U.S. DEPARTMENT OF ENERGY

PNNL-23447

Prepared for the U.S. Department of Energy
under Contract DE-AC05-76RL01830

Investigation of Publically Available Information and Precedent Registries Regarding UF_6 Cylinders

ET Gitau
LE Smith
MW Shaver
NL Mara

July 2014

Pacific Northwest
NATIONAL LABORATORY

Proudly Operated by Battelle *Since 1965*

DISCLAIMER

PACIFIC NORTHWEST NATIONAL LABORATORY
operated by
BATTELLE
for the
UNITED STATES DEPARTMENT OF ENERGY
under Contract DE-AC05-76RL01830

Printed in the United States of America

Available to DOE and DOE contractors from the
Office of Scientific and Technical Information,
P.O. Box 62, Oak Ridge, TN 37831-0062;
ph: (865) 576-8401
fax: (865) 576-5728
email: reports@adonis.osti.gov

Available to the public from the National Technical Information Service
5301 Shawnee Rd., Alexandria, VA 22312
ph: (800) 553-NTIS (6847)
email: orders@ntis.gov <http://www.ntis.gov/about/form.aspx>
Online ordering: http://www.ntis.gov

This document was printed on recycled paper.
(8/2010)

PNNL-23447

Investigation of Publically Available Information and Precedent Registries Regarding UF6 Cylinders

ET Gitau
LE Smith
MW Shaver
NL Mara

July 2014

Prepared for
the U.S. Department of Energy
under Contract DE-AC05-76RL01830

Pacific Northwest National Laboratory
Richland, Washington 99352

Executive Summary

The National Nuclear Security Administration (NNSA) Office of Nonproliferation and International Security's (NIS) Next Generation Safeguards Initiative (NGSI) and the nuclear industry have initiated activities to develop approaches for uniquely identifying and monitoring uranium hexafluoride (UF_6) cylinders. NIS interests are driven by a desire to support the International Atomic Energy Agency's (IAEA) ability to detect and deter the diversion and undeclared production of nuclear material. Industry also has an interest in a standardized UF_6 cylinder identification method to improve efficiency and effectiveness in both operational practices and compliance with existing national regulatory requirements. A registry (e.g., centralized, secure database) that contains information about the cylinders, their movements, and their contents is a key element of the NNSA concept for a global UF_6 cylinder identification and monitoring system.

Pacific Northwest National Laboratory (PNNL) is leading the development of registry concepts and recommendations for the multi-laboratory NGSI project team. To inform this effort, PNNL has investigated the publically available information regarding UF_6 cylinder movements and contents, as well as what, if any, analogous registries currently are used in nuclear and non-nuclear industries.

Publicly Available Cylinder Information

In discussions with the NGSI project team, several industry stakeholders raised questions about the potential for a global cylinder registry to reveal sensitive or proprietary information to the public, competitors, and would-be proliferators. To establish a baseline for information availability, PNNL investigated what data was publically available regarding UF_6 cylinders and their movements and contents. The authors found that the public has access to cylinder data from 1) disclosures by nuclear regulatory authorities and 2) trade intelligence databases that record and store commodity movements through seaports, vehicle, and rail border crossings throughout the world. A review of these publically available resources found the following information typically is available, albeit after some temporal delay:

- The number of cylinders included in a particular shipment
- Estimate of the total mass of UF_6 in shipments
- Approximate ^{235}U enrichment (e.g., categorized as natural or low-enriched)
- The names of shippers, transporters, and receivers of UF_6 cylinder shipments
- Limited shipping logistics information identifying ports and approximate times of arrival and departure of UF_6
- Identification of the destination facility (i.e., which reactor in the world ultimately uses the material as fuel).

There appears to be little consistency in the thoroughness, format, and content of publically available cylinder information. The preceding list represents the most complete set of information that appears to be accessible through public channels.

These relatively simple queries revealed that publically available resources provide a breadth of logistics- and commerce-focused information about cylinder movements. However, such information is only available about groups of cylinders in an aggregated, batched fashion and (often) with considerable time delays. While it is possible that this data could be used to infer or approximate some of the information considered sensitive by facility operators (e.g., shipping patterns and flow volumes), this was not confirmed through analysis of the publically available data found. The finding that no publically available resources appear to reveal timely information about individually identified UF_6 cylinders and their specific contents is most relevant to the concept for a cylinder monitoring registry. It is this timely, cylinder-specific data that compose the backbone of a global cylinder registry. As this specific data do not presently appear to be publically available, industrial concerns about the protection of proprietary information are well-founded. This finding reinforces the working assumption that proposed implementation approaches for a safeguards-focused cylinder registry must adequately address the protection of proprietary information, just as the IAEA presently is obligated to do.

Analogous Industry Registries

Registries from various industries were examined against a set of key characteristics expected to be important to a safeguards-focused cylinder registry. The primary objective of this inquiry was to determine if one or more existing databases are sufficiently similar in terms of purpose, stakeholders, and implementation constraints to serve as a model or, at least, a guide for a safeguards-focused cylinder registry. A framework for comparing and contrasting nine different registries was constructed and used to down-select to two registries with particular relevance to the global cylinder registry concept: 1) U.S. Department of Defense (DoD) Item Unique Identification (IUID) Registry and 2) the International Maritime Organization (IMO) Ship Numbering Scheme and its associated Long-Range Identification and Tracking (LRIT) System. While neither registry was entirely analogous, each offered insights into implementation approaches for a global registry of high-value items.

The DoD registry parallels preliminary concepts for a cylinder registry in several ways. For example, the DoD registry was developed to provide "lifecycle visibility" and to improve the "effective and efficient accountability…of assets and resources."[1] The asset monitoring system is founded on a machine-readable, passive unique identifier with specifications dictated by a governmental agency. There are a large number of stakeholders in the system, many of which are competitors, and the data flow (i.e., primarily one way from vendors to the DoD) helps to ensure data security and protection of proprietary information. A key characteristic of the DoD system is that participation is encouraged through direct financial incentives for vendors - if they do not adopt the standardized IUID, their opportunity for business with the DoD is negatively impacted. Such an incentive system may not be present for a safeguards-focused cylinder monitoring system and registry.

The IMO registry also is relevant to cylinder monitoring for safeguards purposes. For example, the international community has a vested interest in monitoring ships for safety and security reasons, among others. Further, the IMO is an arm of the United Nations and works closely with governmental agencies around the world to perform its missions. The IMO system demonstrates that a monitoring system and global registry can be implemented and operated in an environment where consensus must be met between industrial stakeholders, state regulatory agencies, and an international oversight body comprised of member states.

[1] http://www.acq.osd.mil/dpap/UID/attachments/guides/iuid-registry-brief-20060101.pdf.

Acronyms and Abbreviations

ADAMS	Agency-wide Documents Access and Management System
ASP	Application Service Provider
BIC	International Container Bureau
BPVC	Boiler and Pressure Vessel Code
CNSC	Canadian Nuclear Safety Commission
CPPNM	Convention on the Physical Protection of Nuclear Material
DASN	Deputy Assistant Secretary of the Navy
DIN	Donation Identification Number
DLIS	Defense Logistic Information Service
DoD	U.S. Department of Defense
EMSA	European Maritime Safety Agency
FIN	Facility Identification Number
GNF	Global Nuclear Fuel
IAEA	International Atomic Energy Agency
ICAO	International Civil Aviation Organization
IDE	International Data Exchange
IMO	International Maritime Organization
IMSO	International Mobile Satellite Organization
IUID	Item Unique Identification
LRIT	Long-Range Identification and Tracking
NGSI	Next Generation Safeguards Initiative
NIS	Office of Nonproliferation and International Security
NMMSS	Nuclear Materials Management & Safeguards System
NNSA	National Nuclear Security Administration
NRC	U.S. Nuclear Regulatory Commission
NTI	Nuclear Threat Initiative
PNNL	Pacific Northwest National Laboratory
SAR	Search and Rescue
SOLAS	International Convention for the Safety of Life at Sea
UF_6	Uranium hexafluoride
UII	Unique Item Identifier
USEC	United States Enrichment Corporation

Contents

1.0 Introduction and Background

The National Nuclear Security Administration (NNSA) Office of Nonproliferation and International Security's (NIS) Next Generation Safeguards Initiative (NGSI) and the nuclear industry have initiated activities to develop approaches for uniquely identifying and monitoring uranium hexafluoride (UF_6) cylinders (Whitaker et al. 2013). NIS interests in a global monitoring system for UF_6 cylinders is related to its efforts in supporting the International Atomic Energy Agency (IAEA) in deterring and detecting diversion of UF_6 (e.g., claiming that a diverted cylinder is lost during transit) and/or undeclared production pathways involving UF_6 cylinders (e.g., enriching feed material exceeding 20% assay at centrifuge facilities). Industry interest in a global standard and monitoring system for UF_6 cylinder identification also is related to efficiency and effectiveness improvements in both operational practices and compliance with existing national regulatory requirements for item identification and control that such a standardized system could provide.

