THE REGULATION OF INTERNATIONAL TRADE IN ENRICHED URANIUM IN THE NEW BUILD ERA

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Introduction

Is there a tension between the historic approach to regulation of access to uranium and sensitive nuclear technology as it has evolved since the Second World War, and the supply needs of a nuclear new build era? How can the global new build program be facilitated whilst maintaining proportionate safeguards and security? Does the trend of ever strengthening traditional controls need review But what about terrorism? What about the unequal treatment of some nations? Will emerging nations have access to the benefits of nuclear power?

This paper looks at how the current regulatory regime developed, at some of the issues which have arisen and considers whether it remains fit for purpose or whether further development is required.

Whist the title of this paper relates to enriched uranium the regulation which governs it goes hand in hand with nuclear technology

Against a back-drop of political, strategic and economic interests we see reluctance by nuclear weapons states to enter into formal treaties which could rule out ambiguity and the resulting web of governance created by a combination of general rules of international law together with commitments and informal instruments undertaken by governments.

Uranium - the substance

Uranium is a silvery-white metal with symbol U and atomic number 92 in the periodic table. The most common form of uranium is uranium-238 with uranium-235 accounting for only 0.7% of the element found naturally. When the nucleus of a U-235 atom captures a moving neutron it splits in two (fissions) and releases some energy in the form of heat, also two or three additional neutrons are thrown off. If enough of these expelled neutrons cause the nuclei of other U-235 atoms to split, releasing further neutrons, a fission 'chain reaction' can be achieved. When this happens over and over again, many millions of times, a very large amount of heat is produced from a small amount of uranium. In a nuclear reactor the uranium fuel is assembled in such a way that a controlled fission chain reaction can be achieved. For completeness, plutonium is a byproduct whereby some of the neutrons released by the fission process convert uranium-238 nuclei into plutonium.

Uses

Clearly uranium has military uses but the main use of uranium in the civilian sector is to fuel nuclear power plants. One kilogram of uranium-235 is capable of producing as much energy as 1500 tonnes of coal.

Enriched uranium

Enriched uranium is a type of uranium in which the percentage composition of uranium-235 has been increased through the process of isotope separation. Low-enriched uranium (LEU) has a lower than 20% concentration of ^{235}U and is used in commercial light water reactors (LWR), the most prevalent power reactors in the world. Highly enriched uranium (HEU) has a greater than 20% concentration of ^{235}U or ^{233}U. The fissile uranium used in nuclear weapons contains 85% or more of ^{235}U, known as weapon(s)-grade uranium.

Uranium as part of the nuclear fuel cycle

The fuel cycle is divided into front-end activities (mining, conversion, enrichment and fuel fabrication) to produce fuel for different reactor types and back-end activities to manage the spent nuclear fuel and the nuclear waste (including storage, reprocessing and waste disposal).

Growth in supply and demand

The Red Book is a world reference on uranium jointly prepared by the OECD/NEA and the IAEA. The 2014 edition shows **growth of supply and production to the tune of** seven per cent since 2012, adding 10 years to the existing uranium resource base. Growth is due to a 23 per cent increase in uranium exploration and mine development.

On the demand side, nuclear capacity projections, particularly in East Asia and non-EU states on the European continent, continue to grow.

Where is uranium mined?

More than 20 countries produce uranium, with Kazakhstan, Canada and Australia the largest producers, at 63 per cent of world production. Growth in production is driven by Kazakhstan, with smaller additions in Australia, Brazil, China, Malawi, Namibia, Niger, Ukraine and the United States. New countries including Botswana, Tanzania and Zambia have future plans for mining operations.

Trade in enriched uranium and its cross cutting relationship with concerns about proliferation of nuclear capability and the risk of diversion for non-peaceful purposes

The following circumstances shed some light on the path to the tension of today between certain original Nuclear Weapons States (NWS) and states who aspire to development of nuclear power.

Early realisations

After it became clear that nuclear fission had a role to play in the delicate balance by which future world wars could be avoided post 1945, as well as holding the potential for generation of electricity for commercial use, the nuclear states wanted to consider who should have control of the transfer and trade in enriched uranium, technology and knowhow. The fear was that it could fall into the hands of states seeking to join the limited club of those nations who had exploded a bomb and planned future exploitation of the science.

Taking a step back the first body to look at the potential for the development of nuclear weapons had been the Advisory Committee on Uranium set up by US President Roosevelt, to liaise between the American administration and the scientific world.

In the UK in 1941 a working group, the Military Application of Uranium Detonation committee, had reported that nuclear weapons could become technologically feasible but doubted that this could be possible given the industrial investment required.

In the US the nuclear debate on atomic weapons had become much more focused following the bombing of its Pearl Harbour naval base and its entry into the war. The allies believed Germany had already developed nuclear capability. This turned out not to have been true but propelled a race against the clock to produce a nuclear weapon.

