WORLD NUCLEAR ASSOCIATION

An Effective Export Control Regime for a Global Industry

Title: An Effective Export Control Regime
for a Global Industry
Produced by: World Nuclear Association
Published: April 2018
Report No. 2018/001

Contents

Executive summary

Nuclear energy is making a growing contribution to low-carbon electricity supply around the world. Annual trade in nuclear fuel, reactor systems and components has the potential to increase from about $14 billion today to nearly $40 billion by 2035. Achieving this potential could depend in part on the introduction of a more streamlined and flexible approach to trade, as has occurred in other strategic sectors.

Export controls aim to preclude states and unauthorized entities from acquiring materials, equipment and technology that could be used to make a nuclear or radiological weapon. An overarching regulatory framework is provided by the International Atomic Energy Agency (IAEA) but authority for controlling the increasingly international trade in nuclear technology, goods and services rests with national governments through an exception to the General Agreement on Tariffs and Trade. Unfortunately, disparate and unevenly applied licensing of nuclear exports by national export control authorities can excessively hinder lawful and compliant international trade in nuclear materials and technology. An effective nuclear export control regime should be risk-based, internally consistent and well-communicated, and avoid national disparities in licensing.

Regulations on the transfer of technology can also affect the nuclear community's scope for international cooperation, including safety-related information exchange and the rendering of assistance between nuclear power plant operators. This means, for example, that nuclear facility operators and experts at the World Association of Nuclear Operators cannot always communicate directly with a plant that needs assistance.

All Nuclear Suppliers Group (NSG) participating states have a safeguards agreement with the IAEA and most are also signatories to the amended Convention on the Physical Protection of Nuclear Material. Many governments continue nevertheless to add an extra layer of scrutiny to the licensing process. In principle, exports to recipients whose facilities are under safeguards should not be considered a significant proliferation risk.

The degree of scrutiny accorded to civil nuclear exports should be risk-based. A nuclear power reactor subject to international safeguards poses a relatively low technology risk with respect to proliferation. The same is true for components, spare parts, and maintenance or repair services for that facility. Nuclear fuel assemblies made of low-enriched uranium pose a slightly greater proliferation risk than a nuclear reactor itself (which cannot operate without fuel). However, nuclear fuel should not be subject to a requirement for licence approval prior to shipment between NSG participating states, as they have accepted IAEA monitoring and will have an adequate physical protection regime in place. In these situations a general authorization for low-enriched fuel exports with a simple reporting requirement to the strategic goods control authorities of the countries involved in the shipments should provide sufficient assurance.

Enrichment and reprocessing technologies are associated with a higher proliferation risk and there is thus greater justification for licensing each transaction through an individual application for export.

The world nuclear industry contributes to countering proliferation through robust internal compliance programs at company level to ensure that

transactions do not involve suspect parties. Yet most export control authorities do not issue general export licences for nuclear-related items, even though they do issue such licences for certain non-nuclear dual-use items in, for example, the aerospace and defence industries. Nuclear exporters should be able to gain a status similar to authorized (or trusted) economic operator programs used by customs authorities provided they apply diligently a robust and comprehensive internal compliance program.

Resources can be better employed if exporters and governments made greater use of risk assessment. Companies should be able to direct their efforts to those areas where a proliferation risk exists and to reduce the burden of compliance with a licensing process where the proliferation risk is already controlled by like-minded governments. Destinations of concern could be checked out ('red flagged'), while those that are already under international safeguards could be accepted as eligible to be fast-tracked.

The NSG should do more to exchange information and engage with the industry. A forum for industry-regulator cooperation in the export control and non-proliferation area involving the relevant inter-governmental organizations including the IAEA, NSG, Wassenaar Arrangement, the World Customs Organization, and the UN Office for Disarmament Affairs would be useful. The International Framework for Nuclear Energy Cooperation could act as a forum for the discussions. Agreement on a road-map for streamlining the international export control regime would be a useful early output. A further deliverable could be a first draft of an international standard for export control compliance developed through the International Organization for Standardization.

The World Nuclear Association is ready to collaborate in such a forum to assist in building a more effective and efficient export control regime.

1 Introduction

The civil nuclear power industry operates under a special regulatory regime designed to ensure a high level of safety and to safeguard its technology against misuse. An overarching regulatory framework is provided by the International Atomic Energy Agency (IAEA) but authority for controlling international trade in nuclear technology, goods and services rests with national governments. Inevitably there are differences in regulation and a web of bilateral and multilateral agreements has been built up since the 1950s. These differences and uneven licensing procedures for nuclear exports can hinder lawful and compliant international trade in nuclear materials and technology and safety-related information exchange.

Nuclear power developed as a state-controlled industry in its early years. Then, through government-to-government agreements, reactor technology began to be made available to a wide range of countries. The creation of IAEA safeguards enabled nuclear exports to take place, with the US-organized Coordinating Committee for Multilateral Export Controls (CoCom) relaxing its embargo on nuclear exports provided that the exports would be subject to international safeguards. Thus, the trade control framework began to facilitate as well as restrict nuclear cooperation. International trade in nuclear materials and technology for peaceful purposes has grown and there is now a competitive global market in existence. An international supply chain has emerged, although it remains a nationally controlled system. Regrettably, international export control rules were established informally and are therefore examples of soft law rather than being embedded in international treaties.