A crucial element of this type of system is a registry containing information about the cylinders, their movements, and their contents. To inform Pacific Northwest National Laboratory's (PNNL) development of registry concepts, relevant precedents were investigated from two perspectives and are reported here as two separate but related topics.

The first topic addresses concerns expressed by operators regarding the potential for a global cylinders registry to reveal sensitive information to the public, competitors, and potential proliferators. To better understand these concerns, PNNL investigated current publically available information regarding cylinders and their movements and contents. The second investigation sought to explore other registries that may yield insight, analogies, or even a model for development of a safeguards-focused cylinder registry.

2.0 Publically Available Information on UF_6 Cylinders, Content, and Movement

Stakeholders engaged in discussions regarding global monitoring of UF_6 cylinders have expressed concerns over the potential for a global cylinder registry to reveal sensitive information to the public, competitors, and would-be proliferators, including:

- The ability of an adversary to learn cylinder locations and shipping patterns
- Disclosure of proprietary information, such as the quantity of cylinders, cylinder enrichments, and the weight of a filled cylinder
- Identification of flow volumes.

To establish a baseline from which a change in risk might be determined, PNNL conducted research to identify what information regarding UF_6 cylinder contents and movements currently is publicly available.

2.1 Regulatory Reporting Requirements

In response to the entry into force of the *Convention on the Physical Protection of Nuclear Material*,[2] states implemented a range of regulations that require facility licensees to provide advanced notification regarding imports and exports of nuclear material, including UF_6. While the specific requirements vary by state for operators engaged in commerce with UF_6 cylinders, nuclear regulators generally require that a licensee report:[3]

- The name(s), address(es), and telephone number(s) of the shipper, receiver, and carrier(s)
- A physical description of the shipment (elements, isotopes, form, etc.)
- A listing of the mode(s) of shipment, transfer points, and routes to be used
- The estimated time and date that a shipment will commence and that each country along the route is scheduled to be entered
- The estimated arrival time and date of the shipment at the destination.

For those nuclear regulators held accountable by the public through transparency practices, these notifications may be available to the public upon written request. In the case of the U.S. Nuclear Regulatory Commission (NRC), these advanced notifications are publically available online via the

[2] According to the United States Department of State, the CPPNM "establishes legally binding international norms for physical protection of nuclear material in domestic use, storage, and transport, and adds nuclear smuggling and sabotage to the global penal regime. Article 4 of the Convention requires the advance reporting or notification of the nuclear material shipment between states (including states used as transshipment points/routes) and confirmation of its receipt.

[3] For examples of detailed requirements, refer to U.S. requirements in 10 CFR 73, *Physical Protection of Plants and Materials*. Information on reporting requirements for Canada can be found in SOR/2000-208, Packaging and Transport of Nuclear Substances Regulations under Section 4, "License to Transport While in Transit." Reporting requirements for the Netherlands can be found in Besluit vervoer splijtstoffen, ertsen en radioactieve stoffen (The Fissionable Materials, Ores and Radioactive Substances [Transport] Decree).

Agency-wide Documents Access and Management System (ADAMS)[4] after an unknown release delay. The shortest period found between the date of advance notification communication and the date the notification was added to ADAMS was four months.

Operators commonly use transportation management and coordination firms to submit these advanced notices to nuclear regulators. For submissions to the NRC, there is no standard form or template, resulting in a range of information granularity in the filings. This lack of consistency means locating useful information searching via ADAMS can be a tedious process.

As to the type of information that can be found in the advanced notices filed with the NRC, the notifications consistently provide the total number and type of UF_6 cylinders being shipped. The notices also provide an estimated total mass of UF_6, or uranium, in the shipment. Some notifications also include a categorization of the ^{235}U enrichment for the cylinders, such as "less than 5%" (Peters 2013) or "enriched 5% Max." (Mangusi 2005) Cylinders that contain "heels" often are noted as such (Muench 2006). In some instances, companies provided more precise enrichment values, but this is not the norm (Raffo 2008). Most importantly for the concept of a cylinder monitoring system and operator proprietary concerns, no notifications were found that listed individual identifiers for the cylinders shipped or received.

Regarding locations of cylinders, information found in the advance notifications varies. As required, the name and location of the shipper, consignee, and carrier are listed. In addition, the cylinder shipment routing is provided. For example, the following is the routing information for four Type 30B cylinders containing 16 tons of less than 5% enriched UF_6 (Klassen 2011):

> Sea freight on the Atlantic Companion V. 2252. Vessel sails Liverpool, UK on January 14, 2012. Due to the Port of Halifax, NS on January 22, 2012 and will unload. RSB will then pick up and cross the Canada/USA border at Lacolle, PQ/Champlain, NY or Woodstock, NB/Houlton, ME on/about January 25, 2012. Scheduled to arrive at Consignee on/about February 1, 2012.

Of note, while the preceding example and several other notifications provide estimated dates for departure or arrival at each point during shipment, many provide only the estimated time of departure or arrival for the originating facility and the destination facility.

Some notifications for exports retrieved from ADAMS provided the export license under which the material was cleared to be shipped. These licenses offered additional information, such as the total quantity of uranium and UF_6 destined for a country under that specific license; the reactor(s) where the uranium will be used; and the uranium origins, which include the additional safeguards obligations placed on the material (e.g., uranium mined in Canada but enriched in the United States). Examples of notifications and an export license, as retrieved from ADAMS, can be found in Appendix A.

The NRC is unique among global nuclear regulators in that most of its licensing and oversight documentation is available electronically to the public via the Internet. However, due to the events of September 2001, some information provided to the NRC now is treated as sensitive, unclassified information and not publically available. Effort was made to locate similar publically available

[4] Can be found at http://www.nrc.gov/reading-rm/adams.html.

information from foreign nuclear regulators.[5] While several countries have nuclear regulators with independence and transparency similar to the NRC, no Internet-accessible publication information regarding movement of UF_6 cylinders was found. A more exhaustive study of other countries may well reveal such data, but it was not pursued in this work. It is worth noting that while other regulators do not appear to have electronically accessible publication information about cylinders, all regulators investigated by PNNL do provide contact information (email, physical addresses, telephone), where requests for access to publically available information can be sent.

2.2 Trade Intelligence and Import/Export Databases

Another source of publically available information regarding the location and contents of UF_6 cylinders are commercial trade intelligence and import/export databases. These services typically gather information by indexing bills of lading[6] filed at ports during shipment then charging users a fee to access and search the information. While some services specialize in data from specific countries, there also are several services available that index trade information across the globe. These types of services include: Piers.com (United States), Sicex.com (Columbia/South America), Portexaminer.com (U.S. imports), and Zauba.com (India).

Much like ADAMS, Piers.com[7] provides users information regarding the shipper, carrier, and consignee for each UF_6 shipment. Appendix B features an example of a bill of lading as retrieved from Piers.com. In brief, this bill of lading makes it possible to identify the quantity and type of cylinder being shipped, each cylinder's mass, and the enrichment category (commonly listed as a limit, such as "enriched at 5% max"). The bill of lading also provides other information, including the shipping container number and number of UF_6 cylinders held in each container. An estimated dollar value of the shipment also is provided, although the accuracy of these estimates is unknown.

In comparison to data available from the NRC (i.e., ADAMS), the trade intelligence and import/export services appear to update their records relatively frequently. For example, a UF_6 shipment on Piers.com that arrived at port in late December 2013 was reported some 10 days later. As with the ADAMS database, no bills of lading from these services listed individual identifiers for the UF_6 cylinders shipped or received.