By April 1945 the technology was in place but by this stage Germany was preparing to surrender. US President Truman chose to speed the end of the war by exploding two bombs above the cities of Hiroshima, Nagasaki, and the Japanese Emperor Hirohito also announced his nation's surrender.

The previously inconceivable power of an atomic weapon was now apparent. Also clear was the incredible strategic and political advantage held by those with knowledge of its fabrication. At first all considerations were centered on military uses. The US was nervous of civil exploitation which could become a Trojan horse for development of a weapon. It was also pleased to have a monopoly. However, the need for post war reconstruction and increased electricity generation meant that this could not last.

What grew from these circumstances was a system for nuclear knowledge and material transfer authorisation. To this were added monitoring mechanisms which provided the confidence for authorised use of the science. During the Cold War there was a lack of mutual trust between the US, the USSR and their allies. The latter exploded its first nuclear weapon in 1949 and it was then clear that US policy alone could control nuclear development and knowhow.

How to open up trade? How to control it safely? A bargain is struck in the hope of minimising proliferation

Understandably, there had been a culture of secrecy but US President Eisenhower gave a speech in 1953 which began a new era of openness. The offer was that a state might benefit from a transfer of nuclear material in return for a promise to use it for peaceful purposes only subject to regular inspection.

A regulatory Agency is set up

Statutes establishing the International Atomic Energy Agency (IAEA) were adopted in 1956. The hope of many of a world without nuclear weapons was compromised when the former limited NWS group, the US, USSR and UK admitted France, in 1960, and China, in 1964. In 1963 the countries involved in nuclear research had grown to 26.

The Non-Proliferation of Nuclear Weapons Treaty (NPT)

This came into force in 1970. It is based on three key principles of non-proliferation, disarmament and the right of the Non-Nuclear Weapon States (NNWS) to use nuclear technology for peaceful purposes provided they can prove verifiably that they are not developing nuclear weapons. It establishes rules for the transfer of fissionable materials between NWS and NNWS. Under Articles I and II of the treaty, the NWS agree not to help NNWS develop or acquire nuclear weapons, and under Article VI the NNWS agree to pursue ultimate disarmament of nuclear weapons. Particularly relevant to today's new build era is Article IV which states:

"Parties to the Treaty in a position to do so shall also co-operate in contributing alone or together with other States or international organizations to the further development of the applications of nuclear energy for peaceful purposes, especially in the territories of non-nuclear-weapon States Party to the Treaty, with due consideration for the needs of the developing areas of the world."

Article III tasks the International Atomic Energy Agency with the inspection of the nuclear facilities of non-nuclear-weapon states in order to confirm that NPT commitments are observed and that diversion of nuclear materials for weapons purposes is not taking place. These are known as safeguards.

The first pillar- non-proliferation-difficulties with membership

The NPT has near comprehensive membership but India, Israel and Pakistan are not signatories. The problem is that to accede to the treaty, these states must do so as NNWS, because NWS status is restricted to states that "manufactured and exploded a nuclear weapon or other nuclear explosive device prior to 1 January 1967." India, Israel, and Pakistan, all possess or are suspected of possessing nuclear weapons. To join the treaty as NNWS they have to dismantle these weapons and also place nuclear materials under the IAEA safeguards. South Africa took these steps 1991 but Pakistan sees its exclusion as nuclear apartheid and the NPT signatory states as having formed a cartel which it is not permitted to join.

The treaty is reviewed at a conference held every five years with a decision on extension at 25 years. The 1995 review conference extended the treaty indefinitely and required also that five-year review conferences review past implementation and address approaches to further strengthen the treaty.

The second pillar- nuclear disarmament

The ideal of disarmament has remained an ideal. In theory a nuclear weapon free world the market for enriched uranium could adopt similar characteristics to trade in other energy providing commodities such as coal, and oil and gas.

Israel is believed to be an undeclared nuclear power. North Korea, Iran and Iraq have been or still are pursuing nuclear weapons programmes. South Africa and Libya have discontinued theirs. India and Pakistan have become nuclear weapon states outside of the NPT.

Some argue that whilst the NPT could be argued to have slowed proliferation, the failure of the disarmament pillar is partly attributable to breach by the NWS themselves. As an example, at the time of negotiation of the NPT the North Atlantic Treaty Organisation (NATO) had secret nuclear weapons sharing agreements in place under which the US provided nuclear weapons to be used by, and stored in, other NATO states. Some said this was a breach of Articles I and II. The US argued that it was in control of the weapons within the NATO states, and so no transfer had taken place.

The third pillar- right of the Non-Nuclear Weapon States (NNWS) to use nuclear technology for peaceful purposes

The area of concern here is that enriched uranium used by nuclear reactors generating electricity commercially can either be bought from the international market or enriched domestically. Countries choosing the latter option might easily apply knowledge of enrichment and reprocessing capabilities gained to development of a nuclear weapons programme.

