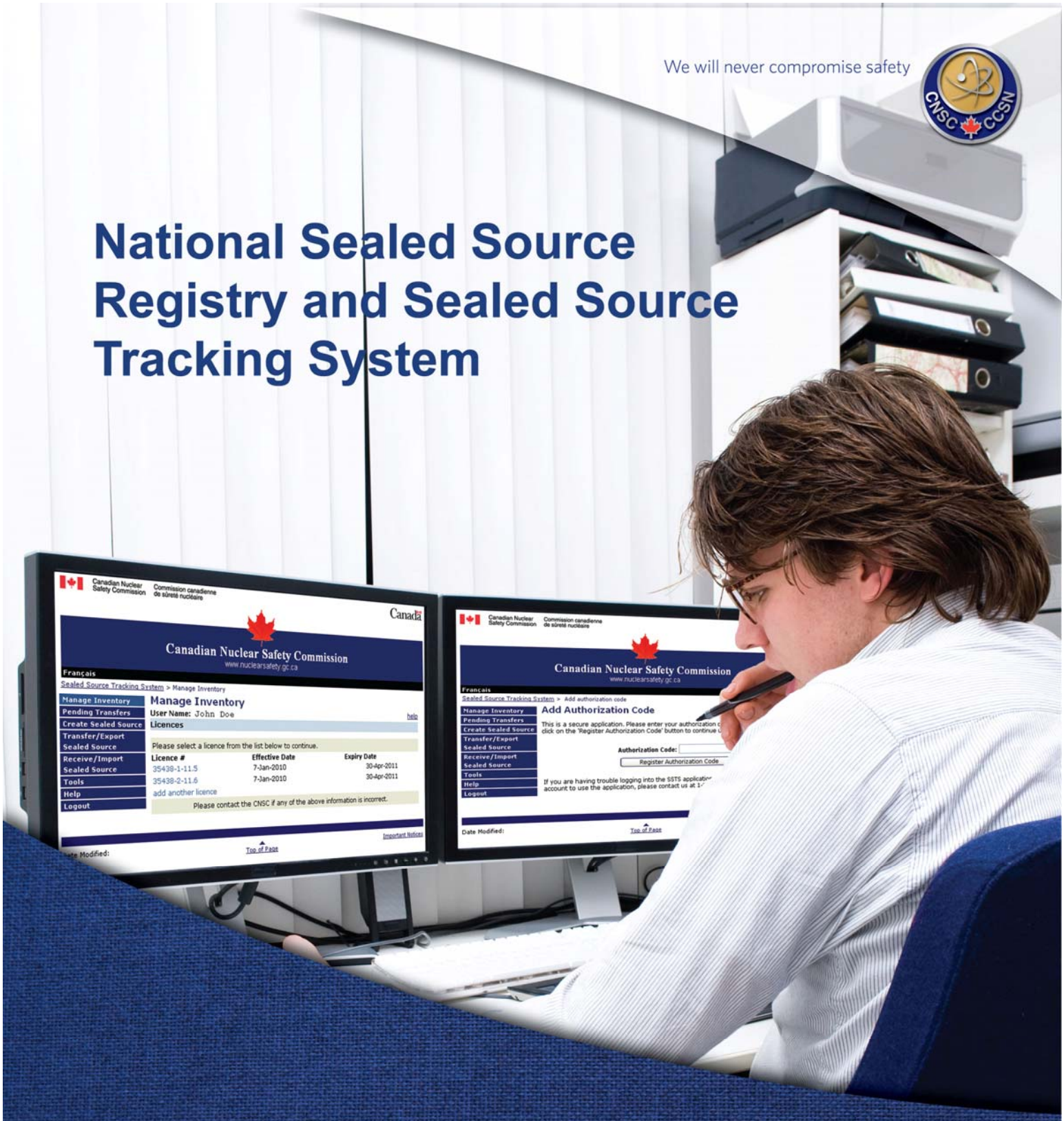
We will never compromise safety

National Sealed Source Registry and Sealed Source Tracking System



Annual Report 2009

Canadian Nuclear Safety Commission
Commission canadienne de sûreté nucléaire

Canada

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To order a printed copy of the document in English or French, please contact:

Canadian Nuclear Safety Commission
280 Slater Street
P.O. Box 1046, Station B
Ottawa, Ontario K1P 5S9
CANADA

Tel.: 613-995-5894 or 1-800-668-5284 (in Canada only)
Facsimile: 613-995-5086
Email: info@cnsc-ccsn.gc.ca
Web site: nuclearsafety.gc.ca

National Sealed Source Registry and Sealed Source Tracking System Annual Report 2009

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Executive Summary

This report provides information on the tracking of radioactive sealed sources in Canada through the Canadian Nuclear Safety Commission's (CNSC) National Sealed Source Registry (NSSR) and Sealed Source Tracking System (SSTS) for the period of January 1, 2009, to December 31, 2009. The report also describes developments made in the NSSR and SSTS during the same period.

The CNSC was the first nuclear regulator among G8 countries to develop a national registry and to implement a Web-based tracking system, along with enhanced export and import controls for high-risk sealed sources. These systems have been efficient and effective since their establishment in 2006.

This is the fourth NSSR-SSTS annual report; previous reports were issued in 2006, 2007 and 2008.

The NSSR is a national database managed by the CNSC that is designed to maintain inventory information on all categories of sealed sources in Canada. Currently, the system contains detailed information of high-risk (categories 1 and 2) and some moderate to low-risk radioactive sealed sources in Canada. This system, in conjunction with regulatory compliance operations, increases the security, safety and management of those sources.