Nuclear energy has failed to grow at the same rate as that of energy consumption or other clean energy sources. Trade in nuclear goods and services has lagged behind general international trade expansion. There are many reasons for the lag in trade and investment in nuclear energy over the past thirty years. These can be grouped under three headings: economics; a partial perspective towards safety; and unnecessary regulatory barriers. Electricity markets often do not value the social and environmental advantages that nuclear energy offers in terms of around-the-clock reliability and a small environmental footprint. Secondly, society tends to ignore the health impacts of fossil fuels and be lopsidedly apprehensive about nuclear safety. Yet the need for nuclear energy to replace dispatchable fossil-fuelled thermal power plants could not be greater in the face of looming climate change. Thirdly, diverse licensing processes introduce additional compliance costs, especially for international supply chains. Additionally, in an increasingly interconnected world, divergences in licencing practice offer opportunities for finding ways to circumvent the rules.

This report examines one aspect of the international regulatory regime: the licensing regime for nuclear exports. The World Nuclear Association proposes changes to the export control system that will simplify, streamline and modernize these procedures whilst maintaining international safety and security. Governments can encourage the development of an international nuclear energy industry operating to the highest of standards by the removal of some of the procedural obstacles that are hindering legitimate trade and exchange of information and by fostering a level playing field for compliance.

2 International trade in nuclear materials, components and technology

There are 448 civil power reactors in the world today. Fifteen countries have reactors under construction, and of these eight entail foreign reactor designs and contractors. A small number of additional countries have embarked upon nuclear programs over the last three decades, notably China, which started nuclear power plant construction in 1987, but also including United Arab Emirates (in 2012), Belarus (2013) and Bangladesh (2018). Several more countries have firm plans to embark on nuclear projects.[1]

International trade in reactor systems and components has the potential to reach $24-30 billion a year by 2035, compared to $6-7.5 billion currently.[2] There are today more than ten consolidated technology vendors offering their technology and services across much of the nuclear fuel cycle. They are Candu Energy, China National Nuclear Corporation and the Chinese State Power Investment Corporation, Framatome, GE and Hitachi, Korea Electric Power Corporation, Mitsubishi Heavy Industries, the Nuclear Power Corporation of India, Rosatom, Toshiba, and Westinghouse. In addition, other significant technology vendors are active in the international market, including Babcock & Wilcox, China General Nuclear, Doosan, and Škoda. Most have developed a supply chain that is increasingly global in scope. The World Nuclear Association's 2016 report *The World Nuclear Supply Chain: Outlook 2035* lists 240 major independent suppliers of nuclear grade structures, systems, components and services. While the industry remains weighted towards domestic markets, the leading vendors are, for the most part, internationally diversified in terms of the corporate make-up and their supplier base.

According to International Trade Centre statistics, the estimated value of world exports of radioactive chemical elements, including natural and enriched uranium, thorium, fabricated and irradiated fuel, and radioisotopes in 2016 amounted to $7.7 billion. The export of natural uranium accounts for well over half of this international trade. Around 30 percent of the value represents exports of enriched uranium.[3] Natural uranium is mined in around 20 countries. It is converted into a suitable form for enrichment by companies including Cameco, China National Nuclear Corporation, ConverDyn, Orano, and Rosatom's TVEL. There are four major suppliers of enriched uranium to the world market – Orano, Rosatom's Techsnabexport (TENEX), URENCO and Centrus Energy Corporation – and several domestic suppliers in Argentina, Brazil, China, India, Iran, Japan and Pakistan. Twelve fuel fabricators supply low-enriched fuel assemblies, of which Cameco, Global Nuclear Fuel (a partnership of General Electric, Toshiba and Hitachi), Orano, TVEL and Westinghouse are the largest.

Competitive pressures are encouraging the localization of manufacturing, joint ventures and international procurement of systems and components for nuclear applications. As a result, production is located in several jurisdictions with materials, semi-processed and

[1] World Nuclear Association, 2017, *The Nuclear Fuel Report: Global Scenarios for Demand and Supply Availability 2017-2035*, London: World Nuclear Association.

[2] World Nuclear Association, 2016, *The World Nuclear Supply Chain: Outlook 2035*, London: World Nuclear Association: pp. iii and 36-38. UN COMTRADE/ ITC trade statistics for commodity product group HS 8401 (Nuclear reactors, fuel elements 'cartridges', non-irradiated, for nuclear reactors; machinery and apparatus for isotopic separation; and parts thereof) shows exports of $5.3 billion in 2015 and $3.9 billion in 2016.

[3] UN COMTRADE/ ITC trade statistics for commodity product groups HS 2844 (radioactive elements, isotopes, compounds and mixtures), HS 284410 (natural uranium, its compounds and alloys) and HS 284420 (enriched uranium, plutonium compounds and alloys). The reported value of exports in 2016 of $7.3 billion is understated because Ukraine and Uzbekistan have not yet reported their trade statistics for these product groups. On the basis of mine production data the missing data would boost the total value of exports by $365 million in 2016.

finished fabrications perhaps crossing several borders prior to reaching the final destination for assembly and installation. Services are also performed in different countries either as a result of sub-contracting or through the participation of specialist divisions of the same transnational corporation or industrial group. Globalization, in short, is as much a part of the civil nuclear scene as it is in other industries.