Other regional treaties similar to the NPT include the Treaty for the Prohibition of Nuclear Weapons in Latin America (Treaty of Tlatelolco), the South Pacific Nuclear-Free-Zone Treaty (Treaty of Rarotonga), the African Nuclear-Weapon-Free Zone Treaty (Treaty of Pelindaba), the Treaty on the Southeast Asia Nuclear-Weapon-Free Zone (Treaty of Bangkok), and the Central Asian Nuclear-Weapon-Free Zone Treaty (Treaty of Semipalatinsk).

The Zangger Committee

The NPT does not provide detail on the definition of nuclear material and technology. So consultations towards agreeing on the export conditions to be required by the supplier states

commenced. As a result in 1971 “equipment or material especially designed or prepared for the processing, use or production of special fissionable material” was categorized and became known as the "Trigger List". Export rules were developed to regulate export of such equipment and material to non-nuclear-weapon states.

Indian atomic test 1974

Two months later India exploded a plutonium device which it stated was a peaceful test. Canada, the US and France had all provided nuclear infrastructure in India on the understanding that it was to be used for electricity generation. Years later in 1997 the physicist who had lead the program, Raja Ramanna, commented that actually "the Pokhran Test was a bomb…*it* was not all that peaceful". A trade embargo with India ensued.

Agreements with Brazil and Pakistan

Additionally at this time agreements were concluded between Germany and Brazil and France and Pakistan for the construction of nuclear power plants and reprocessing facilities. Brazil and Pakistan had not signed the NPT. This added to concerns that as things stood the existing non- proliferation mechanisms were not preventing their signatories from promoting proliferation. Naturally competition for lucrative nuclear contracts was a temptation and additional states were joining the nuclear supply chain.

The US takes action

A new policy was launched by the US to tackle the problem of states which refused to allow access for international inspection whilst converting civilian nuclear activity including enrichment and reprocessing (ENR) technologies and capabilities into programs for military research.

The Nuclear Suppliers Group (NSG) guidelines

By 1977 it had not been possible to reach agreement on a formal treaty so an adoption process by unilateral commitment to Nuclear Suppliers Group (NSG) guidelines was agreed. Guarantees were provided to states which renounced reprocessing that their reactors would be supplied.

These guidelines for "trigger list" items were gradually adopted by an increasing number of states. Decisions on export applications are taken at the national level in accordance with national export licensing requirements. All EU member states are automatic NSG members. However, the guidelines were viewed, by developing countries, as an indication that industrialised countries wanted to promote a monopoly or at best interference in the development of energy industries in countries purchasing nuclear materials, equipment and/or technology. An important feature of the guidelines is that control of the transfer of items included in the trigger list cannot be rendered ineffective by an onwards transfer of the various components of these items.

The NSG Guidelines go beyond the Zangger Committee Guidelines in that they extend to the technology for the development, production and use of the items on the list. They apply to transfers for peaceful purposes to any NNWS (with the exception of India) and, in the case of retransfer, to transfers to any State. Technology transfers associated directly with any item on the list “will be subject to as

great a degree of scrutiny and control as will the item itself, to the extent permitted by national legislation".

US section 123 Agreements

The updated Section 123 of the Atomic Energy Act 1954 (added by US Non Proliferation Act 1974) subjected all future co-operation agreements to nine conditions, reduced to seven when the other contracting party is an NWS. The conditions establish the process for major nuclear cooperation between the United States and other countries. In order for a country to enter into such an agreement with the United States, that country must commit to these non-proliferation criteria. The United States has entered into nuclear cooperation agreements with 23 countries, the International Atomic Energy Agency (IAEA), the European Atomic Energy Community (EURATOM), and Taiwan.

Particularly controversial among the section 123 non-proliferation criteria are:

- U.S. consent is required for any re-transfer of material or classified data.
- U.S. prior consent rights to the enrichment or reprocessing of nuclear material obtained or produced as a result of the agreement.
- Prior U.S. approval is required for highly-enriched uranium (HEU) and plutonium obtained or produced as a result of the agreement. An agreement permitting enrichment and reprocessing (ENR) using U.S. provided material requires separate negotiation.
- The above non-proliferation criteria apply to all nuclear material or nuclear facilities produced or constructed as a result of the agreement.

The President may exempt a proposed agreement from any of the criteria upon determination that maintaining such a criteria would be "seriously prejudicial to the achievement of U.S. non-proliferation objectives or otherwise jeopardize the common defence of the United States." There are no 123 agreements in force that were adopted with such exemptions.