The NSSR's high-risk source tracking component, the SSTS, provides licensees and CNSC staff members with a more efficient and effective way to report and track the movement of high-risk sealed sources.

In late 2007, the CNSC started compiling data on sealed sources in moderate-risk category 3 and low-risk categories 4 and 5. This compilation continued in 2008 as licensees provided detailed inventory information in their annual reports to the CNSC. The CNSC has always required licensees to maintain an accurate inventory of their sealed sources and provide details of these inventories on request. In 2009, a process was developed and implemented to validate the accuracy of all reported information and enable Category 3 and 4 source information to be included in the NSSR. Category 5 sealed sources, considered to be very low risk, will be reviewed and included as required.

In order to facilitate the submission and verification of category 3, 4 and 5 sealed source information, the CNSC is establishing a Web-based reporting module for the licensees' submission of their annual compliance reports (ACR). Licensees will be able to submit and update, on an annual basis, their sealed source inventories, using a secure online system – the ACR Online. The development of the ACR Online system to include reporting of categories 3, 4 and 5 is expected to continue through 2010 and 2011, and will eventually result in the registration and tracking of all categories of sealed sources in Canada.

By the end of 2009, the NSSR had information on 28,132 radioactive sealed sources of all categories in Canada representing an increase of 42% over the previous year. The SSTS was tracking 2,702 category 1 sources, and 17,530 category 2 sources. The remaining 7,900 sources in the NSSR were category 3, 4 and 5, which are not subject to mandatory tracking using the SSTS. The SSTS registered more than 44,000 individual transactions of all types throughout the year, which represents an 8% increase over 2008.

Since its inception in 2006, the SSTS has only tracked the movement of categories 1 and 2 sealed sources in active use in Canada. The CNSC is now assessing and recording in the NSSR, sealed sources that are not in active use, but rather in secure storage awaiting disposal. These sources were originally excluded from the NSSR, unless there was a clear intent to reuse or recycle them in some manner. Category 1 and 2 sealed sources, both in use and in storage, will now be tracked using the SSTS.

The CNSC monitors and tracks unplanned events involving the loss or theft of sealed sources by licensees in Canada. Sealed sources that are found in the public domain are immediately investigated to ensure safety and security are maintained and that the original owners responsible for the material are identified. In 2009, there were no events associated with lost, stolen or found sealed sources involving categories 1, 2 or 3.

Throughout 2009, the CNSC took part in numerous outreach meetings with major distributors of sealed sources pertaining to the use of the SSTS. In June 2009, the CNSC participated in the "*Technical Meeting on the Implementation of the Code of Conduct on the Safety and Security of Radioactive Sources with regard to Long Term Strategies for the Management of Sealed Sources*" at the International Atomic Energy Agency (IAEA) in Vienna, Austria. This provided an effective forum for the exchange of information on the tracking of sealed sources and issues in dealing with orphan sources.

In June 2009, the CNSC was evaluated by the by the Integrated Regulatory Review Service (IRRS) of the IAEA. The report produced by the IRRS recognized CNSC's initiatives in regards to the implementation of the SSTS and the strengthening of the regulatory programs for radioactive sealed sources and radiation devices. The report recommended that the CNSC enhance existing programs for the communication, management and recovery of orphan sources. This resulted in the CNSC initiating development of a comprehensive Orphan Source Program, which is planned for implementation in 2010-2011.

In late 2009, the CNSC and the United States Nuclear Regulatory Commission (USNRC) initiated discussions to determine the feasibility of the electronic exchange of sealed source information between the CNSC's SSTS and the USNRC's National Source Tracking System. Consultations with the USNRC indicated a common interest in the secure exchange of source information. This initiative will be further investigated in 2010.

Introduction

The Canadian Nuclear Safety Commission (CNSC) was the first nuclear regulator among G8 countries to develop a National Sealed Source Registry (NSSR) and to implement a Web-based Sealed Source Tracking System (SSTS). In addition, enhanced controls were established for the import and export of high-risk sealed sources.

CNSC manages Canada's national inventory of high-risk radioactive sealed sources by means of the NSSR. The safety and security of these dangerous sources is increased through effective control and tracking.

This report provides information on the registration and tracking of radioactive sealed sources in Canada through the NSSR and SSTS systems for the period of January 1, 2009, to December 31, 2009. The report also describes developments made to the systems during the same period.

This is the fourth annual report; previous reports were issued in 2006, 2007 and 2008.

Additional information on the SSTS can be found on the CNSC Web site:
nuclearsafety.gc.ca

1 Past to present

From 1998 to 2004, the CNSC participated in international meetings to draft key documents concerning the safety and security of radioactive sources. In 2004, the International Atomic Energy Agency (IAEA) published the *Code of Conduct on the Safety and Security of Radioactive Sources* (the Code), which was followed in 2005 by the *Guidance on the Import and Export of Radioactive Sources* (the Guidance). These documents formed the basic concept for the development and implementation of the NSSR and SSTS which included more stringent control and enhanced security measures on the possession, use and transport of high-risk sealed sources.

The NSSR and SSTS were implemented in January 2006, and export licensing provisions to conform to the Code and the Guidance were implemented in April 2007.

The CNSC maintains specific regulatory requirements for the licensing of all sealed sources and radiation devices containing sealed sources. The CNSC's licences and certificates limit the specific radioactive nuclear substance and the maximum quantity of that nuclear substance allowable for each type of radiation device. For each licensee, the NSSR contains detailed information on each high-risk radioactive sealed source, including serial numbers, type, quantity and location in Canada.

