to nuclear energy, but have capacities to launch full-scale nuclear program.

These states are supposed to participate in the regime as recipients of nuclear fuel services and further I will refer to them as customers.

Thus, there are three groups of countries to be analyzed: suppliers, customers and problematic states. For the purposes of this research, to answer the question of whether countries would join the regime, it is enough to single out one country within each of the

groups that would less likely join the regime. Studying a case of the least likely to join country I assume that this is the worst case scenario and that if this country would join the regime any country within this group would join. This allows to generalize the results of the analysis and, though there is a certain level of uncertainty, it is possible to infer whether this group of countries is likely to join.

6.1 Suppliers

Suppliers have a lot of incentives to join the regime. Economic benefits from cooperation and countries' prestige on the international arena are among them. However, the most important advantage of the regime for this group of countries is that they get to keep the indigenous nuclear capacities they have and at the same time to be founders or shareholders of international centres providing nuclear fuel services established in the form of joint ventures. This enables these countries for the two-line cooperation: directly with a customer and through the multilateral enterprises. When there is a visible tension in relations between a supplier and a customer direct cooperation is impossible. However, to receive the fuel it needs, the customer will apply to the multinational centre and, due to the fact that each nuclear power plant requires fuel which meets its unique specifications, it most likely will apply to the Centre where the supplier is a member. Thus, these two countries still will be able to cooperate and the supplier will still have its revenue.

Therefore, joining the regime is in the best interests of countries within this group. It makes the requirement of the least likely to join state be not applicable. Moreover, the most of proposals discussed in chapter 1 have been proposed by the countries that constitute this group. Therefore, I think it is safe to conclude that countries comprised in this group would definitely join the regime.

6.2 Customers

Customers make the most difficult group. The least challenging countries from the point of view of their willingness to join the regime are those which have no access to nuclear energy and do not have sufficient scientific basis for launching an indigenous nuclear program. Launching a nuclear program requires tremendous investments. Moreover, it can be years since the moment of the program initiation till the moment of the first tangible results to come. For countries with no access to nuclear energy this is unacceptable especially considering gradually increasing energy demand. Therefore, they most probably would join the regime that offers nuclear fuel services, including construction of nuclear power installations and reliable fuel supply that is chipper and faster. The same is applicable to the group of countries which have limited access to nuclear energy and do not have capacities to launch indigenous nuclear program.

The most challenging countries from the point of view of joining the regime are those that have sufficient scientific and economic basis for launching indigenous nuclear program and have already been planning to start investing into nuclear infrastructure development. Joining the regime as a costumer implies that the development of indigenous capacities on fuel production should be foregone. Being a party of the new regime imposes additional restrictions and obligations. And in case of countries which can afford launching of the nuclear program benefits of participation in the regime do not countervail them.

One of the countries that have decided to reconsider negative attitude toward nuclear energy is Germany. Initially “support for nuclear energy was very strong” there, however everything changed after the Chernobyl accident occurred in 1986. The Social Democratic Party (SPD) that initially “had affirmed nuclear power in 1979,” decided to give up nuclear power and issued a resolution according to which nuclear power had to be abandoned till 1998. Then Christian Democrats (CDU) came to power and “maintained support for existing

nuclear power generation" till 1998, when in result of elections Social Democrats gained power again. A coalition of Social Democrats and the Green Party "had the phasing out of nuclear energy as a feature of its policy" and changed the legislation the way to "establish the eventual phasing out of nuclear power" (WNA 2010). In the middle of 2000 a compromise agreement was reached according to which the immediate closure of nuclear power plants was postponed, but the operational life of the nuclear power installations was limited to 32 years (BBC NEWS 2000).

Now the ruling party in Germany is again Christian Democrats. In 2009 the phase-out was put on hold. The current government "is committed to rescinding the phase-out policy" and start development of nuclear energy (WNA 2010).

As it appeared within German government there are two wings: for and against nuclear energy. By now the party in power is the one that pursues the policy aimed at the nuclear energy development. This is seems to be the perfect timing for Germany to join the regime. Though at first it appeared that this is not in the country's best interests, joining the regime and take upon the obligations the regime implies, would help Germany to stabilize its domestic policy towards nuclear energy. International commitments would prevent from cardinal policy change and contribute to policy consistency. Therefore, I think that it is safe to conclude that with this government Germany is most likely to enter the regime in order to guarantee continuation of its policy in the area in case the government changes again.