A 123 agreement alone does not permit countries to enrich or reprocess nuclear material acquired from the United States and permission to do so requires a further negotiated agreement. A debate is currently raging in the non-proliferation community over the "Gold Standard," named after the U.S.-UAE 123 agreement signed in 2009 under which the UAE renounced pursuing enrichment and reprocessing (ENR) technologies and capabilities. The UAE agreement is in contrast to the "blanket consent" granted to India, Japan, and EURATOM, who have ENR approval from the U.S. This consent is being sought by other countries as many 123 agreements are up for renegotiation this year including that of South Korea which would like to be able to enrich and reprocess its own fuel.

In 2011 letter from the Obama administration renounced the idea of a uniform approach to 123 agreements and advocated a case-by-case approach in future negotiations.

Fissile Material Cut-Off Treaty

In 2004, the US declared the prevention of the further spread of uranium enrichment and plutonium as a major aim of its non-proliferation policy. It has been encouraging a number of countries including Pakistan, to sign a Fissile Material Cut-Off Treaty (FMCT). This treaty would prohibit the production of the two main components of nuclear weapons: highly-enriched uranium (HEU), and plutonium. Discussions on this are being held within the UN Conference on Disarmament (CD). This is

a body of 65 member nations established as the sole multilateral negotiating forum on disarmament. The CD requires consensus for action to take place. Unfortunately, negotiations for an FMCT have not as yet been entered into, though preliminary discussions are ongoing.

NNWS to the NPT are already prohibited from producing or acquiring fissile material for weapons. An FMCT would extend this restriction to the five NWS and for the four nations that are not NPT members (Israel, India, Pakistan, and North Korea). Pakistan has been concerned that an FMCT would place them into a disadvantageous position relative to India's larger nuclear stockpile and would like an FMCT to cover current fissile material stockpiles, rather than just future production. In this it is supported by others.

The US, Japan, Australia, and several other countries have stated that they will support moving negotiations for an FMCT from CD to another forum if deadlock continues.

Developments in NNWS states

North Korea built uranium enrichment plant in 2010 and may have or be in the process of constructing others. Talks are ongoing with Iran in relation to winding down its enrichment programme whilst ensuring security of supply of fuel for its nuclear power requirements into the future. The UAE has agreed not to enrich or reprocess nuclear fuel. In accordance with its cooperation agreement with the US the Emirates Nuclear Energy Corporation (Enec) has awarded contracts for the supply of uranium concentrates, conversion and enrichment service to France's Areva and Russia's Techsnabexport (Tenex). Canada-based Uranium One and UK-based Rio Tinto will also supply uranium. Converdyn in the US will also provide conversion services and UK-based Urenco enrichment services. Aligned with these services are various nuclear cooperation agreements with the UK, South Korea and France and an agreement with Australia enables the supply of uranium in support of its arrangements with Rio Tinto and Uranium One. NNWS Turkey has uranium deposits of its own to support its new build program, as does Romania. Poland has a contract with Areva for its uranium requirements. Brazil has enrichment capability. Argentina has plans to resume uranium mining and carries out some front end nuclear fuel services domestically.

Dual use technology

Growing concerns raised by supplier states and by some developing countries, even before the revelations about the Iraqi nuclear program, lead to an informal meeting of the NSG in 1991, the first since 1978. The aim was to consider ways of controlling transactions relating to items relating to peaceful use of nuclear power which could equally be put to use in relation to weaponisation, or dual-use items, not previously covered by the guidelines.

It was decided that recipient states should be requested to:

- apply full scope safeguards i.e. application of IAEA controls to all existing or future trigger list items
- adopt guidelines governing the conditions of transfers of dual-use nuclear items and a list of items to which these guidelines apply was adopted,
- make use of information exchange mechanisms between member states as regards applications for an export licence. These objectives consisted of a commitment by the supplier state to avoid all transfers of dual-use items which could have a major contribution

to the pursuit of “nuclear explosive activities” or a “nuclear fuel cycle activity not subject to safeguards".

The guidelines they introduced the concept of universality by making this non-proliferation principle applicable not only to NNWS but also to NWS where an unacceptable risk of diversion existed.

IAEA inspectors become aware of irregularities

Irregularities picked up by IAEA inspectors in North Korea in 1992 raised the need for a more restrictive export policy. The IAEA required wider access to information, through the taking of samples in the environment, and impromptu inspections.

1995 NPT Extension Conference

The term of the NPT was for a term of 25 years. In 1995 a decision was adopted to extend the treaty indefinitely and unconditionally, but the precise wording was not finalised.

The effect of September 11 2001.

Terrorist risk and the risk presented by terrorist groups acquiring weapons of mass destruction (WMD) came to the fore. Non- proliferation regulation had been designed with states not non state actors in mind. It was now essential to include the fight against terrorism not only in the guidelines of informal instruments such as the NSG, the Wassenaar Arrangement (a multilateral export control regime with 41 participating states including many former Warsaw Pact countries) and the Missile Technology Control Regime (MTCR) (an informal partnership between 34 countries to prevent the proliferation of missile and unmanned aerial vehicle technology capable of carrying a 500 kg payload at least 300 km) but also within specific bodies “whose natural role was not to deal with these issues” such as the G8 Summit, NATO, the OSCE (Organisation for Security and Co-operation in Europe), the European Union and the UN.