[5] Foreign regulators chosen to investigate were identified using the Nuclear Threat Initiative (NTI) Nuclear Materials Security Index (http://www.ntiindex.org/) and identifying countries that would most likely be engaged in the transport of UF_6 cylinders. Rankings used to identify countries with independent nuclear regulators with similar transparency to the NRC in nuclear security were "Nuclear Security and Materials Transparency" and "Independent Regulatory Agency." The countries identified were Germany, France, United Kingdom, and Japan.

[6] A bill of lading is the contract that a shipper and goods owner enter upon to acknowledge the terms under which the goods are to be carried.

[7] Piers.com advertises itself as the "the leading provider of proprietary data, news, business intelligence and analytical content supporting commercial maritime, rail, trucking, warehousing and logistics industries worldwide" with staff at major ports collecting this information. These indexing services commonly are used by port officials "to identify marketplace trends and get a clear view of the commodities, goods, and shippers using their port." Access to Piers.com trade intelligence information requires registration and fee payment to procure detailed shipping information. A cost-free starter account can be established, which allows access to a limited set of information in the bill of lading (as done for this paper).

2.3 Key Findings

PNNL's investigation indicates that third parties can gain access through publically available sources, which includes records from state regulators and trade intelligence databases, to some of the information that operators indicated might be of proprietary concern (e.g., shipping patterns). Using such public data, competitors may be able to infer other parameters of concern (e.g., flow volumes from a particular facility). However, such information is available only about groups of cylinders in an aggregated, batched fashion, often with considerable time delays. The nature of the publically available data likely would limit the veracity of analyses in revealing the competitive information of greatest concern to operators.

However, of most importance to a safeguards-focused cylinder registry, publically available cylinder information does not appear to reveal detailed data on specific cylinders, including the cylinder identifier and content characteristics (i.e., relative enrichment and isotopic masses)—data of particular concern among operators. In addition, publically available information does not contain information about the movement of cylinders and material between key points within facilities—data that also would be stored in a cylinder registry, at least for certain facilities.

3.0 Analogous Registries

To guide the search for an analogous registry, fundamental characteristics of the global cylinder registry were identified. It was determined that a potentially comparable registry would capture information about:

- A high-value, semi-fungible item/commodity
- Items stored in a container stamped or labeled with identification information
- Containers/commodities shipped between facilities
- Reused containers
- Eventually retired or destroyed containers
- Items whose contents (all or some portion) may be removed
- Items subjected to a period of inspection/inventory
- Registries with only a few, large stakeholders
- Registries where necessity was not the driving requirement for the registry.

A series of questions was formulated to compare and contrast various registries:

- Who are the key stakeholders?
- How many key stakeholders are there?
- What is driving the need for the registry?
- How many items are being monitored per year?
- Who has regulation authority?
- What authorities does the regulator have?
- How is the registry funded?
- Who operates and maintains the registry?
- How is the information used?
- How is the information collected and updated?
- How is the information protected?
- How is the information shared and with whom?
- How was the registry adopted and implemented among the stakeholders?

Through investigation of various registries, it was determined that the preceding criteria and questions could be distilled into three key criteria:

1. A registry must build upon a unique numbering or identification scheme. This scheme is the standard by which it can be assured that no two items are given the same identification number or signature, ensuring that each item is uniquely identifiable.

2. A registry must be centralized and supervised under a single entity, where information on each uniquely identified item is stored.
3. A registry must enable active monitoring of the items throughout their lifecycles.

Using these three specific criteria, PNNL categorized each of the nine candidate registries under consideration as: a) a unique numbering scheme, b) a registration database, or c) a registry analogous to preliminary concepts for a global cylinder registry. Appendix C includes a list of all candidate databases investigated by PNNL, a brief description, and their categorization according to the labels described here. A more detailed discussion of the two registries deemed most comparable to a global cylinder registry - one used by the DoD and another by IMO - follows.

3.1 Department of Defense Item Unique Identification Registry

In the early 2000s, the DoD overhauled its supply chain management policy, instituting a unique identification program and accompanying centralized tracking registry. Known as the Item Unique Identification, or IUID, Registry, it supports "lifecycle visibility" for all new acquisitions, legacy items, and government-furnished property,[8] facilitating the "effective and efficient accountability and control of Department of Defense assets and resources" (OUSD [AT&L] 2006).

The IUID Registry's backbone is a machine-readable unique item identifier (UII) (Young 2008). These UIIs are a string of globally unique, unambiguous characters that may be no more than 50 characters in length, containing only capital letters, numbers, forward slashes, and dashes. The UIIs are non-transferrable and can never be used more than once - even after an item has been destroyed or consumed (DPAP 2010). Referred to as "automatic identification technology" by the DoD, the IUID Registry relies on the use of two-dimensional barcodes, or data matrices, as UIIs (DASN [ELN] 2013). The costs associated with compliance to this DoD policy were - and continue to be - borne by DoD prime contractors, recognized as a cost of doing business with the DoD and included in the contract pricing process. It is the prime contractors' responsibility to flow the UII requirements to their subcontractors or vendors. Meanwhile, the DoD supports the cost of the registry itself (DPAP 2010, LM 2012).

These UIIs tie each item to the IUID Registry, which is used to maintain the following information on each item (OUSD [AT&L] 2006):

- What the item is
- How and when it was acquired
- The initial value of the item
- Current custodian (government or contractor)
- How it is marked.

[8] Per Defense Federal Acquisition Regulation Supplement (DFARS) 252.211-7007 "Reporting of Government-Furnished Property," Government-furnished property tracked, managed, or controlled by its serial number "regardless of unit-acquisition cost" must be reported to the IUID registry. Refer to stated DFARS for specific exemptions to this policy.

Once a UII has been created, an accompanying data file is created and uploaded to the registry electronically via the Internet. Only DoD prime contractors that are required to do so, prime contractors in possession of government-furnished property, and DoD departments and agencies are allowed to upload these data packets to the registry. Access restrictions are in place to prevent competitive vendors or contractors from obtaining sensitive information, such as item price from the registry (LM 2012, Young 2008). Entries within the registry are updated as the item is transferred from deployment, storage, and maintenance, and the UII is read (Tomalka 2012). The DoD does not endorse or require use of any specific data matrix reader vendors to support IUID implementation (Young 2008).

The DoD defines policy and oversight of the IUID Registr with the physical registry hosted by Defense Logistics Information Service (DLIS). The DoD and its vendors and contractors have incrementally completed transition to this new registry. Implementing policy required that all new contracts issued after January 1, 2004 include language requiring use of a UII that was to be registered in the IUID Registry. Legacy items and items in the contractors' possession were scheduled to be integrated into the system over the following two years. However, they continue to be registered to this day. As of June 2011, the IUID Registry contained almost 14 million uniquely identifiable items and was growing at a rate exceeding 39,000 new UIIs per week from some 2500 contractors and vendors (Tomalka 2012).

3.2 International Maritime Organization Ship Number and Long-Range Identification and Tracking System

The IMO is a specialized agency within the United Nations responsible for "the safety and security of shipping and the prevention of marine pollution by ships" (LRF 2006). In 1987, the IMO adopted Resolution A.600(15), requiring all propelled, seagoing merchant ships of 100 gross tons and above[9] be identified by a unique identifier (LRF 2006). This identifier was mandated for use among all relevant ships in the 162 signatory states to the International Convention for the Safety of Life at Sea (SOLAS) (IMO 2014). These 162 signatory states are responsible for approximately 99% of the some 80,000 merchant ships worldwide (IMO 2014, 2012 and Equasis 2013). The numbering scheme adopted, the Lloyd's Register Ship Numbering system, was already widely used by the shipping industry (LRF 2006). Now maintained by IHS Maritime (formerly Lloyd's Register-Fairplay), the Lloyd's Register Ship Numbering system became the IMO Ship Identification Number Scheme, which consists of the letters "IMO" and a unique seven-digit serial number that must be displayed prominently on the required vessels (LRF 2006). IHS Maritime is the entity responsible for issuing the unique seven-digit number, as well as for maintaining a database containing design details for each vessel, the vessel's owner, and the company that requested the IMO number. The IMO number is issued at no charge and, once assigned, the IMO number can never be reassigned to another vessel (LRF 2006).

The IMO number database facilitates functionality of the Long-Range Identification and Tracking (LRIT) System (Figure 1), established in 2006 by IMO resolution MSC.202(81) to increase ship safety and security (IMO 2014). LRIT is used by (EMSA 2014a):

- States interested in locating ships they have flagged

[9] Exceptions include: "vessels solely engaged in fishing, ships without mechanical means of propulsion, pleasure yachts, ships engaged on special service (e.g., lightships, SAR vessels), hopper barges, hydrofoils, air cushion vehicles, floating docks and structures classified in a similar manner, ships of war and troopships and wooden ships." The IMO numbering scheme has been extended to some of these vessels on a voluntary basis (LRF 2006).