The rapid development of telecommunication has facilitated the intangible transfer of information while the growing amount of personal travel means that people can carry knowledge with them on electronic devices. Knowledge management processes are required within organizations to protect intellectual property and ensure compliance with export controls, but also to facilitate learning and share experience, especially in relation to safety. Though these objectives are not incompatible with each other they call for active management.

Despite the development of regional free trade areas, such as the European Union, the North American Free Trade Area, the Asia-Pacific Economic Cooperation area and others, export controls on nuclear technology, reactor components and radioactive materials are still exercised exclusively on a national basis. Article XXI of the General Agreement on Tariffs and Trade (GATT) allows governments to protect their essential security interests by exempting fissionable materials and the implements of war from the treaty's obligations to remove barriers to international trade. This situation is unlikely to change in the foreseeable future but steps can be taken by both suppliers and export control authorities to facilitate legitimate trade in nuclear materials, components and technology and safety-related information exchange.

3 The international export control regime for nuclear energy

Strategic export controls are part of governments' armoury to prevent weapons of mass destruction from being acquired by unauthorized entities. They complement the other elements of non-proliferation/ counter-terrorism strategy to protect the public against such threats and to pursue and prosecute those responsible.

Implementing the strategic export control regime is achieved through a number of measures:

- Legislation to establish the appropriate competencies and enforcement processes;
- Regulation to define the technologies, goods, services and materials to be controlled (a control list);
- Export licensing of defined technologies, goods, services and materials;
- Border control activities (*e.g.*, intelligence gathering, detection, inspection, interception);
- Financial sanctions on specified parties; and,
- Awareness-raising measures, public information and outreach to industry.

This report focuses on the export licensing measures and makes recommendations on this area and on related industry outreach.

Background

The International Atomic Energy Agency (IAEA) was established in 1957 to serve as an intergovernmental forum for scientific and technical cooperation in the peaceful use of nuclear technology and to provide international safeguards against its misuse. All non-nuclear weapons states that are IAEA members are required to conclude a comprehensive safeguards agreement with the agency to ensure that fissionable materials are not diverted for military purposes. This obligation was strengthened through the adoption of the Treaty on the Non-Proliferation of Nuclear Weapons (NPT). States already possessing nuclear weapons were not obliged to accept IAEA safeguards but most opened up their civil nuclear facilities to IAEA inspectors voluntarily. States that do not accept IAEA surveillance and inspection are excluded from international cooperation and trade involving nuclear technology.

IAEA member states are expected to introduce laws and regulations to control the management of nuclear technology, nuclear-related activities and nuclear materials.[4] These norms cover the control of imports and exports, amongst other elements. After the NPT came into force in 1970, several signatories formed an informal inter-governmental grouping in 1971, known as the NPT Exporters Committee or Zangger Committee (after its first chairman Claude Zangger), to agree which technologies (such as uranium enrichment technology), radioactive sources and fissionable materials should be covered by export controls. It sought to provide a common interpretation of Article III.2 of the NPT, which requires governments to control nuclear materials and certain other materials and equipment. The Zangger Committee agreed a list of goods that 'trigger' the requirement to introduce export controls and assurances that the importing state implements IAEA safeguards. This is the so-called 'trigger list'. The guidelines (or 'common understandings') are not legally binding.

[4] IAEA, 2016, *Guidance for States Implementing Comprehensive Safeguards Agreements and Additional Protocols*, IAEA Services Series No. 21, Vienna: p. 9.

[5] Australian Safeguards and Non-Proliferation Office, 2009, Nuclear Trade Outside the Nuclear Suppliers Group, Briefing Paper: p. 1. States with civil nuclear capability outside the NSG include three which have never been NPT signatories (Israel, India and Pakistan) and the Democratic People's Republic of Korea (North Korea), which withdrew from the NPT in 2003. India, Pakistan and Namibia are candidates for NSG membership.

The Nuclear Suppliers Group (NSG) was set up in 1974 by a number of countries adhering to the NPT to issue guidelines on safeguarding and controlling the international trade in nuclear and related dual-use technology, equipment and materials. The NSG's guidelines originally included two elements: a 'trigger list', which was more comprehensive than that of the one maintained by the Zangger Committee, and 'guidelines', which set out the circumstances under which nuclear exports could take place.

In the early 1990s, as the international community became more aware of the existence of clandestine nuclear weapons development programs in certain countries, the NSG guidelines were revised to address the risk that a state could covertly import strategic technologies. The guidelines concerning the trigger list (part 1 of the guidelines) were broadened to require the application of full-scope safeguards in the importing country as a condition of export. A second 'dual-use list' was added (part 2 of the guidelines) covering technologies whose export would not trigger a requirement for IAEA safeguards but which would nonetheless require a licence from the national authority in the exporting state. The guidelines were also updated to include the 'Non-Proliferation Principle', whereby an exporting country's government must satisfy itself that the transfer of technology or export of goods and services will not contribute to the proliferation of nuclear weapons or pose a risk of nuclear terrorism. If there is doubt concerning an importing country's government's intentions to comply with its commitments under the NPT (or other equivalent treaties), then the transfer or export concerned must be prohibited. In some cases the exporting country's government may request assurances from the importing country's government that the goods or technology to be supplied will not be used to make a weapon. As the NSG is not linked to the NPT, or to any other body of international law, these measures were not legally binding on participating states.

