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Reducing Safeguards Accounting and Verification Efforts on Retained Wastes[1]

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ABSTRACT

The global expansion of nuclear energy will generate increasing quantities of waste with low levels of plutonium or other nuclear materials (NM) potentially subject to International Atomic Energy Agency (IAEA) safeguards. Reducing requirements on retained wastes has the potential to reduce future demands on already strained IAEA resources. We describe an effort to help the IAEA and Member States better estimate projected waste loads and associated safeguards obligations by developing a reporting tool to estimate types and sizes of future waste-storage and -disposal facilities. States can use such information to plan waste facilities, including size and type. The IAEA can use these data for inclusion in multiple agency reports and products for the benefit of member states.

INTRODUCTION

Spent nuclear fuel (SNF) and radioactive waste are byproducts of nuclear reactors used for power generation, research, training, and isotope production. Radioactive waste is also generated from a variety of radioactive materials used in medicine, industry and research. Of special concern is SNF, which contains long-lived radionuclides and requires that States appropriately dispose SNF (or, if reprocessed, any waste streams that contain long-lived actinides and fission products). Requirements for managing and disposing radioactive wastes depend in large part on whether waste is classified as high-level (HLW), intermediate-level (ILW), low-level (LLW) or very low-level (VLLW). Final disposal of these various wastes can range from deep geological disposal (for HLW and SNF) to near-surface disposal in trenches (for some LLW and VLLW).

The IAEA has periodically summarized the status of and trends in global waste inventories, and has gleaned information about national programs for managing SNF and other radioactive wastes. The IAEA collects much of this information through its Net Enabled Waste Management Database (NEWMDB) [2]. In 2018, the IAEA published an overview of the status and trends in SNF and radioactive waste management (with data current through 2013), including expected future waste arisings and national strategies for managing these materials now and in the future [3]. The 2018 publication is based primarily on national profiles submitted by 47 participating Member States, supplemented by published reports to the *Fifth Review Meeting of the Contracting Parties to the Joint Convention* [4].

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These data indicate that, worldwide, approximately 250,000 t-HM (tonnes heavy metal) of SNF is in storage and another 120,000 t-HM of SNF has been reprocessed. The global inventory of solid radioactive waste is approximately 35 million m^3, of which 28.5 million m^3 has been disposed (82% of the total) and another 6.3 million m^3 is in storage awaiting disposal (18%). More than 98% of the *volume* of solid radioactive waste is classified as VLLW or LLW, with most of the remainder being ILW. In terms of total radioactivity, however, 95% of *radioactivity* is associated with HLW and SNF [3].

Disposal facilities for VLLW and LLW are operating in several countries; however, disposal options in many countries, especially those with small waste volumes, remain underdeveloped. Developing disposal facilities for HLW and SNF present difficult challenges for many States; although notable progress is being made in a few countries (e.g., Finland and Sweden), many national waste-management programs are progressing slowly.

In order to facilitate and prepare for long-term management of waste inventories, the IAEA plans to develop a tool for Member States to better estimate future wastes arisings from the variety of sources under their control. This new effort will complement current IAEA data-collection methods, notably those associated with the Net-Enabled Radioactive Waste Management Database (NEWMDB).

NEWMDB

The IAEA has been collecting and publishing information about radioactive-waste management since 1991. NEWMDB is a web-based data-collection tool that began gathering such information in 2002. NEWMDB has information about national programs for managing radioactive wastes; relevant laws and regulations; national waste-management policies, plans and activities; and radioactive-waste inventories and disposal.

NEWMDB improves Member-State access to radioactive waste management information and provides

- a system for maintaining international "memory" of information about radioactive waste management;
- reference material accessible to Member States and a variety of IAEA programs, including the IAEA's Technical Assistance program and its Waste Management Technical Review and Assessment Program (WATRP);
- a resource for researching and assessing Member States' national systems for radioactive-waste management, including their development and implementation; and
- a tool for Member States that supports reporting requirements of the *Joint Convention on the Safety of Spent Fuel Management and on the Safety of Radioactive Waste Management* (Joint Convention).

The new tool for estimating waste types and inventories will complement NEWMDB by improving estimates of waste types and amounts arising, and will include waste-management plans and potential future safeguards requirements.