- States interested in identifying any flagged vessel within 1000 nautical miles of their coast
- States whose port(s) have been identified as a destination for a vessel
- Search and rescue authorities.

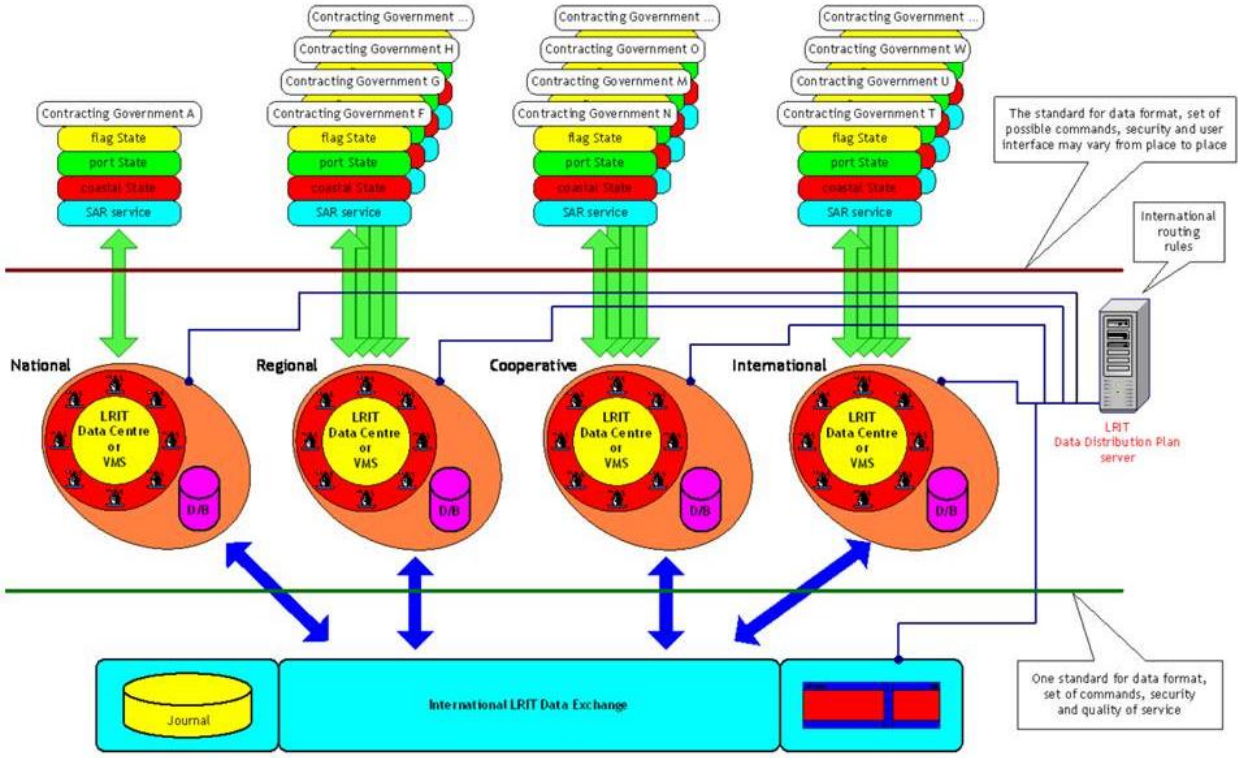

Figure 1. LRIT System Architecture (IMO 2012)

LRIT guidelines require vessels to report their LRIT equipment identifier, position (latitude and longitude), and date and time of transmission via satellite at least four times a day or on-demand (IMSOa). These satellite transmissions are received by an Application Service Provider (ASP)[10] who transmits the information to an identified national, cooperative, or regional data center within the LRIT network. The ASP attaches additional information to the transmission to identify the responsible data center and IMO ship number (IMSOa). Each of the currently 65 data centers reporting within the LRIT are responsible for collecting, storing, and making available the transmitted LRIT information for vessels within their buffer zones (EMSA 2014b). While not yet realized by the IMO, the LRIT system is meant to expand to include an International Data Center, whereby countries that do not wish to establish their own data center or join a cooperative or regional data center still can benefit from LRIT services (IMSOa). Information about ships is shared between data centers through the LRIT International Data Exchange (IDE). The IDE functions as a communications hub for the LRIT network, routing messages and requests from some 117 governments and territories (EMSA 2014c). Data centers that provide information to other data centers through this network may charge the requesting center a fee.

[10] ASPs provide satellite communications from ships to LRIT data centers. Current commercial firms used are Inmarsat and Iridium.

LRIT data centers and the IDE operate using electronic databases, many available to necessary stakeholders via secure Internet portals. As information collected and exchanged by LRIT data centers is of both security and commercial value, caution is taken to prevent unauthorized access. This includes verification of data request authorization prior to transmission and encryption during transmission (IMSOa).

Many parties are involved in the LRIT data network's management and operation. Each state, cooperative, or regional authority that establishes a data center is responsible for maintaining and operating the facility within the specific limits and procedures established by the IMO. The IMO Maritime Safety Committee manages any political and technical decisions regarding the IDE and LRIT (IMSOa). Management of the physical IDE resides with a contracted entity. Since 2011, the European Maritime Safety Agency (EMSA) has hosted the IDE on behalf of the IMO (EMSA 2014d). In this role, EMSA has no right to access or archive information exchanged between data centers (IMSOa). The LRIT Coordinator oversees the LRIT (audit and review of performance). When the LRIT was established, this title was appointed to the International Mobile Satellite Organization (IMSO), an intergovernmental organization under the auspices of the IMO with 98 members (IMSOb).

3.3 Key Findings

The DoD and IMO registries each have features relevant to a global cylinder registry. Both offer insights into the potential advantages and disadvantages for implementation approaches for a global UF_6 cylinder registry.

In the case of the DoD registry, the lifecycle of items in the database are monitored via a series of snapshots taken as the passive, machine-readable UII is scanned at key points. This passive IUID approach is consistent with the findings and recommendations developed by the NGSI project team in an assessment of candidate technologies for standardized, machine-readable cylinder identification technologies (Hockert and Wylie 2014). While the registry allows authorized users to review information they have submitted to the registry, information moves only in one direction: into the registry from each non-DoD stakeholder. There are approximately 2500 stakeholders in the DoD registry, and many are industrial competitors, making the protection of proprietary data a particular concern among industrial participants. The DoD has sole oversight and authority to require stakeholder compliance with its implementation and use. Again, it is important to note that industrial participants shoulder the cost of compliance with DoD specifications for the UID and data reporting. The DoD owns and operates the registry and bears the associated costs. A key difference between the DoD registry and early concepts for a safeguards-focused registry is in the incentives for industrial participation: DoD's purchasing power provides this incentive directly.

The IMO registry and LRIT system rely on real-time tracking of vessels via satellite transmission of identifying information from active identification components on the vessels. While the IUID and communication approach differs from cylinder concepts, there are some important parallels. For example, the LRIT system covers ship movements across the globe as they traverse areas under the oversight of countries ultimately responsible for reporting information on ship movements. Furthermore, much like the expectation for a global cylinder registry, the LRIT system ultimately is under regulatory control of an international body (within the United Nations) where participation is voluntary. An interesting point to

take away from the LRIT system is that while one organization maintains control over the system, another voluntary, international body is responsible for the system's implementation and oversight.

4.0 References

DASN (ELM) - Deputy Assistant Secretary of the Navy - Expeditionary Programs and Logistics Management. 2013. "Item Unique Identification (IUID) 201." Washington, D.C. Accessed March 20, 2014 at http://www.secnav.navy.mil/rda/OneSource/Documents/Item%20Unique%20IDentification%20(IUID)/Webinars/2013/iuid20128mar13.pdf.

DPAP – United States Department of Defense Office of Defense Procurement & Acquisition Policy. 2010. "IUID Frequently Asked Questions." Washington, D.C. Accessed March 20, 2014 at http://www.acq.osd.mil/dpap/pdi/uid/docs/Extended_FAQ_List_May_2010.pdf.