Under the NSG arrangements, countries producing the defined technologies, software, equipment and materials may only export these to those countries that have accepted the full-scope safeguards applied by the IAEA to their nuclear facilities (unless alternative exceptional arrangements are agreed). The NSG's participating governments have agreed a system for notifying each other of any decisions to restrict exports to a particular country. They apply the guidelines to each other as well as to states that are not members of the NSG. States can choose to adhere to the NSG guidelines without participating in the NSG. Most trade of nuclear technologies, equipment and materials is either between countries that participate in the NSG or involves a participating state as either a buyer or a seller, although there are some notable exceptions.[5]

The NSG and Zangger guidelines are disseminated by the IAEA.

In addition to the Zangger and NSG regimes, all governments are required to take measures to prohibit unauthorized entities and individuals from acquiring or using nuclear weapons and sensitive materials and technology, under UN Security Council Resolution 1540 of 2004. International cooperation mechanisms under the amended Convention on the Physical Security of Nuclear Materials (1987 and 2017) and the International Convention for the Suppression of Acts of Nuclear Terrorism (2007) have also been established for detecting, countering and punishing acts of: theft and smuggling of materials; the unlawful release of radioactive sources or detonation of devices; and sabotage or attacks on nuclear facilities. The conventions oblige states to: safeguard all radioactive and nuclear materials (including military stocks); return all stolen materials and devices to the country of origin; prosecute or extradite terrorist suspects; and render assistance in a crisis.

Participating governments of the Nuclear Suppliers Group (48 countries)

North America: Canada, Mexico, United States of America	**Europe:** Austria, Belarus, Belgium, Bulgaria Croatia, Cyprus, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, Netherlands, Norway, Poland, Portugal, Romania, Russian Federation, Serbia, Slovakia, Slovenia, Spain, Sweden, Switzerland, Turkey, Ukraine, United Kingdom
South America: Argentina, Brazil	
Asia: China, Japan, Kazakhstan, Republic of Korea	
Africa: South Africa	**Oceania:** Australia, New Zealand

A large number of countries have agreed an 'Additional Protocol' with the IAEA, since 1997. The model protocol is aimed at strengthening the safeguards system and places additional reporting requirements on IAEA member states. Article 2 (a) (ix) requires governments to provide information on the export of nuclear equipment and certain non-nuclear materials (IAEA member states are obliged to report on nuclear material transfers as part of the general safeguards regime). If requested, governments must also provide information on imports.[6] It should be noted that although natural uranium (uranium oxide, U_3O_8) is a controlled material and must be protected according to prudent practice, it is not capable of undergoing fission until after it is converted into uranium dioxide, UO_2. Uranium mines may be inspected by the IAEA under the terms of the Additional Protocol, but the mines and mills are not subject to the full safeguards applied to nuclear facilities.

Export controls

Export controls aim to preclude states and unauthorized entities from acquiring materials, equipment and technology that could be used to make a nuclear or radiological weapon. They are not intended to hinder legitimate trade and exchanges of information or persons. Governments recognize this point and in many cases have instituted target response times to applications for export licences so as to provide greater certainty to the exporter and avoid unnecessary delay. Good communication between the exporter and the licensing authority also assists both parties in assessing the proliferation risk attached to the transfer. Inter-agency communication is also important, as several agencies may be involved in export control, including the customs and border services.

Export licences can take one of several generic forms:

- General licence – applies to a broad category of controlled items and requires a simple declaration by the exporter of the goods and services to be exported; it is normally granted under a streamlined procedure or requires no prior authorization or even subsequent notification.
- Individual licence – requires an application from the exporter for the export of defined goods, services, or technologies to a specified destination and/or an end-user but may be granted for multiple shipments; the export control authority may consider that an assurance is needed from the importing country's government (e.g. a *note verbale*) on the use to be made of the exported item by the end-user prior to issue of the licence.
- Project licence – may be issued where a substantial project involving capital expansion or repair of a facility would otherwise require multiple applications by an exporter; the licence would be normally granted for a specified period of time.
- Global licence – covers goods and services that are being exported as part of a government-to-government agreement and is issued to the exporter (who is under contract to one of the government parties) on the basis of a declaration by the exporter through a streamlined procedure.

National and regional export control regimes vary in terms of the types of licence they are prepared to issue. Most export control authorities do not issue general export licences for nuclear-related items, even though they do issue such licences for certain non-nuclear dual-use items. This policy puts the nuclear

[6] IAEA, 1997, Model Protocol Additional to Agreement(s) Between the IAEA and State(s) for the Application of Safeguards, INFCIR/540. Annex II of the Additional Protocol specifies the equipment and non-nuclear materials that should be reported to the IAEA in the event of their export or import.

industry at a disadvantage in comparison with, for instance, the aerospace and defence industries. In a globalized world economy, transnational companies need to be able to undertake technology transfer and move sub-components and people from one division to another across national borders. A general licence would allow a company this freedom to transfer technology, sub-components and people between specified jurisdictions. At the moment Canada and the USA are able to offer general licences of this sort and provision exists for such a general licence within the European Union's regulation. The Union General Export Authorization (EU001) permits exports of some dual-use items but not those in Category 0 (nuclear technologies and materials) to Argentina, Australia, Canada, Iceland, Japan, Republic of Korea, New Zealand, Norway, South Africa, Switzerland, Turkey and the USA. There also exists the Community General Licence for Intra-Community Trade but its application to nuclear technology is restricted to source materials (and some special fissile materials such as low enriched uranium) and their related technology and software.