2 Descriptions of the NSSR and SSTS

The SSTS is a secure information management computer program used to populate the NSSR, and allows licensees to report their source transfers online. The NSSR enables the CNSC to build an accurate and secure inventory of sealed sources in Canada, starting with those that are classified as high-risk. The information is as current as the reporting timeframes required by the licence (e.g., reporting within two days of receipt and seven days in advance of any transfer).

Sealed sources are classified by the IAEA into five different categories (see Appendix 1), with categories 1 and 2 being designated as high-risk (or risk-significant), Category 3 sources being moderate-risk, and categories 4 and 5 sources as low-risk. The CNSC has focused its efforts to accurately capture data about these sources. Currently, the NSSR contains detailed information on category 1 and 2 sealed sources in Canada, and limited information on sources in categories 3, 4 and 5. More complete information about the categories 3, 4 and 5 is planned to be associated with the NSSR by the end of 2010.

3 Major developments in 2009

3.1 Review of sealed sources in storage

Since its inception, the SSTS has tracked the actual movement of category 1 and 2 sealed sources in active use in Canada. The CNSC is now assessing and recording sealed sources that are not in active use, but in secure storage awaiting planned disposal. These sources were originally excluded from the registry, unless there was a clear intent to reuse or recycle them in some manner, however they will now be added to the NSSR.

3.2 Category 3, 4 and 5 sealed sources

Licensees have always been required to maintain an accurate inventory of their sealed sources and provide this information to the CNSC upon request. Inventories on category 3 and 4 sealed sources are now being reviewed and validated for accuracy, then compiled and maintained in an intermediate database for a future inclusion in the NSSR. Category 5 sealed sources, considered very low risk, will be reviewed only as required. A Web-based program, currently under development, will allow licensees to securely submit inventory details in an electronic format. The functional design plan for this online reporting system was completed in 2009, with further development and testing to occur in 2010. This project is expected to undergo multiple phases of development throughout 2010 and 2011, and will eventually result in the electronic registration and tracking of all categories of sealed sources in Canada.

3.3 Outreach program

The CNSC held several meetings with major distributors of sealed sources in Canada, to discuss issues pertaining to the use of the system and population of the NSSR. These meetings occurred in April and September of 2009, and helped resolve issues with respect to bulk file transactions, data accuracy and timeliness of reporting.

3.4 International presentations

In June 2009, CNSC subject matter experts attended the International Atomic Energy Agency "*Technical Meeting on the Implementation of the Code of Conduct on the Safety and Security of Radioactive Sources with regard to Long Term Strategies for the Management of Sealed Sources*" at the Agency's headquarters in Vienna, Austria. Staff delivered presentations on the status of the NSSR and SSTS, as well as the initial investigation into the development of an orphan source recovery program. This program will address sealed sources that have been lost, stolen or abandoned, and that may subsequently be discovered in locations such as landfills and recycling facilities.

3.5 Orphan source program

An orphan source is a radioactive source that is not under proper regulatory control. Experience with these sources has shown that most of the accidents resulting in severe radiological consequences occur when high-risk sealed sources are outside of a regulatory control system. Orphan sources are often discovered in industrial locations such as scrap metal facilities. The CNSC is developing an Orphan Source Program (OSP) to provide better control over these sources when they are discovered.

Elements of the OSP and a corresponding action plan will be based on the IAEA Code and associated guidance documents. The OSP will include initiatives for promotion, communication, prevention and response in order to help those who come across orphan sources to manage them safely.

In the initial stages of development of the OSP, specific information has been provided to scrap metal dealers, to show them what radioactive sources and devices may typically look like. The CNSC funded a research study to evaluate the situation on the use of portal monitors in Canada. The abstract for RSP-0237, a report on the *Use and Location of Vehicle Portal Radiation Monitors in Canada*, is available on the CNSC Web site. The study showed that the majority of scrap metal facilities, municipal landfill sites and private hazardous waste sites in Canada have installed portal vehicle radiation detectors, in order to assess the contents of transport vehicles for radioactive material.

If radioactive material is detected, facility operators can contact the CNSC for assistance or information. If the owner of the radioactive material can be identified, they may be required to recover the material and pay all the costs associated with its disposal and cleanup. In situations where the owner cannot be identified, the CNSC will provide assistance and support to determine the nature, origin and disposal options for the radioactive material.

4 Performance management

4.1 System audit and evaluations

In 2009, the NSSR and SSTS was audited and evaluated by its internal audit services. The audit (Audit of Sealed Source Controls) found that "*controls established by the CNSC for the purpose of tracking sealed sources are adequate and effective*". Minor inconsistencies between licensee and CNSC inventory records. These differences were attributed to the quality of the information provided by authorized system users, as well as errors in CNSC data entry. These inconsistencies were immediately addressed and rectified. The audit also made a recommendation for an electronic link between the export licensing database and the SSTS in order to ensure immediate validation of authorized exports of sealed sources. Currently, this is a manual (non-automated) process.

In June 2009, the CNSC hosted the IAEA's Integrated Regulatory Review Service (IRRS) mission to Canada. The IRRS is a service offered to member countries that evaluates and compares a country's regulatory practices with international standards and good practices elsewhere in the world. Peer reviews provide opportunities for both the CNSC and the IAEA to learn about different approaches to the organization and practices of national nuclear regulatory bodies. The reviews can also provide feedback to the IAEA on the application of international safety standards, and contribute to the harmonization of regulatory approaches among member countries.