The Proliferation Security Initiative (PSI) was proposed by the United States in Krakow in May 2003 and endorsed by the G8. The PSI intercepts suspect transfers associated with WMD. It is a co-ordination instrument implemented through the goodwill of the participating states.

In 2004 it came to light that A.Q. Khan, when he was head of the Khan Research Laboratory in Pakistan, operated an illicit network that supplied sensitive nuclear technologies and equipment to help some states fulfil their nuclear weapons ambitions. This included the transfer of enrichment technology to North Korea, Iran and Libya. North Korea may have offered technology to other states, e.g., Iraq and Syria.

The United Nations Security Council adopted Resolution 1540.[90] This stipulates that “states shall refrain from providing any form of support to non-state actors that attempt to develop, acquire, manufacture, possess, transport, transfer or use nuclear, chemical or biological weapons and their means of delivery”.

The failure of the 2005 NPT Review Conference

In May 2005, the seventh five yearly NPT Review Conference was held in a difficult international context which prevented the adoption of a final declaration. North Korea had announced its intention to build a nuclear weapon, the Libyan nuclear program for military end use had been discovered as had Iran's undeclared enrichment program. Progress by the NWSs had been negligible.

Egypt, blocked consensus on the agenda of the conference for five days. Iran took advantage of Egypt's position to prevent its case from being discussed. The United States blocked all progress, as did France which also had an interest in no result being achieved.

However, no member state called the treaty into question and the potential for imposition of enhanced rights of inspection via of the IAEA's Additional Protocol tool was widely accepted,

India is made an exception to the NPT rules

An agreement was signed between the U.S and India in 2005 announcing full co-operation on civilian nuclear energy between them. The re-opening of India's nuclear market to foreign exporters, in particular U.S. suppliers, was made conditional on implementation of certain commitments by India. US President Bush undertook in return to persuade the U.S. Congress to amend the Arms Export Control Act and the US Nuclear Non-Proliferation Act 1978, and "convince" the NSG member states to introduce an exception to their guidelines for trade with India. This was needed because India does not meet the NSG's two main export conditions; to authorise nuclear transfers only if the supplier state is convinced that the planned transfers will not be used to develop a nuclear weapon, and that the recipient state has an agreement with the IAEA on the full scope of safeguards.

India agreed to: identify its civilian nuclear installations and to separate them from military activities; to make its civilian nuclear activities subject to full scope safeguards; to sign an additional protocol; to maintain its moratorium on nuclear testing; to develop an export control regime in line with NSG and MTCR, to "secure" the technologies and materials in its possession to prevent their proliferation, to support the proposed treaty banning the production of fissile material for nuclear weapons and to promote nuclear disarmament.

The US Nuclear Non-Proliferation Act of 1978, which transposes NSG guidelines into domestic law indirectly prevents the conclusion of any nuclear agreement with states with nuclear weapons which have not signed the NPT. So it was consequently necessary first to amend the Nuclear Non-Proliferation Act with a view to introducing a specific exception for India.

The resulting Hyde amendment passed in 2007 has been criticized for undermining U.S. international counter-proliferation efforts.

There was a knock on effect in that it the NSG guidelines also needed to be amended.

France wanted to prevent the United States from monopolising the Indian market. India and France met and France agreed to "full international civilian nuclear co-operation with India".

In August 2008, the IAEA approved a safeguards agreement between India and the IAEA. India signed the additional protocol which gave the IAEA the widest possible powers to inspect and control its civilian nuclear facilities and nuclear activities subject to safeguards. So India fulfilled the essential undertakings and the US moved on to persuade the NSG to introduce an exception authorising nuclear trade with India after a nuclear embargo lasting almost 35 years.

Japan opted not to trade with India. In 2008, France, the United States and Russia concluded co-operation agreements with India, joined, in 2009 by Kazakhstan, Argentina, Canada, Namibia and Mongolia.

It is clear that the exception was agreed to in the light of the opportunity for commercial exploitation. Some members remained skeptical including Netherlands, Austria, Ireland, New Zealand, Norway and Switzerland.

In order to meet these concerns New Delhi undertook to refrain from contributing to proliferation and to suspend all nuclear testing. China strongly opposed approval of the exception for India by the NSG, but did not in the end object.

A radical change to the principles of non-proliferation

The NSG exception in favour of the India changed the principles of non-proliferation of nuclear weapons as established by the NPT. India has, in effect, de facto NWS status. It can be argued that NPT does not prohibit civil trade with a state not party to the treaty, provided that trade is compliant with IAEA safeguards. Equally, it can be argued that by developing a military nuclear program, it has not breached any international commitment as it is not a party to the NPT.