Only the USA provides exporters with the opportunity to apply for a single individual licence covering the supply of a complete reactor (plus the initial fuel-loading and supply of spare parts), in effect granting a project licence. In other jurisdictions this type of licence is not issued and so exporters must apply for several individual licences. For one on-going nuclear construction project outside of the USA this has required the exporting reactor vendor to make 700 applications and obtain an equal number of import certificates; all of these from governments that profess to have removed trade barriers between themselves. (This figure excludes the applications made by the exporter's many suppliers under its sub-contracts.)

Almost all NSG participating countries control nuclear exports through the issue of individual licences, whereby an exporter is permitted to deliver a specified item to a single end-user. Some export control authorities issue multi-annual export licences for the export of the same item to the same customer. Licences for multiple shipments of the same item to the same customer are also available.

Re-export of an item after its delivery – for further manufacturing work to be performed or assembly or testing – is hindered by an over-reliance on individual licensing.

Technology is defined by the NSG as the information necessary for the development, production or use of controlled items. It may take the form of 'technical data' (e.g., blueprints, calculations, diagrams, formulae, models or specifications) or 'technical assistance' (e.g. knowledge and skills, instruction and training, or consulting services). The 1996 Wassenaar Arrangement on Export Controls for Conventional Arms and Dual-use Goods and Technologies has the same definition but provides additional examples of what constitutes technical data and technical assistance. In addition the USA treats foreign personnel at US nuclear facilities as potential recipients of sensitive technology ('deemed exports').

Regulations on the transfer of technology affect the civil nuclear energy community's scope for international cooperation. Since regulatory approaches differ in practice between countries, operator-to-operator cooperation must avoid crossing certain national borders to

side-step the need to apply for an export licence. It means that some licensed nuclear operators and experts at the World Association of Nuclear Operators (WANO) cannot always communicate directly with a plant that needs assistance. Communication is instead routed indirectly through countries whose governments are known to permit such exchange of information without prior authorization.

The policy on electronic transfers of technology also needs to be examined at the international level to scope out a more consistent and coherent strategy – this is particularly so on issues such as: server location (including cloud computing); use of laptops and hand-held devices abroad; access by third party IT support services and encryption of material. As is well known, electronic communication may be routed through servers based in many different countries and telecommunication providers do not offer designated routing that will preclude particular jurisdictions. Networks are also vulnerable to intrusion by state and non-state entities.

Individual licensing of technology transfer also deters international collaboration in tendering, potentially reducing the opportunities for obtaining best value in bidding for work and the cross-fertilization of good practice and the diffusion of innovation. These barriers have been eased to a degree in the USA by the general authorization for the transfer of non-sensitive nuclear technology to the majority of NSG participating states and to the IAEA.

Greater usage of general licences and project licences need not diminish the depth of information that governments are required to supply to the IAEA under the Additional Protocol since export control authorities will continue to receive such information in the application for a project licence or if a requirement for notification of an export (or import) has been included under a general licence.

A common international approach would assist companies in evaluating the degree of security provided by their corporate procedures for data storage on portable devices and could offer the reassurance necessary to government agencies and the international community. It could permit authorized company employees, such as sales personnel or maintenance technicians for example, to access controlled information and data remotely while travelling between eligible destinations.

Governments participating in the NSG should try to iron out divergences in their licensing approaches in order to level the playing field and adapt the export control regime to the interconnected world of the twenty-first century.

4 Towards a risk-based export control regime

Fuller collaboration between the nuclear industry and governments is critical to strengthening the strategic export control regime and nuclear security more generally. There is a shared responsibility for safeguarding nuclear technology from misuse, to which both the industry and the public authorities can contribute. For the industry, 'compliance' implies the existence of clearly communicated requirements on what must be done and what types of activity are prohibited. From the viewpoint of the export control authority, an application for an export licence needs to be accompanied by sufficient information to enable a determination to be made on the basis of the proliferation risk involved. Both parties require information to be able to:

- Screen customers to check if they are legitimate end-users or agents of a legitimate end-user;
- Understand the range of potential applications of the product and to 'red flag' proposed transactions where the end-use is unclear;
- Have confidence that the supply and logistics chain is secure against diversion;
- Identify suspicious enquiries, endorsements and paperwork;
- Have confidence that an exporter's internal compliance program is adequate to undertake the above activities.

Assessing the risk of diversion or misappropriation is central to the licensing process and will depend upon the quality of information available to the exporter and to the export control authority. Companies can be expected to be knowledgeable about their customers and suppliers but may lack information about the overall situation in unfamiliar markets. Governments have more resources than companies to monitor events and trends around the world but lack specialist knowledge of industry sectors and technological developments. The resources for investigating a particular end-user or potential weak links in the supply and logistical chains are always going to be constrained and governments must be prepared to provide guidance on where they consider the risks lie in relation to specific destinations and end-users (who may be hiding behind 'front companies').

A related issue is that the method used by export control authorities to determine the degree of risk is not clear to exporters. Canada, for example, provides general export licences for nuclear technology, goods and services to a number of eligible destinations. There are also banned destinations, as a result of UN Security Council mandates. But it appears that certain other destinations are worthy of greater scrutiny, even when the country is a fellow NSG government and signatory to the NPT. In such cases, the export control authority may request that the foreign ministry obtain an end-user certificate from the importer that has been certified by the government concerned, which is usually a long-drawn out process unless a nuclear cooperation agreement is in place. The implication is that NSG participating governments do not apply the same level of export control in practice. The NSG and IAEA should encourage mutual recognition among its participating governments to confirm that they have a consistent level of exports controls in place and are applying an appropriate level of domestic control to ensure the physical protection and safeguarding of nuclear material and facilities within their jurisdiction.