EMSA - European Maritime Safety Agency. 2014a. "LRIT CDC – Users." Accessed March 20, 2014 at http://emsa.europa.eu/lrit-home/users.html.

EMSA - European Maritime Safety Agency. 2014d. "LRIT IDE - Background." Accessed March 20, 2014 at http://emsa.europa.eu/lrit-ide/lrit-ide-background.html.

EMSA - European Maritime Safety Agency. 2014b. "LRIT IDE - List of Data Centres connected to the IDE." Accessed March 20, 2014 at http://emsa.europa.eu/lrit-ide/lrit-ide-countries.html. Last updated January 2014.

EMSA - European Maritime Safety Agency. 2014c. "LRIT IDE - List of Contracting Governments in the LRIT system." Accessed March 20, 2014 at http://emsa.europa.eu/lrit-ide/list-of-contracting-goverments.html.

Equasis. 2013. "The world merchant fleet in 2012: Statistics from Equasis." Accessed March 20, 2014 at http://www.equasis.org/Fichiers/Statistique/MOA/Annual%20Statistics/Equasis%20Statistics%20-%20The%20world%20fleet%202012.pdf.

Hockert J and J Wylie. 2014. Assessment of Technologies for Uniquely Identifying UF_6 Cylinders: Task 3.1.1 Report – Identification System Requirements Development. PNNL-23162, Pacific Northwest National Laboratory, Richland, WA.

IMO - International Maritime Organization. 2012. "Implications of the United Nations Convention on the Law of the Sea for the International Maritime Organization." LEG/MISC.7, January 12, 2012, London, United Kingdom. Accessed March 20, 2014 at http://www.imo.org/ourwork/legal/documents/implications%20of%20unclos%20for%20imo.pdf.

IMO – International Maritime Organization. 2012. "Long-Range Identification and Tracking System Technical Documentation (Part I)." MSC.1/Circ.1259/Rev.5, May, 28, 2012. London, United Kingdom. Accessed March 20, 2014 at http://www.imo.org/OurWork/Safety/Navigation/Documents/LRIT/1259-Rev.5.pdf

IMO – International Maritime Organization. 2014. "Long-range identification and tracking (LRIT)." Accessed March 20, 2014 at http://www.imo.org/OurWork/Safety/Navigation/Pages/LRIT.aspx.

IMO - International Maritime Organization. 2014. "Summary of Status of Conventions." Accessed March 20, 2014 at http://www.imo.org/About/Conventions/StatusOfConventions/Pages/Default.aspx. Last updated February 28, 2014.

IMSOa - International Mobile Satellite Organization. "Long Range Identification and Tracking of Ships (LRIT)." Accessed March 20, 2014 at http://www.imso.org/LRIT.asp.

IMSOb - International Mobile Satellite Organization. "What is IMSO?" Accessed March 20, 2014 at http://www.imso.org/whatisimso_UK.asp.

Klassen, R. 2011. "NRC Import Notice - RSB 0112-604 (UF_6)." E-mail message to Advance Notifications Resource (USNRC), December 15, 2011, Rockville, MD. Accessed March 20, 2014 at http://pbadupws.nrc.gov/docs/ML1211/ML12110A051.pdf.

LM - Lockheed Martin. 2012. "IUID Frequently Asked Questions." Accessed March 20, 2014 at http://www.lockheedmartin.com/content/dam/lockheed/data/corporate/documents/suppliers/iuid-rfid-faqs.pdf.

LRF - Lloyd's Register - Fairplay. 2006. "Setting Industry Standards." Redhill, United Kingdom. Accessed March 20, 2014 at http://www.ihsfairplay.com/about/imo_standards/Setting_Industry_Standards.pdf.

Mangusi, J. 2005. "Transnuclear reference: TNY 05025-6 Advance notification for an import shipment of nuclear material from countries that are not party to the Convention on the Physical Protection of Nuclear Material." Letter to Gloria Bennington, Office of Nuclear Security & Incident Response, US NRC, May 23, 2005, Rockville, MD. Accessed March 20, 2014 at http://pbadupws.nrc.gov/docs/ML0525/ML052550187.pdf.

Muench, M. 2006. "Advance Notification of Export – 0306-761B." E-mail message to Gloria Bennington at USNRC, May 2, 2006, Rockville, MD. Accessed March 20, 2014 at http://pbadupws.nrc.gov/docs/ML0619/ML061920463.pdf.

OUSD (AT&L) - United States Department of Defense Office of the Under Secretary of Defense for Acquisition, Technology, and Logistics. 2006. "The IUID Registry." Washington, D.C. Accessed March 20, 2014 at http://www.acq.osd.mil/dpap/UID/attachments/guides/iuid-registry-brief-20060101.pdf.

Peters B. 2013. "Export Notifications." E-mail message to AdvanceNotifications Resource (USNRC), March 14, 2013, Rockville, MD. Accessed March 20, 2014 at http://pbadupws.nrc.gov/docs/ML1321/ML13214A187.pdf.

Raffo, J. 2008. "SAM-3039.REV.1 - Advanced Notification to NRC – Export." E-mail message to AdvanceNotifications Resource (USNRC), December 10, 2008, Rockville, MD. Accessed March 20, 2014 at http://pbadupws.nrc.gov/docs/ML0907/ML090750088.pdf.

Tomalka, J. 2012. "DASN Training #3 IUID Registry Overview." Washington, D.C. Accessed March 20, 2014 at http://acquisition.navy.mil/rda/content/download/7636/35249/file/no3%20iuid%20registry.ppt.

Whitaker, JM; JL White-Horton, and JB Morgan. 2013. Preliminary Concept of Operations for a Global Cylinder Identification and Monitoring System. ORNL/TM-2013/278, Oak Ridge National Laboratory, Oak Ridge, TN.

Young, JJ. 2008. "Department of Defense Instruction 8320.04." Washington, D.C. Accessed March 20, 2014 at http://www.dtic.mil/whs/directives/corres/pdf/832004p.pdf.

Appendix A: Examples of Advance Notification of Exports and Export Licenses from ADAMS

Examples of Advance Notification of Exports and Export Licenses from ADAMS

Advance Notification of Export from Transport Logistics International, Inc. (Raffo 2008):

NRC Shipment Notification Letter – Export –
Low Strategic Significance Material

U.S. Nuclear Regulatory Commission
11545 Rockville Pike
Rockville, MD, 20852-2738
NSIR, DNS, NTWS, M-S T-4 D-8
Attn: Mrs. Adelaide Giantelli
Senior Program Manager (301-415-3521)
Asg2@nrc.gov

December 10, 2008
Ref No.: SAM-3039
Notification Rev. 1

Export License No.: XSNM3520

This letter constitutes Transport Logistics International's advance notification to the U.S. NRC in compliance with the requirements of Physical Protection Of Plants and Materials as outlined in 10 CFR 73.73 of for export shipment of **Special Nuclear Material (SNM) of low strategic significance.**

Per 10 CFR 73.73 (a) (3) (i):

Shipper:	Consignee:	Notify:
TLI Inc. for USEC 5600 Hobbs Road Paducah, KY, 42002 USA Tel: 270-441-5679	**KHNP (Yonggwang 4)** **c/o SAMDO Shipping Co.** 3rd FL, Jeong Jin Bldg., 61-12 Nonhyeon 2 Dong, Kangnam-Gu, Seoul 135-012, Korea	**SAMDO Shipping Co.** 3rd FL, Jeong Jin Bldg., 61-12 Nonhyeon 2 Dong, Kangnam-Gu, Seoul 135-012, Korea
Carrier (Inland):	Carrier (Ocean):	Carrier (Air):
SOUTHERN PINES 423 Frankfort Road Monaca, PA, 15061 800-377-1049	**HANJIN Shipping** Garden City Terminal 2 North Main Street Garden City, GA, 31408	**N/A**

Per 10 CFR 73.73 (a) (3) (ii): Physical Description:

Proper Shipping Name:	UN2977; RQ, Radioactive Material, Uranium Hexafluoride, Fissile; 7(8),
Qty and type of packages:	3 x 30B cyls/PSPs
Maximum enrichment:	2.1 %
Net Weight:	4,668.0 Kgs
Maximum U Weight:	3,155.470 Kgs
Maximum U 235 weight:	63.172 Kgs
Category:	III

Per 10 CFR 73.73 (a) (3) (iii):

Modes of Transport:	Inland Truck/ Ocean
Transfer Points:	Unloading from Southern Pines at the port of Savannah, GA and transfer to the M/V HANJIN SAN FRANCISCO 0077W for delivery to Busan, Korea
Routes to be used:	U.S. Inland Routing will be in accordance with 49 CFR 397.101

Per 10 CFR 73.73 (a) (3) (iv):
ETD from originating facility: December 29, 2008

Per 10 CFR 73.73 (a) (3) (v):
ETA to Destination: January 29, 2008

The shipper certifies that the necessary arrangements have been made for pick-up and delivery of the above material and that the receiver has agreed to receive it. Both receiver and shipper have also agreed to the shipment dates as specified above.