The final evaluation from the review service, "IAEA Integrated Regulatory Review Service Mission to Canada", indicated the following with respect to the NSSR and SSTS:

"*The CNSC follows a "cradle-to-grave" approach in regulating radioactive sealed sources and radiation devices, recognizing that every stage in the life cycle of radioactive sources has its own unique needs for regulatory control and security.*"

It also recognized the SSTS as a good practice that could provide an excellent model for other Member countries.

"*The CNSC's online sealed source tracking system is outstanding, and provides an excellent model for others to follow*."

4.2 Performance measures and verification

In order to gauge the effectiveness of the SSTS program and verify the accuracy of data in the system, CNSC inspectors physically cross-reference data in the SSTS against the licensees' actual inventory of sealed sources. Routine CNSC compliance inspections now include requirements to verify SSTS tracking information. Inconsistencies are immediately addressed to ensure accuracy in the data. These inconsistencies include errors in source serial numbers and reference dates as well as the use of non-standard terminology when identifying radiography sealed source assemblies.

The results of the CNSC compliance verification of SSTS tracking requirements will be presented in an industry report for DNSR licensed activities, which is under preparation and planned to be completed by December 2010.

4.3 Event mitigation

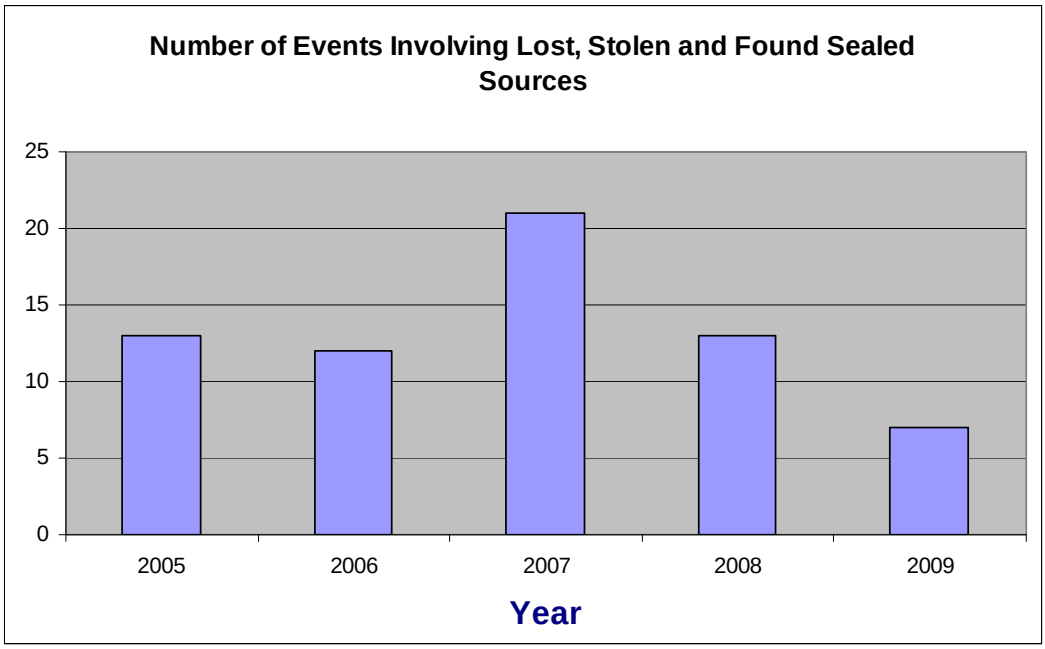
The NSSR and SSTS are essential to the maintenance of the safety and security programs for high-risk sealed sources. It is important for the CNSC to track and assist with the licensee's mitigation of all events involving sealed sources. Current regulations require all licensees to immediately report lost or stolen nuclear substances to the CNSC, with written descriptions of any actions taken or proposed in order to recover the missing material. Any loss or theft of high- or moderate-risk sealed sources requires the licensee to work with local police and other authorities, to inform the public and to obtain any required additional resources to assist with the search. All events involving sealed sources are investigated or followed-up by the CNSC, to ensure that the licensee is taking all necessary actions to mitigate the event. If an event involves the loss or theft of a sealed source or radiation device, the CNSC informs national and international stakeholders of the event, in order to assist with the recovery.

Information on lost and stolen nuclear substances can be found in the CNSC document "*Lost or Stolen Sealed Sources and Radiation Devices Report*", located on its *Reading Room/Reports* Web page found at nuclearsafety.gc.ca/eng/readingroom/reports/. The report lists all the lost, stolen and found sealed sources and radiation devices in Canada, as reported to the CNSC since 2005. In 2009, there were seven events involving lost, stolen or found sealed sources in Canada. There were no events associated with lost, stolen or found sealed sources involving categories 1, 2 or 3. Increased safety and security oversight by the CNSC as well as enhanced due diligence by licensees are the main reasons for a continuing decrease in the number of recorded events.

Events involving categories 4 and 5 included:

- Five events involving **Category 4** low-risk sealed sources, including one where a sealed source was lost and subsequently recovered, two where sealed sources were stolen and two events involving the discovery of orphan sources, one that originated in Canada and the other from the United States. The two missing sealed sources are still being investigated by the licensees. Orphan or lost category 4 low-risk sources are unlikely to be dangerous to persons when not safely and securely protected.
- Two events involving **Category 5** very low risk sealed sources. This involved two lost sealed sources, neither of which has been recovered. Orphan or lost category 5 low-risk sealed sources pose no personal danger to persons due to their low activity, short half-life or by their radiological nature.

Chart #1: Number of events involving lost, stolen and found sealed sources



5 Planned improvements and objectives

5.1 Ongoing documentation

As enabling tools are created and modified, internal documentation associated with the NSSR and SSTS will be revised. This includes any additions to the source activity decay calculator, category identification and licence number look-up table.