There is no accepted method of risk assessment. It appears that the risk is adduced from intelligence where suspicion about an organization's

activities is aroused, or from geo-political factors. Little advice appears to be offered by governments on how companies could in practice rate the proliferation risk posed by their products in relation to potential destinations and end-users.

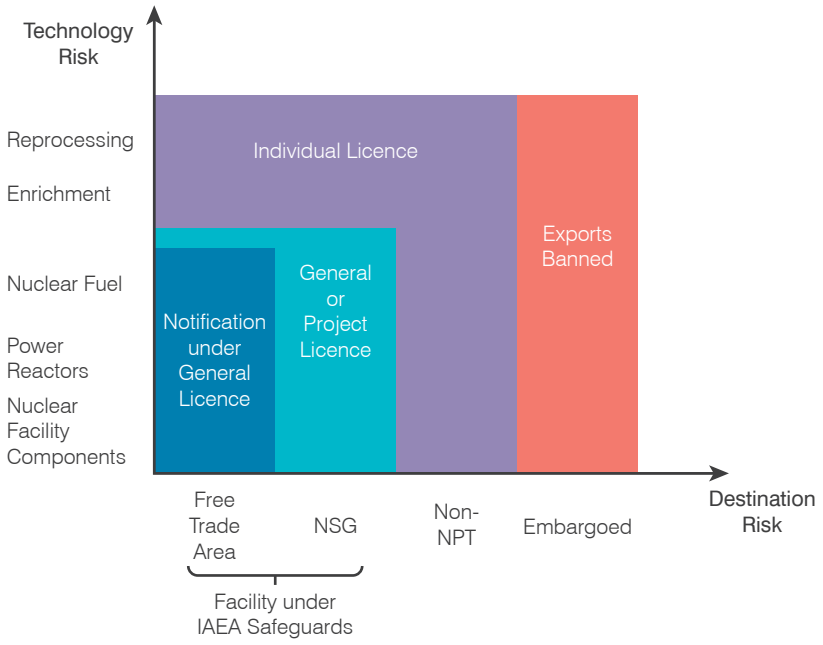
Furthermore, there needs to be much closer liaison between the export control function of governments and the diplomatic and security wings. The latter functions appear unaware that the long delays experienced in obtaining government-to-government assurances have a detrimental effect on cross-border cooperation in nuclear new build, the refurbishment of existing nuclear power plants and exchange of technical information to improve safety, to learn from other plants' good practice or for international procurement. The process of issuing such assurances needs to be streamlined if it cannot be eliminated altogether. Agreement on what should be fairly standard assurances, particularly between NSG member countries, should be afforded far greater priority.

A missing element in the current inter-state system, which is based on soft international law and avoids multilateral or binding obligations by states, is the absence of a verification mechanism to check that end-users have not diverted fissile material or sensitive technology for non-peaceful purposes. (The current system instead loads compliance onto commercial undertakings through, for example, 'catch-all' licence conditions.) Governments within the NSG should be encouraged to recognize that they are each applying an appropriate level of domestic control to ensure the physical protection and safeguarding of nuclear material and facilities. Improved inter-governmental cooperation in export control could be built upon the closer cooperation between national security and policing services in combatting international terrorism, illicit trafficking and customs fraud. The regular bilateral exchange of information between countries on exports and imports is another area where cooperation between NSG participating states is possible.

The safeguards regime on nuclear facilities, technology, equipment and materials overseen by the IAEA is the backbone of the international non-proliferation system. One element of the regime is the control of exports and imports by national governments, which are obliged to report specified transfers to the IAEA. Governments should also ensure that recipients in importing countries do not misuse the technology, equipment and materials, and this obligation has been strengthened by the adoption of Security Council Resolution 1540.

But many governments appear to have added an unnecessary layer of scrutiny to the licensing process given the fact that in many instances IAEA safeguards on nuclear facilities already exist. In principle, exports to recipients whose facilities are under safeguards should not be considered a significant proliferation risk. Conversely, exports to unsafeguarded facilities – in states that have not acceded to the NPT or, say, to nuclear power plant construction sites – must be checked out thoroughly. In all cases the crucial factor is the status of the recipient: does the recipient operate a safeguarded and appropriately secured facility or not? In the case of exports associated with the construction of a nuclear power plant, a government will wish to assure itself that the plant in question will be placed under safeguards on its commissioning. It will also want to check out the status of intermediate recipients and system integrators, who may be assembling the sub-modules of the planned plant from components arriving from various locations and suppliers.

Figure 1. Model for a risk-based export control regime



There therefore appears to be no essential security interest in maintaining the exemption of nuclear materials and technology from the General Agreement on Tariffs and Trade (GATT) since their end-use is subject to IAEA safeguards and to the physical protection regime for civilian nuclear facilities afforded by signatories to the Convention on the Physical Protection of Nuclear Material.[7]

Streamlining the export control system is essential for effective compliance. Companies should be able to direct their efforts to those areas where a proliferation risk exists and to reduce the administrative, management and investigative burden of compliance with a licensing process where the proliferation risk is already controlled by like-minded governments. The adoption of a risk-weighted approach to assessing proliferation will enable companies and export control authorities to deploy their resources more effectively by focussing on higher risk transactions. A model risk-weighting approach is shown in Figure 1.