Per

Julio A. Raffo
Manager – Front End Fuel Services

Advance Notification of Export from RSB Logistic, Inc. (Klassen 2011):

RSB LOGISTIC
www.rsblogistic.com

RSB LOGISTIC INC.
219 Cardinal Crescent
Saskatoon, SK S7L 7K8
Canada

Phone: 306-242-8300
Toll-Free 800-667-3934
Fax 306-242-2311

August 25, 2011

Robert Caldwell, Chief
Fuel Cycle Security and Transportation Branch
U.S. Nuclear Regulatory Commission
Office of Nuclear Security and Incident Response
Division of Security Policy

RSB Reference No.: 0611-526

ADVANCE NOTIFICATION OF IMPORT

In accordance with the requirements for implementation of the Convention of the Physical Protection of Nuclear Material, we are submitting the following:

1) Shipper, Receiver and Carrier

RSB LOGISTIC PROJEKTSPEDITION GmbH
On Behalf of:
Urenco Deutschland GmbH — 011-49-22-36-704-330
Gronau

AREVA NP — 509-375-8202
2101 Horn Rapids Road
Richland, WA 99352

RSB LOGISTIC SERVICES, INC. — 270-444-6004
2425 South 4th Street
Paducah, KY 42003

Atlantic Container Line — 732-452-5486
194 Wood Avenue South, Suite 500
Iselin, NJ 08830

2) Physical Description

This shipment will consist of 4 x 30B cylinders in sealed UX-30 overpacks containing a maximum of 6,160 kg uranium enriched to less than 5% weight of U-235. UN 2977 Radioactive material, Uranium hexafluoride, fissile (UF6).

3) Transportation and Route Schedule

The ocean transportation from Hamburg, Germany to Halifax, NS will be the responsibility of Atlantic Container Line. The inland transportation from Halifax, NS to AREVA NP/Richland, WA by road will be the responsibility of RSB LOGISTIC SERVICES, INC. Entry into the United States will occur at Sweetgrass, MT (Primary) or Champlain, NY or Houlton, ME (Secondary) on or about September 8, 2011.

Shipment Routing:

Sails Hamburg Germany via "Atlantic Conveyor" V. 1232	August 24, 2011
Arrives Sweetgrass, MT or Champlain, NY or Houlton, ME	September 8, 2011

This shipment will be protected during transport in accordance with Annex 1 to the Convention on Physical Protection of Nuclear Materials.

Sincerely,

Rob Klassen
International Transportation Specialist
RSB LOGISTIC SERVICES, INC.

Advance Notification of Export from Edlow International Company:[11]

121702-2

Edlow International Company
1666 Connecticut Ave., N.W., Suite 201
Washington, D.C. 20009 U.S.A.
Tel (202) 483-4959
Fax (202) 483-4840
e-mail: info@edlow.com

U.S. Nuclear Regulatory Commission
Division of Safeguards and Transportation
Washington, DC 20555

Date: December 4, 2002
Ref: CNEIC-563-30-CG

Attn: Ms. Gloria Bennington

In accordance with the Convention on the Physical Protection of Nuclear Material and the NRC final rule of March 26, 1987, Edlow International Company hereby makes the following notification of upcoming shipment:

Shipper:
Edlow International Company
c/o China Nuclear Energy Industry Corporation
3A Nan Li Shi Lu
Beijing 100037
China

Receiver:
Westinghouse Electric Corporation
Commercial Nuclear Fuel Division
5801 Bluff Rd
Columbia, SC 29250

Global Nuclear Fuel
Castle Hayne Road
Wilmington, NC 28401

ANP-Framtome
2101 Horn Rapids Road
Richland, WA 99352

Carrier (Ocean):
China Ocean Shipping Company
100 Lighting Way
Secaucus, NJ 07094

Carrier (US Inland):
R and R Trucking
2329 S. Hayden Road
Airway Heights, WA 99001

Physical Description: Uranium Hexafluoride, Fissile, containing more than 1% U-235 // 7 // UN 2977. Gross Weight: 147,388.422 Kgs; Net Weight UF6: 88,950.043 Kgs; Net U Weight: 58,867.192 Kgs; Max. Enrichment: 4.95%; UF6 contained in forty (40) x 30B cylinders.

Mode(s) of Transport: 10 x 20' flatracks containing 40 x 30B cylinders to be transported by truck from Seattle, WA to Richland., WA/Wilmington, NC/Columbia, SC.

Transfer Points: Seattle, WA for unloading from "Fengushan" and loading onto truck for shipment to ANP/GNF and Westinghouse.

Routes to be used: U.S. Inland Routing will be in accordance with 49 CFR 397.101.

Shipment Details: ETD Zhanjiang, China 01/29/2002; ETA Seattle December 12th; ETA ANP on December 16, 2002 (4Cyls) / Westinghouse (20 Cyls/PSPs) and GNF (16 Cyls/PSPs) on December 17, 2002.

The shipper certifies that the necessary arrangements have been made for pick-up and delivery of the above material and that the receiver has agreed to receive it. Both receiver and shipper have also agreed to the shipment dates as specified above.

Per
Kinion H. Proctor December 4, 2002

Sunsi Review Complete
Rids: NMS504 Public
Template: NMS5008

[11] Proctor, K. 2002. "CNEIC-563-30-CG." Letter to Gloria Bennington at USNRC, December 4, 2002, Rockville, MD. Accessed March 20, 2014 at http://pbadupws.nrc.gov/docs/ML0624/ML062400254.pdf.

Export License (corresponds to TLI advance notification in this appendix):[12]

EXPORT LICENSE

NRC FORM 250
(10-07)

UNITED STATES OF AMERICA
Nuclear Regulatory Commission
Washington, D.C. 20555

NRC LICENSE NO.:	XSNM3520 Page 1 of 3
NRC DOCKET NO.:	11005720
LICENSE EXPIRES	December 30, 2009

Pursuant to the Atomic Energy Act of 1954, as amended, and the Energy Reorganization Act of 1974 and the regulations of the Nuclear Regulatory Commission issued pursuant thereto, and in reliance on statements and representations heretofore made by the licensee, a license is hereby issued to the licensee authorizing the export of the materials and/or production or utilization facilities listed below, subject to the terms and conditions herein.

LICENSEE	ULTIMATE CONSIGNEE(S) IN FOREIGN COUNTRY(IES)
Transport Logistics International, Inc. 4000 Blackburn Lane, Suite 250 Burtonsville, MD 20866 Attn: Mark T. Lambert	Ultimate Consignee(s) – See Page 2 of 3 (Reload fuel for Yonggwang Units 1, 2, 3 and 4; and Kori Units 3 and 4)
INTERMEDIATE CONSIGNEE(S) IN FOREIGN COUNTRY(IES)	**OTHER U.S. PARTY(IES) TO EXPORT**
Korea Nuclear Fuel Co., Ltd. 493 Deokjin-Dong, Yuseong-Gu Daejeon 305-353 Korea (Conversion and Fabrication)	Other Parties to Export – See Page 2 of 3 (Enrichment)
APPLICANT'S REFERENCE NO.: SAM-2008	ULTIMATE DESTINATION: Republic of Korea

QUANTITY	DESCRIPTION OF MATERIALS OR FACILITIES
3,790.0 kilograms	Uranium-235 Contained in 82,400.0 kilograms enriched uranium to 4.6 w/o maximum, as uranium hexafluoride (UF_6). The shipment of Australian and Canadian-obligated material is authorized. Conditions 6 and 8 on Page 3 of this license apply to this export.
//////////////////////	//END//

Neither this license or any right under this license shall be assigned or otherwise transferred in violation of the provisions of the Atomic Energy Act of 1954, as amended, and the Energy Reorganization Act of 1974.