5.2 Population of the NSSR with Category 3, 4 and 5 sources

In 2008, the CNSC started compiling data on sealed sources in categories 3, 4 and 5. In 2009, the CNSC began the design of a Web-based module, whereby licensees will be able to submit and update their yearly source inventories using a secure online Annual Compliance Report (ACR) system. Licensees will be able to enter their inventory data directly into structured data tables included in the online version of the ACR. As inventory information is received from licensees, it is validated for accuracy and consistency and reformatted where necessary. This will facilitate eventual inclusion into the NSSR. The ACR tables will also be made available to licensees offline, so that they can maintain their inventories in a common format to the CNSC and allow for efficient inventory reporting. The CNSC will then be able to maintain data on all categories of sealed sources used, stored or transported in Canada. The ACR online reporting system for categories 3, 4 and 5 is planned for 2010.

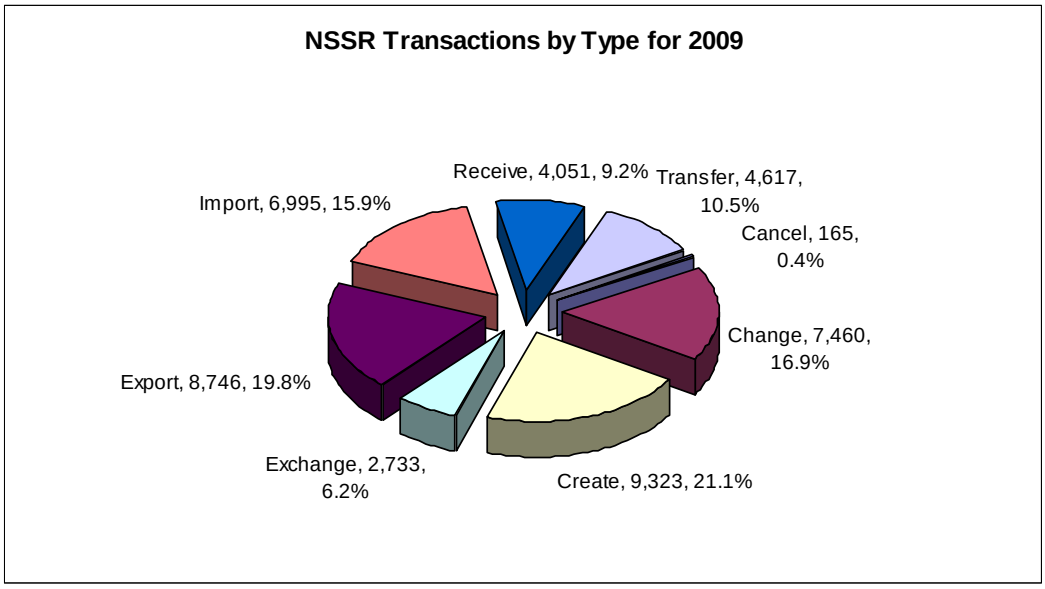
5.3 International exchange of data

In late 2009, the CNSC and the United States Nuclear Regulatory Commission (USNRC) initiated discussions to determine the feasibility of the electronic exchange of sealed source information between the CNSC's SSTS and the USNRC's National Source Tracking System. The exchange of data will provide essential information on authorized sealed source import and export transactions between Canada and the United States. This initiative will be further reviewed for implementation in 2010 and 2011.

6 Operational Data

Throughout 2009, the NSSR continued to be populated with high-risk source information, as licensees reported their transactions. The following operational data encompass the entire NSSR and SSTS. The data includes all sources reported by mail, fax and e-mail, as well as Web transactions (transfers, receipts, imports, exports, cancellations, changes, and creations).

Chart #2: NSSR transactions by type for 2009



Types of transactions

Receive: Represents sources received by licensees at licensed locations;

Transfer: Represents the number of sources transferred within Canada between licensees and licensed locations;

Cancel: Data change due to unforeseen circumstances (export and shipment cancellations and delayed transfers);

Change: Data change or correction (e.g. to reference date of source activity);

Create: Creation of a new source manufactured in Canada;

Exchange: The replacement of one source for another in a device or prescribed equipment, at a licensed location;

Export: Represents sources shipped out of Canada; and

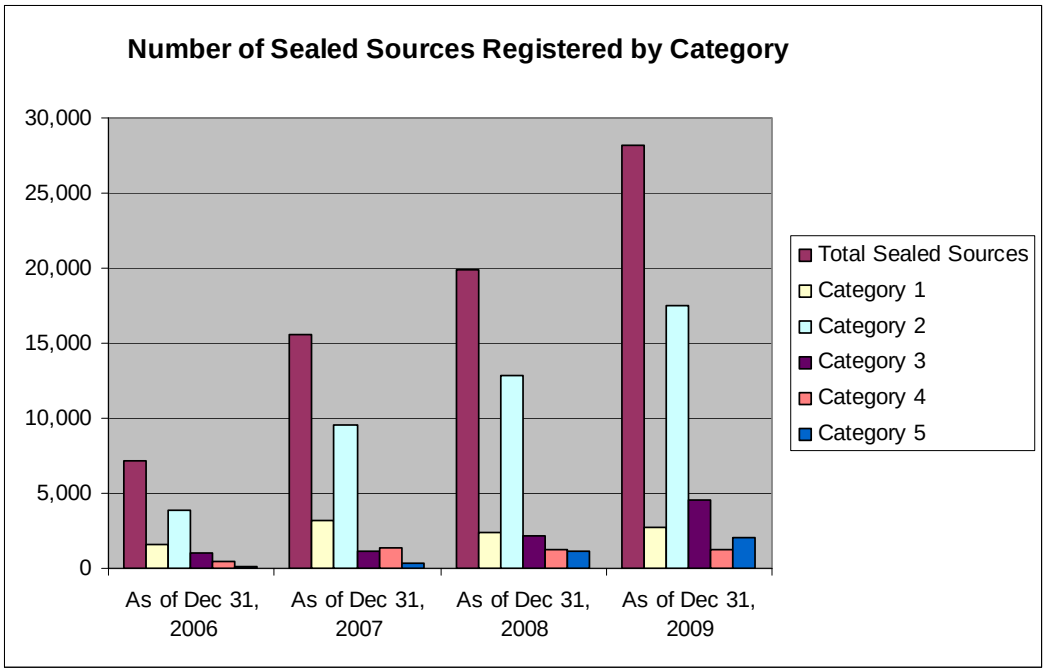
Import: represents sources shipped into Canada.