A nuclear power reactor subject to IAEA safeguards poses a relatively low technology risk with respect to proliferation. The same is true for components, spare parts, and maintenance or repair services for that facility. Therefore, under a risk-based approach the export of components and complete power reactors should be unrestricted within free trade areas such as the European Union, subject to notification at the time of shipment. It should also be possible to export components under general authorization, without a prior licence, to another country that is a participating state in the NSG, subject to notification being provided to the strategic goods control authorities of the exporting and importing countries concerned.

Thus companies engaged in international trade in nuclear technologies, good and services should be able to obtain a general licence to undertake their business in accordance with the reporting (and monitoring) conditions of the licence, where the destination for a controlled export is to another NSG participating state. A project licence should be required from the export control authority of the state in which the reactor vendor is domiciled for the supply of a complete (or substantially complete) nuclear reactor to another NSG participating state.

If the exporter was certified (by the customs service or an independent body) as operating a robust and comprehensive internal compliance program, the export control authority would have the assurance that the requisite notifications were being provided.

Nuclear fuel assemblies are composed of fissile material and therefore pose a slightly greater proliferation risk than a nuclear reactor itself (which cannot operate without fuel). However, as nuclear fuel is normally made of low enriched uranium it should not be subject to a requirement for licence approval prior to shipment within the NSG, as these states have accepted IAEA monitoring under the agency's safeguards arrangements. Thus there should be general authorization for low-enriched fuel exports with a simple reporting requirement to the strategic goods control authorities of the countries involved in the shipments.

Reprocessing technology is associated with the highest proliferation risk since it involves isotope separation from used nuclear fuel that could potentially be diverted to military applications. Similar considerations apply to enrichment

[7] The Convention on the Physical Protection of Nuclear Material and its Amendment imposes a duty on signatory states to protect nuclear material and facilities against threats and malevolent acts and to recover and return stolen materials. Governments are obliged to apply fundamental security principles set out by the IAEA in relation to their physical protection regime. There are 116 contracting parties to the amended convention, covering all NSG participating states with the exception of Belarus and Brazil.

technology, which could be used to enrich uranium to higher fissile concentrations, suitable for some nuclear explosive devices, and there is thus greater justification for licensing each transaction through an individual application for export. A risk-based approach would suggest that individual applications for export licences should be applied even between NSG participating states to maintain a strong level of confidence between states that they remain committed to the goals of the NPT.

In the case of countries that are not participating in the NSG and which have not ratified the NPT, all exports of nuclear technology, goods and services should be subject to prior licensing on a case-by-case basis. States under a trade embargo relating to nuclear technology are, of course, subject to a ban on relevant exports.

An issue could arise from the possibility that a recipient of an exported controlled item might in turn re-export this. But much of the international trade in nuclear technology, goods and materials takes place between NSG participating states. Therefore, in principle, these governments operate a system of export control already. Where this is not the case, the exporting country and the importing country may conclude a nuclear cooperation agreement (known as a "123 Agreement" in the USA), which commits the parties to peaceful collaboration in using nuclear technology under IAEA safeguards. There will often be a pre-existing level of government-to-government assurance regarding the general usage of nuclear technology.

An industry-driven consensus standard could be developed to demonstrate compliance with international principles and guidelines and core national requirements.

The standard would provide verification that an organization was meeting international guidance and national regulations on a range of proliferation-sensitive security issues, including export compliance.[8]

The International Organization for Standardization (ISO) has developed a series of standards for risk management (ISO 31000 series) and for supply chain security (ISO 28000 series). A standard for internal compliance programs relating to dual-use goods and strategic technologies could be developed within the ISO framework. For example, ISO 28001: 2007 for security management systems for the supply chain was designed to assist meeting the criteria established by the World Customs Organization for authorized economic operator status. Such an exercise would have to involve a range of industries, not simply the nuclear sector. Under the ISO system, organizations are certified to a standard by an independent accredited auditor. An international standard would provide the benchmark for export control authorities to award trusted economic operator status to companies and would bolster confidence in the risk-weighted model outlined above. (An export control authority would not be expected to automatically accept certification to the standard as a sufficient basis on which to award trusted economic operator status and would be free to exercise its discretion in this regard.)

Extending the trusted economic operator program to embrace export control compliance also has the potential to strengthen the overall strategic export control regime. As the customs service already audits companies on their compliance with other aspects of customs and border control, the extension of this type of program to cover export

[8] See for example, Debra Decker and Kathryn Rauhut, 2016, *Nuclear Energy: Securing the Future – A Case for Voluntary Consensus Standards*, Managing across Boundaries Program, Washington, DC: Stimson Center: pp. 6-7; see also Debra Decker and Kathryn Rauhut, 2016, The Quest for Nuclear Security Standards, *Policy Analysis Brief*, Muscatine, IA: The Stanley Foundation.

licensing compliance could prove cost-effective in many cases, though not all companies would wish to take this up. Such an arrangement should facilitate transactions taking place between units within the same company or industrial group and between companies undertaking repeat business.