This license is subject to the right of recapture or control by Section 108 of the Atomic Energy Act of 1954, as amended, and to all of the other provisions of said Acts, now or hereafter in effect and to all valid rules and regulations of the Nuclear Regulatory Commission.

THIS LICENSE IS INVALID UNLESS SIGNED BELOW BY AUTHORIZED NRC REPRESENTATIVE

SIGNATURE: Scott W. Moore

NAME AND TITLE: Scott W. Moore, Deputy Director, Office of International Programs

DATE OF ISSUANCE: February 5, 2008

EXPORT LICENSE

[12] US Nuclear Regulatory Commission. 2009. "Export License: XSNM3520." Accessed March 20, 2014 at http://pbadupws.nrc.gov/docs/ML0803/ML080380097.pdf.

ULTIMATE CONSIGNEE(S) IN FOREIGN COUNTRY(IES): Cont'd

1. Korea Hydro & Nuclear Power Co., Ltd.
Yonggwang Nuclear Power Div. Units 1, 2, 3, and 4
Kiema-Ri 517, Hongnong-Eub
Yonggwang -Gun, Jeon-Nam
Republic of Korea

(Reload Fuel for Yonggwang Units 1, 2, 3 and 4)

2. Korea Hydro & Nuclear Power Co., Ltd.
Kori Nuclear Power Div. Units 3 and 4
Kori 216, Jangan-Dub
Yangsan-Gun, Kying-Nam
Republic of Korea

(Reload Fuel for Kori Units 3 and 4)

OTHER PARTIES TO EXPORT: Cont'd

1. United States Enrichment Corporation
Paducah Gaseous Diffusion Plant
5600 Hobbs Road
Paducah, KY 42002

(Enrichment)

2. United States Enrichment Corporation
Portsmouth Gaseous Diffusion Plant
3930 State Route 23
Piketon, OH 45661

(Enrichment)

U.S. NUCLEAR REGULATORY COMMISSION
EXPORT LICENSE

LICENSE NUMBER: XSNM3520

Conditions

Condition 1 -- Licensee shall file with the Customs Officer or the Postmaster two (2) copies, in addition to those otherwise required, of the Shipper's Export Declaration covering each export and mark one (1) of such copies for transmittal to the U.S. Nuclear Regulatory Commission, Washington, D.C. 20555-0001. The following declaration should accompany or be placed on the Shipper's Export Declarations for such exports:

> "This shipment is being made pursuant to specific license number (**specific license number**) filed at (**location of customs office where license is filed**), on (**date license was filed**). This license expired on (**expiration date of license**), and the unshipped balance remaining on this license is sufficient to cover the shipment described on this declaration."

Condition 2 -- Exports authorized in any country or destination, except Country Groups Q, S, W, X, Y, and Z in Part 370, Supplement No. 1, of the Comprehensive Export Schedule of the U.S. Department of Commerce.

Condition 3 -- This license covers only the nuclear content of the material.

Condition 4 -- The material to be exported under this license shall be shipped in accordance with the physical protection requirements for special nuclear material in 10 CFR 73.

Condition 5 -- Special nuclear material authorized for export under this license shall not be transported outside the United States in passenger-carrying aircraft in shipments exceeding (1) 20 grams or 20 curies, whichever is less, of plutonium or uranium 233, or (2) 350 grams of uranium 235.

Condition 6 -- This license authorizes export only and does not authorize the receipt, physical possession, or use of the nuclear material.

Condition 7 -- The licensee shall complete and submit an NRC Form 741 for each shipment of source material exported under this license.

Condition 8 -- The licensee shall advise the NRC in the event there is any change in the designation of the company who will package the nuclear material to be exported under this license, or any change in the location of the packaging operation, at least three (3) weeks prior to the scheduled date of export.

Appendix B: Example Bill of Lading from Piers.com

Example Bill of Lading from Piers.com

Import Bill of Lading Detail

Shipper	Consignee
URENCO NEDERLAND BV DRIENEMANSWEG 1 POSTBUS 158 ALMELO 7600 AD NL	GLOBAL NUCLEAR FUEL AMERICAS 3901 CASTLE HAYNE ROAD WILMINGTON NC 28401 US
Notify Party	**Also Notify**
TRANSNUCLEAR INC 7135 MINSTREL WAY SUITE 300 COLUMBIA MD 21045 US	ORDER

PACKAGING INFORMATION

Weight:	52,615.00 KG	**Measure:**	75 X
Quantity:	12 PCS	**TEUs:**	3.00

SHIPMENT DETAIL

Carrier:	ATLANTIC CONTAINER LINE	**Country of Origin:**	BELGIUM
SCAC:	ACLU	**Coastal Region:**	East Coast
Vessel:	ATLANTIC CONVEYOR	**Port of Arrival:**	1401 - NORFOLK
Voyage:	3266	**Port of Departure:**	42305 - ANTWERP
Bill of Lading Number:	ACLU3266S6325425	**U.S. Destination:**	NORFOLK
Pre Carrier:	ANTWERP	**Foreign Destination:**	
IMO Number:	8215534	**Mode of Transport:**	11
Inbond Code:		**Arrival Date:**	10/21/2013
Estimated Value:	$2,682,786.24		

AMS COMMODITIES

Container	Qty	Description
BNFL0000600	4	• X30B CYLINDERS OF RADIOACTIVE MATERIAL IN UX30 OPPS CONTAINING UF6 ENRICHED AT 5 MAX URANIUM HEXAFLUORIDE FISSILE CLASS 7 UN 2977 UX-30 NR ACL 012 / ACL 057 / ACL 005 / ACL 032
BNFL0000690	4	• X30B CYLINDERS OF RADIOACTIVE MATERIAL IN UX30 OPPS CONTAINING UF6 ENRICHED AT 5 MAX URANIUM HEXAFLUORIDE FISSILE CLASS 7 UN 2977 UX-30 NR ACL 041 / ACL 054 / ACL 014 / ACL 003
BNFL0000910	4	• X30B CYLINDERS OF RADIOACTIVE MATERIAL IN UX30 OPPS CONTAINING UF6 ENRICHED AT 5 MAX URANIUM HEXAFLUORIDE FISSILE CLASS 7 UN 2977 UX-30 NR ACL 049 / ACL 008 / ACL 044 / ACL 048 ON BOARD FREIGHT PREPAID EXPRESS BL

Marks & Numbers

Container	Marks & Numbers
BNFL0000600	• NO MARKS....
BNFL0000690	• NO MARKS....
BNFL0000910	• NO MARKS....

PIERS Commodity Description

Qty	Units	PIERS Commodity Description	HS Code	JOC Code
4	PCS	ENRICHED URANIUM HEXAFLUORIDE FISSILE	284410	4225220

Appendix C: Industry Examples of Naming Schemes, Registration Databases, and Registries

Industry Examples of Naming Schemes, Registration Databases, and Registries

A variety of numbering schemes, registration databases, and registries were reviewed to identify those most similar to the proposed global cylinder registry. Details regarding each scheme, database, or registry identified in Table A.1are presented in this appendix. Details of the DoD, CNSC, and IMO registries are provided in the body of this document.

To ensure consistency, definitions for a numbering scheme, registration database, and registry have been reproduced here from Section 3.

- Unique numbering or identification scheme–the standard by which it can be assured no two items are given the same identification number or signature, ensuring that each item is uniquely identifiable
- Registration database–a centralized system or directory under the control of a single entity, where information on each uniquely identified item is stored
- Registry–a registration database where data stored on each item is actively or continuously updated, tracked, or monitored by some system.