All category 1 and 2 high-risk sources are subject to mandatory source tracking. Some category 3, 4 and 5 sources have been reported by licensees as an integral part of their overall inventory. The number of these sources increased in 2009, as higher risk sources naturally decayed to lower categories and as more licensees added their inventories to the system. The number of sources in categories 1 and 2 varied with the number of sources created, disposed, imported or exported by manufacturers and licensees.

Table 1: NSSR statistics

NSSR Statistics	As of Dec. 31, 2006	As of Dec. 31, 2007	As of Dec. 31, 2008	As of Dec. 31, 2009
Number of NSSR transactions	**30,167**	**39,645**	**40,711**	**44,090**
Number of sources in NSSR (all categories) in Canada	**7,150**	**15,538**	**19,847**	**28,132**
Number of category 1 sources tracked in Canada	**1,638**	**3,224**	**2,410**	**2,702**
Number of category 2 sources tracked in Canada	**3,920**	**9,523**	**12,881**	**17,530**
Number of category 3 sources recorded in the registry	**995**	**1,186**	**2,137**	**4,578**
Number of category 4 sources recorded in the registry	**500**	**1,312**	**1,273**	**1,263**
Number of category 5 sources recorded in the registry	**97**	**293**	**1,146**	**2,059**

Chart #3: Number of sealed sources registered by category



Since 2006, use of the online SSTS has gradually increased. Issues with respect to compatibility with various Web browsers lead to improvements in the system. The system can now be used with all popular Web browsers. As online connection issues are reported, the CNSC will investigate and adapt the system where required.

Table 2: SSTS Online Use

SSTS Statistics	As of Dec. 31, 2006	As of Dec. 31, 2007	As of Dec. 31, 2008	As of Dec. 31, 2009
Number of SSTS Web Sessions [1]	**368**	**873**	**3,187**	**4,586**

[1]. A Web Session is an authorized access to the online SSTS, and may involve multiple transactions.

Chart #4: Number of SSTS Web sessions per year

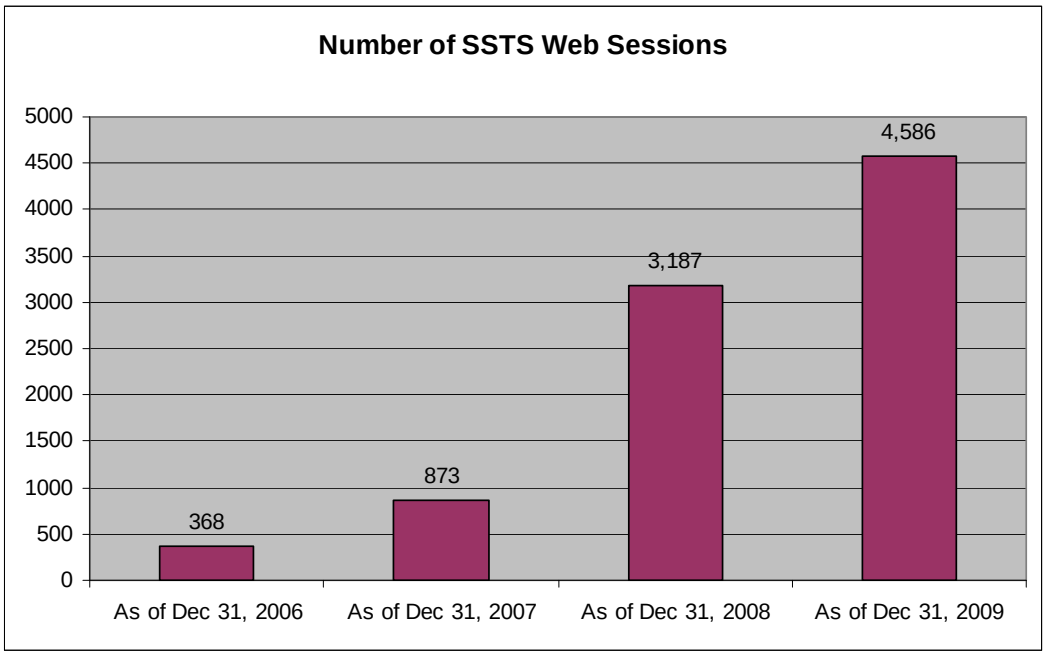
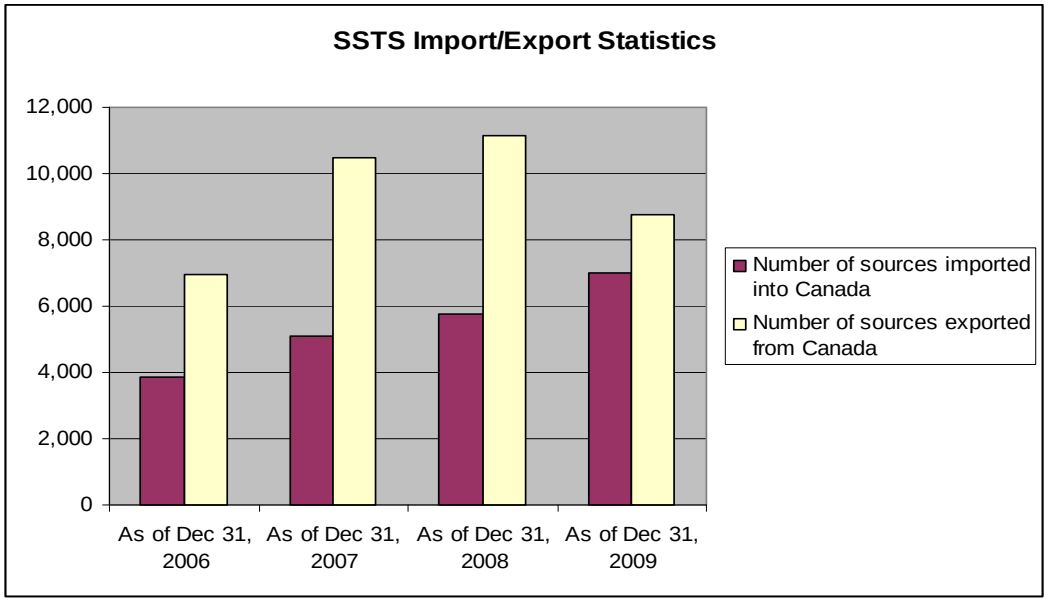