Some states took political decisions to renounce nuclear weapons for the right of access to civilian technology. But the NSG break with this principle has created a risk that some states, feeling that their efforts have not been adequately rewarded and they may be missing out, might reconsider their political decisions.

Resolution 1887

In 2009 (with the US in the chair) the United Nations Security Council adopted Resolution 1887 by which it took a role in reinforcing the global framework for the non-proliferation of weapons of mass destruction, emphasising nuclear weapons. The Resolution encourages states party to the NPT to comply with their obligations and undertakings and states not party to the NPT to accede to the treaty as non-nuclear-weapon states. All states should reinforce national export control systems, secure sensitive materials and control access to intangible transfers of technology and sensitive goods and technologies relating to the nuclear fuel cycle.

States are also to require, as a condition of nuclear exports, that the recipient state agrees that, in the event that it should terminate, withdraw from or be found by the IAEA Board of Governors to be in non-compliance with its IAEA safeguards agreement, the supplier state would have the right to require the return of nuclear material and equipment provided prior to such termination, non-compliance or withdrawal, as well as any special nuclear material produced through the use of such material or equipment. Clearly, demanding requirements.

Export control systems

As we have seen in relation to dual-use technology many technologies and materials required for the creation of a nuclear power program can be vulnerable to diversion for nuclear weapons.

In a new build era the construction of more nuclear reactors unavoidably increases nuclear proliferation risks.

If development of nuclear programs is "poorly managed or efforts to contain risks are unsuccessful, the nuclear future will be dangerous"[(i)] For nuclear power programs to be developed and managed safely and securely, it is important that countries have domestic "good governance" characteristics.

These characteristics include:

- low degrees of corruption
- high degrees of political stability as a measurement of the likelihood that the government will be destabilized or overthrown by unconstitutional or politically-motivated violent means or terrorism,
- high governmental effectiveness scores measured in terms of the quality of the civil service and the degree of its independence from political pressures and the quality of policy formulation and implementation, and
- a strong degree of regulatory competence

Uranium trade control in the EU and the UK

In the UK the Export Control Organisation (ECO) regulates who can export controlled goods and the process for obtaining a licence under the Export Control Order 2008 made under the Export Control Act 2002. The Uranium Enrichment Technology (Prohibition on Disclosure) Regulations 2004 (the UET Regulations) govern Uranium Enrichment Technology (UET).

European regulation, EU Dual Use Regulations 2009 running alongside UK legislation, stipulate how Dual Use technology should be dealt with and the UK Department for Business, Innovation and Skills (BIS) maintains and publishes a list of Dual Use Items.

A body will also require authorisation from a member state to act as a broker in the export of dual use items. ".

What is an export?

An "export" occurs when material, including material sent electronically or communicated verbally, crosses the UK border. An intention to export is not necessarily required. An export could include the taking or sending of any information outside of the UK via the following means:

- Physical exports – laptop, blackberry, memory stick, disk or hard copy document;
- Electronic transfer – email, fax, video conference, intranets or shared data environments; and
- Remote access from overseas to emails or corporate networks.

Technology contained on an employee's laptop will be exported if that employee takes the laptop outside the UK. An export can also take place for certain sensitive technology where that technology is transferred within the UK but where it is known or ought reasonably to be known that such technology will be used outside the UK. That would include, for example, a site visit by someone who may then transfer that technology outside of the UK.

UET may still be export-controlled, for example, even though the intended project purpose is the treatment of nuclear waste because the technology is capable of being used for uranium enrichment.

The "specified activities" covered by the UET Regulations include: treating uranium with a view to enrichment; manufacturing enrichment equipment; adapting equipment to make it capable of enrichment and testing the working of enrichment equipment. Importantly, an unauthorised disclosure does not have to be made intentionally, the person disclosing merely has to be "reckless" in doing so.

A person is reckless if at the time of making a disclosure of UET:

- he has actively recognised that any disclosure would create a risk that somebody seeking to carry out a "specified activity" might be assisted by receiving that information; or
- he is indifferent to the risk; or
- if the risk is obvious, he has failed to give any thought to the probability that disclosure would create a risk.

Breach is a criminal offence. Penalties vary depending on the type of offence but they focus on blatant and often intentional breaches of export regulations.

The UET Regs provide that:

- no person within the UK (of any nationality), and
- no 'UK person' (being a UK national, a 'British Overseas citizen', or a corporate body incorporated under UK law) who is outside of the UK

may disclose UET to any person (of any nationality) anywhere in the world.

However, the UET Regulations allow the ECO to authorise such a disclosure within the terms of a licence depending on the complexity of the proposed transfer. For instance, a Standard Individual Export Licence (SIEL) is designed to cover a single shipment to a single End-User. This will be quicker to process than an Open Individual Export Licence (OIEL) covering multiple shipments to multiple End-Users.