A compliance system that strengthens the capability of the business community in preventing proliferation will provide greater assurance among governments that the strategic export control regime is working effectively. Defining an international standard for compliance related to dual-use goods and strategic technologies will take several years. Nevertheless, embarking upon a common track to strengthening and streamlining the international export control regime, with an industry-driven road map endorsed by the inter-governmental organizations (*e.g.* IAEA, NSG, World Customs Organization and UN Office for Disarmament Affairs), would be an excellent starting point. The International Framework for Nuclear Energy Cooperation (IFNEC), an intergovernmental body, and the World Nuclear Association could provide a forum for the discussions. The output could be a first draft of a standard for export control compliance and milestones to assess progress towards developing an international standard on compliance through ISO.

The continued peaceful use of nuclear technology is constructed on a foundation that is partly multilateral and treaty-based and partly based upon non-binding inter-governmental cooperation. It has evolved through agreement between a small number of states which historically developed nuclear know-how and assumed that this knowledge could be contained within national borders and released to other countries only on specific terms that they themselves dictated. Globalization has invalidated these assumptions. The civil nuclear industry has outgrown the boundaries but at the same time its expansion has been constrained by strict licensing requirements imposed by national authorities.

Technological, economic and environmental challenges threaten to overwhelm the capacity of national public institutions to manage systemic stresses, according to the World Economic Forum. The world has entered an unsettling period of geopolitical flux and multilateral rules-based approaches have become frayed. The response should therefore be interconnected, involving collaboration between governments, international organizations, civil society and enterprises.[9] Cooperation between like-minded governments adhering to common principles and applying equivalent controls lies at the heart of putting collective security into practice. Governments should be willing to permit trade and information exchange between countries on the basis, firstly, that they trust each other's capability and commitment to manage proliferation and security challenges and, secondly, because the companies involved are themselves trustworthy organizations, conscious of their responsibilities.

[9] World Economic Forum, 2018, T*he Global Risks Report 2018*, Geneva: World Economic Forum: pp. 5, 6-7 and 37.

5 Recommendations

Export controls aim to preclude states and unauthorized entities from acquiring materials, equipment and technology that could be used to make a nuclear or radiological weapon. However, disparate and unevenly applied licensing of exports is hindering the scaling-up of nuclear energy's contribution to a low-carbon economy. These controls could also impede the exchange of safety-related technical information and assistance between nuclear power plant operators as part of industry lesson-learning and continual improvement.

The degree of scrutiny accorded to nuclear technology should be risk-based. A nuclear power reactor under safeguards poses a relatively low technology risk with respect to proliferation. The same is true for components, spare parts, and maintenance or repair services for that facility. Under a risk-based approach the export of components and complete power reactors should be made possible under general authorization, without a prior individual licence, to another country that is a participating state in the Nuclear Suppliers Group, subject to notification being provided to the national authorities of the exporting and importing countries concerned. Within free trade areas, such as the European Union's single market, shipments should be notifiable but otherwise unrestricted.

Nuclear fuel assemblies made of low-enriched uranium should not be subject to a requirement for licence approval prior to shipment between Nuclear Suppliers Group participating states, as these states have accepted International Atomic Energy Agency monitoring. There should be general authorization for low-enriched fuel exports with a simple reporting requirement to the strategic goods control authorities of the countries involved in the shipments.

Enrichment and reprocessing technologies are associated with a higher proliferation risk and there is thus greater justification for licensing each transaction through an individual application for export.

The world nuclear industry contributes to countering proliferation through robust internal compliance programs at company level to ensure that transactions do not involve suspect parties. Export control authorities should be able to recognize good practice by offering authorized (or trusted) economic operator status to companies that apply diligently a robust and comprehensive internal compliance program to their operations.

The Nuclear Suppliers Group and the International Atomic Energy Agency should encourage mutual recognition among its participating governments to confirm that they have a consistent level of export controls in place and are applying an appropriate level of domestic control to ensure the physical protection and safeguarding of nuclear material and facilities within their jurisdiction.

The Nuclear Suppliers Group should do more to exchange information and engage with the industry. Industry-regulator cooperation in the export control and non-proliferation area could be achieved through a forum involving the relevant inter-governmental organizations including the International Atomic Energy Agency, Nuclear Suppliers Group, Wassenaar Arrangement, World Customs Organization, and the United Nations Office for Disarmament Affairs.

World Nuclear Association
Tower House
10 Southampton Street
London WC2E 7HA
United Kingdom

+44 (0)20 7451 1520
www.world-nuclear.org
info@world-nuclear.org

The World Nuclear Association is the international organization supporting the people, technology and enterprises that comprise the global nuclear energy industry. The association advocates the tripling of nuclear energy generation over the next three decades to provide 25 percent of global electricity production by 2050.

World Nuclear Association membership encompasses uranium mining, conversion, enrichment and fuel fabrication; reactor vendors; major nuclear engineering, construction, and waste management companies; and the majority of the world's nuclear generation. Other members provide international services in nuclear transport, law, insurance, brokerage, industry analysis and finance.

An Effective Export Control Regime for a Global Industry considers how the strategic export control regime should be streamlined and modernized to facilitate lawful and compliant international trade in nuclear materials and technology and information exchange. Disparate and unevenly applied licensing of exports is hindering the scaling-up of nuclear energy's contribution to a low-carbon economy. These controls can also impede the exchange of safety-related technical information and assistance between nuclear power plant operators.