Table 3: SSTS import and export statistics per year

SSTS Annual Statistics	As of Dec. 31, 2006	As of Dec. 31, 2007	As of Dec. 31, 2008	As of Dec. 31, 2009
Number of sources imported into Canada	**3,846**	**5,093**	**5,763**	**6,995**
Number of sources exported from Canada	**6,945**	**10,476**	**11,127**	**8,746**

Chart #5: Number of Import and Exports per year:



7 Conclusion

The NSSR and SSTS contain information on the movement and location of high-risk radioactive sources in Canada, from their manufacture to their final disposition. The CNSC was the first nuclear regulator among the G8 countries to implement a national registry of high-risk sealed sources and monitor their movement using a Web-based tracking system. Ongoing improvements and enhancements to the systems continue to demonstrate the CNSC's commitment to the safe and secure control of high-risk radioactive sealed sources.

The CNSC is enhancing existing electronic information systems, to allow data on category 3, 4 and 5 sealed sources to be efficiently and effectively registered and tracked. Current performance measures and data verification and validation are under continuous review, and are being improved as required. Statistics show a 46% increase in the number of radioactive sealed source transactions since 2006. This indicates an increase in licensee commitment to the NSSR and SSTS and an improvement in the systems' effectiveness. This increase is expected to continue as more category 3, 4 and 5 sealed sources are included in the registry.

Appendix 1

Categorization of sources

Radioactive sealed sources are used throughout the world in medicine, industry, agriculture, research and education, and vary widely in radiological risk.[5] In 2005, the IAEA published a risk-based ranking of radioactive sources and practices, which uses five categories. The category assigned to each practice or radioactive nuclear substance (which the sealed source is made of) takes into account factors such as the following:

1. Radiological risk associated with the source;
2. The nature of the work (or application for which the source is used);
3. The mobility of the source, experience from reported accidents; and
4. Typical versus unique activities within an application.

These factors were used to assign sources and practices to one of five categories. If not managed safely and securely, Category 1 sources are considered to pose the greatest risk to human health, while Category 5 sources pose the lowest risk.

Category 1 sources are classified as "personally extremely dangerous."

Category 1 (Very High-risk)
This radioactive material, if not safely managed or securely protected, would be likely to cause permanent injury (in some cases fatal) to a person handling or in contact with the material for a period of a few minutes. Exposure would be fatal if a person were close to it in an unshielded manner for a few minutes to an hour.[6] Category 1 sources are associated with licensed activities to which the CNSC *Class II Nuclear Facilities and Prescribed Equipment Regulations* apply.

Examples of a Category 1 source usage:

- Self Shielded Irradiators: Gamma sources are used in these irradiators for experimental purposes or as a means of sterilization. Gamma irradiation kills bacteria by breaking down bacterial DNA and inhibiting cell division. Blood products, for example, are sterilized in self-shielded irradiators.

Image #1: Cobalt-60 Gammacell.

- Gamma Knife Radiosurgery: An advanced form of surgery, performed with highly focused beams of radiation. As many as 201 radioactive sealed sources create intersecting beams of gamma radiation which deliver a concentrated dose of radiation to a precise area of the brain. These radiation beams form the "knife".

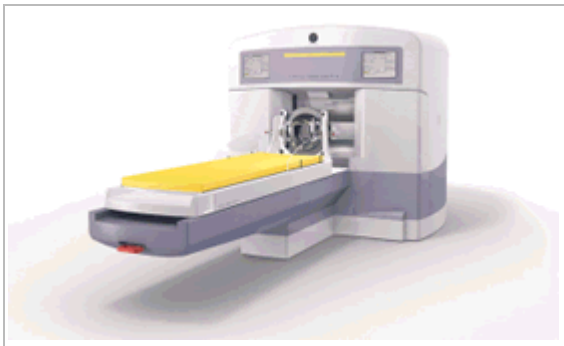


Image #2: Elekta Gamma Knife Image

#3: Gamma Knife in use

- Radioactive Source Teletherapy: External beam radiotherapy otherwise known as "teletherapy" is the most frequently used form of radiotherapy. Radiotherapy is the medical use of radiation (produced by a radioactive sealed source mounted inside the machine) as part of cancer treatment or to control malignant cells.