Licensing can be subject to changes even where licenses have been granted, for instance, the UK Government has restricted dual-use exports to Argentina and Russia as part of political sanctions strategies.

Practical example of the steps taken to avoid breach

A small part of the technology used within a proposed nuclear waste processing facility is similar to that used in the uranium enrichment process and so subject to export controls and the UET Regulations.

The Project has the benefit of an OIEL. Under its terms disclosure of UET to anyone located in a country outside of those listed on the OIEL is prohibited. A disclosure which is compliant with the OIEL is an "authorised disclosure" and therefore not a breach.

The design for the facility carried out by a third party is sent to the developer of the nuclear waste processing facility. It is initially deposited in the central IT network space accessible by the wider project team. However, UET is identified, segregated and marked as "Protect-Commercial" information within the IT network, but separated from the wider project data. In the meantime, an

outsourced engineering team in a non OIEL country is working on the "non-sensitive" content of the Project.

If UET is exported outside of the OIEL listed countries, a reckless disclosure could be alleged.

In avoiding a breach of the UET Regulations, the segregation of UET and the granting of access to authorised personnel only within the UK and OIEL countries only is key. Beware, privileged IT personnel may have access to UET regardless of how it is separated on their network. Strict security processes must be in place for such personnel to protect against breach.

The ECO would not typically seek to punish those who attempt to comply with the UK's Export Rules but breach them in "minor" ways. They see their role as enforcing the rules against those who seek to flout the rules, and guide those who seek to comply with them).

Export control in the US

As seen above the US applies a gold standard to nuclear export control. Its export controls apply even if controlled goods are neither exported to nor from the US. The tests are: Is any of the technology of US origin? Are or were any of the exports comprised of US origin material? Or does the exporter (or its client) have US exposure which might result in the exporter being exposed to US law even if the technology is not US origin technology? This level of 'extra-territoriality' of USA export control laws is unique and breaching them can carry heavy penalties.

Customers of the US must deal with four departments which administer four sets of regulations, and go through a complex interagency review process. The rules refer to "assistance to foreign atomic energy activities" but lack detail.

There is a legal requirement for bilateral nuclear cooperation agreements for transfers of source and special nuclear material (enriched uranium), which also require U.S. consent for retransfers of certain U.S.-origin equipment, components and material, retransfers of material produced through the use of such items, and for any enrichment or reprocessing of such material.

Other nuclear supplier countries have followed suit and entered into nuclear cooperation agreements with customer countries. Such agreements set out any restrictions on exchange of nuclear technology, any retransfer requirements and indicate export application processing time periods.

For instance Russia has agreements in place with India, Czech Republic, the UK, the Republic of Korea and Japan. The Republic of Korea has agreements in place with India Czech Republic, the UK and Japan.

The US decision-making on export license applications is slower than for other regimes. It has developed over many years. By contrast, the regimes designed by, for instance, Russia, Japan and South Korea are more modern, easier and quicker to navigate. US exporters have complained that these differences leave them at a disadvantage next to their competitors in the international export market.

In 2010 the then-US Secretary of Defence Robert Gates stated:

The problem we face is that the current system, which has not been significantly altered since the end of the Cold War, originated and evolved in a very different era with a very different array of concerns in mind. ... The current arrangement fails at the critical task of preventing harmful exports while facilitating useful ones.

Is it time for review?

In his address to the IAEA's *56th General Conference*, IAEA Director General Yukiya Amano noted that developing countries continue to show keen interest in nuclear power.Whilst some have a chronic need for stable electricity supplies in order to progress their economic and social infrastructure and aspire to become nuclear states many nations already benefiting from nuclear programs have traditionally looked to place the bar even higher, driven by security and safeguarding concerns.The safeguarding regime initially designed to combat institutional proliferation by states relying on policing by their customs authorities may not now be suitable to combat non- state nuclear terrorism. In the US context can section 123 agreements continue to be the way forward in relation to the development of nuclear power in emerging nuclear states? Do the current good governance guidelines set out above remain realistic? What other regimes could be considered?

A view from the European Commission

The Commission has concerns that its current approach to control of the export of dual use items and therefor its role in counter-proliferation is due for review. On the expansion of nuclear power into third countries it is of the view that differentiated control standards can create distortions of competition and weak links in the global supply chain that proliferators can take advantage of. To counter this it sees the way forward through standardised export control arrangements.

Like the US it believes the current regime may have the effect of hampering the competitiveness of its member states.

The Commission suggests the development of an integrated risk-driven strategic trade control model, which would involve a review of existing regulation, development of guidelines and pooling arrangements, a review of the coherence of export control mechanics, openness, stakeholder engagement review of the international dimension.