6.3 Problematic states

India, Israel, Pakistan and the North Korea are *de-facto* nuclear states. Their incentives for joining the regime are clear. Having full nuclear energy infrastructure, including stages of uranium enrichment, they could potentially enter the regime as suppliers and enjoy all the economic benefits of cooperation.

However, being *de-facto* nuclear states, these countries have sensitive technology but can not be officially recognized as nuclear states. And since only nuclear states are not obliged to put their facilities under the IAEA Safeguards, joining of problematic states to the regime would be stipulated by the additional requirement, that is, all their nuclear facilities have to be putted under the IAEA Safeguards, and this requirement will heavily hamper the process.

Though the least likely to join country would be the North Korea, I think it is safe to take India as an example especially due to the fact that in India disputes about nuclear facilities being putted under the IAEA control have already occurred with regard to the Agreement 123 between the United States and India.

The ruling party was the United Progressive Alliance and there political opposition against this deal was huge. The Left Front, whose support was crucial for party to have a majority in the parliament, opposed the deal. On June 19, 2008, news media reported that Dr. Manmohan Singh , Indian Prime Minister, was ready to resign if the Left Front would not change its position (Bhatt 2008). United Progressive Alliance could not sign any deal with the IAEA not having the majority. There were ongoing negotiations and consultations; some groups of the opposition changed their position and supported the deal. On July 22, 2008, the party faced its first confidence vote and won with 275 votes to 256 of the opposition. Eventually, the deal was approved by the parliament (BBC NEWS 2008).

This shows that even with the additional requirement in place, problematic states, though the process is promised to be hard, still can join the regime. Thus, the additional requirement is sure an obstacle but can be overcome.

Therefore, it can be concluded that generally countries would join the regime, though in some cases the process is going to be difficult and time consuming. Reasons for joining the regime are different and would vary depending on a country in question.

CONCLUSION

A number of proposals on realization of multilateral nuclear fuel cycle have been put forward and actively worked out in recent years; all of them are aimed to prevent the spread of sensitive technology in the context of the anticipated "nuclear renaissance". These proposals are uncoordinated and dealing with different causes of fuel supply disruption and different aspects of ensured supply arrangements. However, they all require participation of all countries; otherwise they will not be effective in prevention of proliferation of sensitive technologies.

On the basis of compatible proposals a new regulatory regime was created. This regime acts with respect to the world nuclear market and is flexible to alterations in international politics that makes fuel supply guaranteed and independent from the policy of any single country. Its primary goal is the same as the goal of all of the proposals, that is, to prevent the global spread of sensitive technologies. The fundamental requirement is also remains - the arrangement has to have a universal character that as been shown in the thesis, is possible.

Applying the two-level game theory I tested the regime on whether countries would join the arrangement on the examples of countries from three different groups: suppliers, customers and problematic states. As the analysis shows, generally, though sometimes the joining process can be hampered, participation in the regime is in the interests of courtiers and eventually they would join. This is what the German and Indian cases demonstrated. From the first sight there was no indication that the regime might be somewhat profitable for Germany. However, it appeared that joining the regime might help to stabilize the nuclear policy situation on domestic level. Indian example is different. Since India possesses sensitive technology, its economic benefits from joining the regime as a supplier are obvious. But as India is a *de-facto* nuclear state, its nuclear facilities have to be under the IAEA Safeguards.

Although in India this has been already done for yet another arrangement, this experience is applicable for the present research. It showed that, though the process was very difficult, it is still manageable to make such a strict requirement acceptable on the domestic level.

Although the results of the analysis are optimistic, it should be remembered that the analysis only indicates the possibility of the desirable outcome. In reality things are much more complex and sometimes to persuade a country to join the regime additional incentives might be necessary. In case of *de-facto* nuclear states there is always a problem of recognition of their nuclear status that is impossible due to the clear provision of the NPT that there can only be five nuclear states. Therefore, there should be special mechanisms of their joining to the regime and their membership should be arranged in a way to evade the necessity of their status to be explicitly defined.

Nevertheless, once being implemented the arrangement would resolve a lot of issues emerged due to the nuclear renaissance and threat of a climate change. It would successfully prevent the spread of sensitive technologies. At the same time, the regime comprises a mechanism how to fulfill the provision of the Article 4 of the NPT and provide non-nuclear states with the right to use nuclear energy for peaceful purposes. This would resolve the issues raised by “nuclear renaissance” and strengthen the non-proliferation regime.

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