Image #4: Co-60 Teletherapy

Category 2 sources are classified as "personally very dangerous."

Category 2 (High-risk)
This radioactive material, if not safely managed or securely protected, could cause permanent injury to a person either handling it, or in contact with it for a short period of time (minutes to hours) – or be fatal if close to it in an unshielded manner for a few days. Category 2 sources are associated with licensed activities to which the CNSC *Nuclear Substances and Radiation Devices Regulations* mostly apply.

Example of a Category 2 source usage:

- Industrial radiography is a non-destructive testing (NDT) application that uses gamma radiation from a highly radioactive source, and photographic film, for the detection of internal physical imperfections (such as voids, cracks, flaws, segregations, pores and inclusions) in pressure vessels, pipelines, ships and reactor components. Radiography produces images on photographic film, similar to X-ray images, which show varying densities according to the amount of radiation absorbed in the material.

	
Image #5: Industrial radiography "camera" contains the radioactive sealed source	Image #6: NDT pipeline inspection using industrial radiography equipment

Category 3 sources are classified as "personally dangerous."

Category 3 (Moderate-Risk)

This radioactive material, if not safely managed or securely protected, could cause permanent injury to a person either handling it, or otherwise in contact with it, for some hours. It could possibly — although unlikely — be fatal to be close to this amount of unshielded radioactive material for a period of days to weeks.[7] Category 3 sources are associated with licensed activities to which the CNSC *Nuclear Substances and Radiation Devices Regulations* apply.

Examples of a Category 3 source usage: • Industrial gauges: These gauges are usually installed in fixed positions for measuring and process control purposes. These include density gauges, level gauges, belt mass meters, and thickness gauges. The radioactive sealed source is mounted inside the gauge and projects a radiation beam, through the material, and is picked up by a detector to provide a measurement.	 Image #7: Industrial fixed gauge
• Brachytherapy delivers a concentrated dose of radiation to cancerous tissue from within. High dose rate (HDR) brachytherapy is the placement of a small, highly radioactive sealed source, for a short period of time, directly into cancerous tissues. The procedure is sometimes guided by ultrasound or 3D computerized mapping techniques.	 Image #8: HDR Brachytherapy

Category 4 sources are classified as "unlikely to be dangerous."

Category 4 (Low-risk)
It is very unlikely that anyone would be permanently injured by this radioactive material. However, if this unshielded radioactive material is not safely managed or securely protected, it could — although it is unlikely — temporarily injure someone either handling it, in contact with it, or is who close to it for a period of several weeks.[8] Category 4 sources are associated with licensed activities to which the CNSC *Nuclear Substances and Radiation Devices Regulations* apply.

Example of Category 4 source usage:

- Low dose rate industrial gauges, such as moisture and density gauges, are used to measure the density of asphalt, soil, aggregate or concrete, as well as the moisture content of soil or aggregate.

Image #9: Portable gauge

Image #10: Portable gauge in use

Category 5 sources are classified as "not dangerous."

Category 5 (Very Low-risk)
No one could be permanently injured by this radioactive material.[9] Category 5 sources are associated with licensed activities to which the CNSC *Nuclear Substances and Radiation Devices Regulations* apply.

Examples of a Category 5 source usage:

- Electron capture detector Ni-63 sources are used in gas chromatography instruments. They detect minute amounts of chemical compounds, such as halogenated organic chemicals in environmental samples. Pesticide levels in foodstuffs, for example, are measured with these detectors.

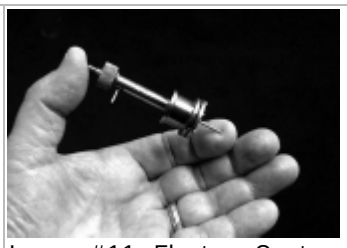


Image #11: Electron Capture Detector

• Low dose rate (LDR) brachytherapy involves exposure to small radioactive sealed sources for a few hours or days. Ocular melanoma is one example of a tumour that can be treated with LDR brachytherapy. In another example, radioactive seeds of iodine-125 are surgically implanted to treat prostate cancer.	 Image #12: LDR Brachytherapy

[1] *"Categorization of radioactive sources", IAEA TECDOC-1344, 2003.*

[2] This number represents all transactions for the NSSR and SSTS systems, including new sources added by manufacturers, as well as imports and exports.

[3] This number represents the number of sources transferred within Canada, between licensees and licensed locations.

[4] This number represents the number of source transfers within Canada, as conducted by licensees using the on-line Web tool. The difference between lines 9 and 10 represents the number of transactions conducted by phone, fax, mail and e-mail.

[5] IAEA, *Categorization of Radioactive Sources*, RS-G-1.9, (2005), p.1

[6] IAEA, *Categorization of Radioactive Sources*, RS-G-1.9, (2005), Table 3

[7] IAEA, *Categorization of Radioactive Sources*, RS-G-1.9, (2005), Table 3

[8] IAEA, *Categorization of Radioactive Sources*, RS-G-1.9, (2005), Table 3

[9] IAEA, *Categorization of Radioactive Sources*, RS-G-1.9, (2005), Table 3