Table A.1. Industry Numbering Schemes, Registration Databases, and Registries Identified

Title	Framework Type	Commodity/Item Registered
International Council for Commonality in Blood Bank Automation (ICCBBA) Numbering Scheme	Numbering Scheme	Blood donations, tissue, and cellular therapy products
International Container Bureau (ICB) Numbering Scheme	Numbering Scheme	International intermodal shipping containers
Canadian-Origin Diamond Registration Database	Registration Database	Canadian-origin diamonds
Register of Objects Launched into Outer Space	Registration Database	Satellites, probes/landers, manned spacecraft, space station components, etc.
National Board of Boiler and Pressure Vessel Inspectors Registration Database	Registration Database	U.S.- and Canadian-origin boilers, pressure vessels, piping, and nuclear components
International Civil Aviation Organization (ICAO) International Registry	Registration Database	Aircraft
Canadian Nuclear Safety Commission (CNSC) Cylinder Registry	Registration Database	UF_6 cylinders
Department of Defense (DoD) Item Unique Identification (IUID) Registry	Registry	U.S. Government-furnished property

International Maritime Organization (IMO) Ship Number and Long-Range Identification and Tracking System (LRIT)	Registry	Propelled, seagoing merchant ships of 100 gross tons and above[13]

International Council for Commonality in Blood Bank Automation Numbering Scheme[14]

The ICCBBA was established and given the responsibility for implementation and management of the ISBT 128 Standard Technical Specification. The ISBT 128 is a system for identifying, labeling, and processing human blood, tissue, and cellular therapy products using an internationally standardized system. Each blood product is given a unique donation identification number (DIN), which includes an assigned facility identification number (FIN). This allows every product to be specifically identified and tracked anywhere in the world. This is combined with a two-digit collection year and a six-digit serial number. This allows each facility to track 1 million units per year for 100 years without duplicate DINs. Two "flag" characters exist for the local facility and have no meaning for anyone else. Finally, a check-digit calculated from the 13-digit DIN provides a method to ensure accuracy when manually entering a DIN. While no central database on each blood, tissue, or cellular product is maintained, the ISBT 128 standard facilitates local registries in that sites maintains information on products they handle, use, or ship.

International Container Bureau Code for Uniquely Numbering Intermodal Containers[15]

Maintained by the International Container Bureau[16] (BIC), a non-governmental organization, the BIC Code is used by thousands of carriers, manufacturers, operators, shippers, international organizations, and many others to facilitate the free circulation of intermodal containers worldwide. The numbering scheme, known as ISO 6346, assigns a unique three-letter code to each company that owns these containers then an additional letter that identifies the object as a container, a six-digit serial number, and a seventh digit used to validate the number transmission. This numbering scheme was adopted by URENCO as the unique identification scheme for its UF_6 cylinders. While there is no central database where information on each uniquely identified container is maintained, the BIC Code facilitates local registries in that each port where the containers pass maintains a database of containers that have passed through.

Canadian-Origin Diamond Registration Database[17]

The Canadian Diamond Code Committee (CDCC) is a non-profit, self-regulatory, volunteer industry body responsible for the implementation of the Voluntary Code of Conduct for Authenticating Canadian Diamond Claims. This code was established to provide diamond industry stakeholders and consumers

[13] Exceptions include: "vessels solely engaged in fishing, ships without mechanical means of propulsion, pleasure yachts, ships engaged on special service (e.g., lightships, SAR vessels), hopper barges, hydrofoils, air cushion vehicles, floating docks and structures classified in a similar manner, ships of war and troopships and wooden ships." The IMO numbering scheme has been extended to some of these vessels on a voluntary basis.

[14] International Council for Commonality in Blood Bank Automation. "Frequently Asked Questions." Accessed March 20, 2014 at http://www.iccbba.org/isbt-128-basics/frequently-asked-questions.

[15] BIC - Bureau International des Containers. "Presentation of the BIC-Codes." Accessed March 20, 2014 at http://www.bic-code.org/presentation-of-the-bic-codes.html.

[16] Formally known as Bureau International des Containers et du Transport Intermodal.

[17] Canadian Diamond Code of Conduct. "Consumer Information." Accessed March 20, 2014 at http://www.canadiandiamondcodeofconduct.ca/EN_consumer_information.htm.

assurances that diamonds identified as originating in Canada truly did so and are not from illicit or conflict origins. This code fulfills its mission by requiring the diamond mining sector, cutters and polishers, and retailers to maintain a paper trail so diamonds can be tracked by their unique diamond identification laser-inscribed on the diamond. The code represents an example of a registration database relying heavily on its unique identifying scheme that while overseen by a central organization, does not maintain a centralized electronic database.

United Nations Register of Objects Launched into Outer Space[18]

Established by the Convention on Registration of Objects Launched into Outer Space in 1976, the United Nations Register of Objects Launched into Outer Space is maintained by the United Nations Office of Outer Space Affairs. The register was established to reaffirm the importance of international cooperation in outer space exploration and use and to assist states in identifying space objects. The index contains information on more than 96% of the satellites, probes/landers, manned spacecraft, space station components, etc., that have been launched into space since the early 1960s by its almost 60 signatories. Entries in this registration database follow the unique naming scheme known as the COSPAR designation.

National Board of Boiler and Pressure Vessel Inspectors Registry[19]

The American Society of Mechanical Engineers (ASME) International Boiler and Pressure Vessel Code (BPVC) establishes pressure integrity safety limits that govern "the design, fabrication, and inspection of boilers and pressure vessels, and nuclear power plant components during construction."[20] The National Board of Boiler and Pressure Vessel Inspectors is responsible for ensuring that boilers and pressure vessels manufactured in the United States and Canada adhere to the BPVC. The National Board achieves this by inspecting U.S.- and Canadian-sited boilers and pressure vessels during manufacture and by assigning a unique serial number to each UF_6 cylinder, which is stored in a database maintained by The National Board.

International Civil Aviation Organization International Registry[21,22]

The ICAO, a specialized agency of the United Nations, sets the necessary standards and regulations for "aviation safety, security, efficiency and regularity, as well as for aviation environmental protection," for its 191 member states.[23] Early in its inception, the ICAO realized that if international air travel and navigation was to become a reality, one of its priorities had to be establishment of rules for aircraft

[18] Hedman, N. 2010. "The United Nations Register of Objects Launched into Outer Space." UN/Thailand Workshop on Space Law, November 16-19, Bangkok, Thailand. Accessed March 20, 2014 at http://www.oosa.unvienna.org/pdf/pres/2010/SLW2010/02-04.pdf.

[19] The National Board of Boiler and Pressure Vessel Inspectors. "A Brief History of NB Registration." Accessed March 20, 2014 at http://www.nationalboard.org/Index.aspx?pageID=58.

[20] American Society of Mechanical Engineers. "Boiler and Pressure Vessel Code 2013 Edition." Accessed March 20, 2014 at https://www.asme.org/shop/standards/new-releases/boiler-pressure-vessel-code-2013.

[21] ICAO - International Civil Aviation Organization. "Foundation of the International Civil Aviation Organization." Accessed March 20, 2014 at http://www.icao.int/about-icao/pages/foundation-of-icao.aspx.

[22] ICAO - International Civil Aviation Organization. 2013. "Regulations and Procedures for the International Registry Fifth Edition." Accessed March 20, 2014 at http://www.icao.int/publications/Documents/9864_5ed.pdf.

[23] ICAO - ICAO - International Civil Aviation Organization. "About ICAO." Accessed March 20, 2014 at http://www.icao.int/about-icao/Pages/default.aspx https://www.un.org/en/aboutun/structure/.

registration and identification. Under its Convention on International Interests in Mobile Equipment and its protocol specific to aircraft equipment, the ICAO established the International Registry "as the facility for effecting and searching registrations under the Convention and the Protocol" (ICAO 2013). While called a registry by the ICAO, the International Registry, within the hierarchy identified for this report, really is a registration database. Under the ICAO, countries are assigned a set of unique string of alphanumeric characters. For example, all aircraft registered in the United States will begin with the letter "N." Also known as an aircraft "tail number," these are reported back to the ICAO and maintained within their database. While not actively monitored internationally by a single entity, using this tail number facilitates air travel and is used by national aviation authorities across the globe to track the aircraft movement within their respective airspace.

Canadian Nuclear Safety Commission UF_6 Cylinder Registration Database[24]

The CNSC is the national nuclear regulator responsible for the safety and security of nuclear facilities operating in Canada. In fulfilling this role, the CNSC requires that only containers of a certified design that have received confirmation of registration with the CNSC can be used for transporting UF_6. Each cylinder is expected to have a serial number, and the facility operator is expected to ensure that the cylinder has been registered with CNSC prior to use. From conversations with this regulator, it was stated these numbers are required to be reported to the national nuclear regulator. However, per conversations with CNSC staff, it was determined that while Canadian operators report these serial numbers, the numbers merely are maintained in a database and not tracked or monitored.

[24] CMSC - Canadian Nuclear Safety Commission. 2011."Packaging and Transport of Nuclear Substances Regulations. Packaging and Transport of Nuclear Substances Regulations, Subsection 14 (1) and (2)." SOR/2000-208, Ottawa, Canada.