The vision of the Commission includes evolving a "human security" approach which goes wider than nuclear security, and a "smart security" approach involving the development of an "EU technological reaction capacity" for responding to technical discussions of control lists, and challenges posed by emerging technologies such as cloud computing, 3-D printing, and nanotechnology) together with de-control of items that have become obsolete or are widely available commercially.

Subject to consultation the Commission would wish to move to an effective EU response to the use of cyber-space for proliferation without hindering the competitiveness of the EU (ICT) industry and its integration into global supply chains**.**

It considers that through clarifying the notion of export, exporter and broker it may be possible to move towards a different mode with an emphasis on end-use monitoring and better facilitation of legitimate exports and detection of illicit trade. It would also like to study intangible transfers of technology and its traceability with a view to exploring the suitability of pre-transfer control provisions such as registration, self-auditing and post-transfer monitoring or compliance audits - rather than on the transmission itself.

It would want to encourage more open licensing potentially introducing levels of control which were variable allowing "Low Value Shipments" to facilitate export of small quantities of items; "Encryption", to allow the export of ICT items widely used in highly competitive industrial processes; "Intra-company technology transfers" for research and development purposes; ease of "Intra-EU transfers"; "Large projects" allowing authorities to look at the "bigger picture" rather than an accumulation of individual licensing applications.

The IAEA, a Multilateral Nuclear Approach (MNA)

The IAEA has been concerned that the decades long nuclear non-proliferation effort is under threat from a number of fronts not least that the civilian nuclear industry appears to be poised for worldwide expansion. Rapidly growing global demand for electricity, the uncertainty of supply and price of natural gas, oil prices, and climate change concerns have forced a fresh look at nuclear power. As we have seen greater number of States are considering development of their own fuel cycle facilities and nuclear know-how, and will seek assurances of supply in materials, services and technologies.

To counter this the IAEA has suggested five possible approaches:

1 Reinforcing existing commercial market mechanisms on a case-by-case basis through long-term contracts and transparent suppliers' arrangements with government backing. Examples would be: fuel leasing and fuel take-back offers, commercial offers to store and dispose of spent fuel, as well as commercial fuel banks.

2 Developing and implementing international supply guarantees with IAEA participation. Different models should be investigated, notably with the IAEA as guarantor of service supplies, e.g. as administrator of a fuel bank.

3 Promoting voluntary conversion of existing facilities to a multilateral nuclear approach (MNA), and pursuing them as confidence-building measures, with the participation of NPT non-nuclear weapon States and nuclear-weapon States, and non-NPT States.

4 Creating, through voluntary agreements and contracts, multinational, and in particular regional, MNAs for new facilities based on joint ownership, drawing rights or co-management for front-end and back-end nuclear facilities, such as uranium enrichment; fuel reprocessing; disposal and storage of spent fuel (and combinations thereof). Integrated nuclear power parks would also serve this objective.

5 The scenario of a further expansion of nuclear energy around the world might call for the development of a nuclear fuel cycle with stronger multilateral arrangements – by region or by continent - and for broader cooperation, involving the IAEA and the international community.

Assurance of Supply for Nuclear Fuel

In 2010, the IAEA authorized the establishment of a reserve of low enriched uranium (LEU), to be owned and managed by the IAEA. Should an IAEA Member State´s LEU supply to a nuclear power plant be disrupted, and the supply cannot be restored by the commercial market or other existing arrangements it may call upon the IAEA LEU bank to secure LEU supplies, without distorting the commercial market. LEU from the bank would only be supplied to an IAEA Member State which has brought into force a safeguards agreement requiring the application of IAEA safeguards to all its peaceful nuclear activities. Availability of fuel from the bank would avoid the need for the state to develop its own enrichment technology.

Kazakhstan is interested in hosting this and donor states have pledged 125 million US dollars and 25 million euros to cover the initial estimated operational expenses and of delivery of LEU to the IAEA LEU bank.

Conclusion

Despite the lack of comprehensive consensus on how to regulate trade in enriched uranium and related technology and knowhow, and the inequalities driven by the history of the development of the nuclear industry, it is clear that overall there have been improvements to the system of regulation.

Where remedies for non- compliance are not set out in detail, or would be difficult to pursue, failure to comply with commitments will generally produce a diplomatic or economic reaction by the other partner States. The desire to impose such sanctions is partly driven by the sacrifice of trading opportunities which those states have made in placing their political commitments over their economic and commercial interests by refusing to enter into competition in an unacceptably run market.

However, in a new build era it is surely important to develop a system which eases access to enriched uranium and other nuclear materials especially to those nations looking to rely on nuclear power for economic step change.

Is it possible that the EU's suggested integrated risk-driven strategic trade control model, the multilateral approach of the IAEA and/or the proposed Fuel Bank can herald a new direction? Only time will tell.

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[i] Steven E. Miller & Scott D. Sagan (Fall 2009). "Nuclear power without nuclear proliferation?". *Dædalus*.