WASTE ESTIMATES AND NEWMDB METHODOLOGY

Because national regulations governing radioactive-waste management vary among States, NEWMDB is designed to facilitate flexible reporting, and the level of detail provided to NEWMDB is decided by each country. While some Member States might provide highly detailed accounts of their waste-management programs, other might provide only summary information. In addition, because Member States differ in how they define radioactive wastes, attempting to determine global totals by summing or comparing inventories among countries or regions can lead to large uncertainties and other problems. The Waste Class Matrix in NEWMDB attempts to address this issue. The NEWMDB Waste Class Matrix provides each Member State a way to report their waste classes along with a way to convert each country's waste class into an IAEA standard classification scheme. Waste inventories are therefore entered according to each country's waste classification scheme, which is translated into IAEA standard classes for direct comparison.

After defining its waste matrix (or matrices) in NEWMDB, each Member State builds a Framework that represents its physical radioactive waste management infrastructure. This Framework is structured according to Groups, Sites, and Facilities.

Groups form the primary level of the NEWMDB Framework, with each Waste Matrix being assigned to a Group. Groups allow each Member State to differentiate between major regulatory or physical divisions, such Government vs. Commercial or Past Practices vs. Current. Groups are also used for waste in other countries, such as occurs with SNF reprocessing.

Sites refer to major waste-management locations (sites) within a country. Although most submissions to NEWMDB refer to existing sites, some countries might define virtual sites, such as "All NPPs" or similar categories; virtual sites might also be used when a county has too many sites to list individually or when waste from individual sites is not tracked at the national level. States commonly report and track waste data at the Site level; however, States might report waste at the individual Facility level instead.

Facilities refer to individual waste management facilities at a given Site. Facilities are grouped into three categories according to function: Processing, Storage, and Disposal (some facilities might have multiple functions). States document physical details of each facility, such as type (building, trench, etc.), in NEWMDB.

Waste Data include information about the waste's physical form (liquid or solid), treatment or conditioning status, and origin, as well as volume (in cubic meters)—except for Disused Sealed Radioactive Sources, which are reported in Groups by nuclide and activity level.

EXPANDED DATA COLLECTION ON NUCLEAR AND RADIOACTIVE WASTE GENERATION

A next step is to help Member States plan more comprehensively for future waste generation, with an emphasis on nuclear materials (NM) potentially subject to safeguards. This new effort will begin with nuclear-power reactors, assessing wastes generated by common reactor types worldwide (PWR, BWR, PHWR, etc.). The IAEA will invite member states with these types of reactors to provide information

about types and quantities of wastes generated as well as rates of waste generation projected over operational lifetimes. These estimates will be used to help Member States plan for and manage projected waste inventories and to help the IAEA estimate and plan for future safeguards obligations associated with NM-bearing wastes from nuclear-power reactors.

Tis effort will continue by estimating wastes generated from other nuclear facilities, including research reactors, front-end facilities (conversion, enrichment fuel fabrication, etc.), and back-end facilities (reprocessing, conditioning, disposal, etc.). The goal is to generate for each member state reasonably accurate estimates of volumes, activities and potential NM content of wastes produced by each nuclear facility in that country. Estimates would include, for example, cumulative SNF generated (and under safeguards) from power and research reactors, volumes of resin wastes (which might contain NM from leaking fuel rods), tritium-bearing wastes, decommissioning wastes, and others. The IAEA and Member States, including those developing or planning new nuclear-energy programs, can use these estimates (updated as necessary) to plan for storage and disposal of wastes generated throughout the nuclear fuel cycle and to anticipate future safeguards obligations on NM-bearing wastes.

This new effort will begin with IAEA consultancy and technical meetings, during which member states that have nuclear facilities of interest will gather to develop a methodology for reporting waste data and to assist those states seeking assistance to make such estimates.

The goals of this effort are to 1) generate data on types of waste generated and rates of accumulation by facility type; 2) create a mechanism for Member States to estimate types and sizes of waste-storage and -disposal facilities a State will require; and 3) estimate associated safeguards requirements. These data will be used as part of a tool (or methodology) that Member States can use to better plan for waste repositories that will be needed for each waste type (SNF, HLW, ILW, LLW, VLLW). The IAEA can use these estimates for planning future safeguards obligations and can include such data in agency reports and products for the benefit of Member States.

SUMMARY

The global expansion of nuclear energy will generate increasing quantities of waste with low levels of plutonium or other nuclear materials (NM) potentially subject to International Atomic Energy Agency (IAEA) safeguards. Reducing requirements on retained wastes has the potential to reduce future demands on already-strained IAEA resources. We describe an effort to help the IAEA and Member States better estimate projected waste loads and associated safeguards obligations by developing a reporting tool to estimate types and sizes of future waste-storage and -disposal facilities. The new tool for estimating waste types and inventories will complement NEWMDB by improving estimates of waste types and amounts arising, and will include waste-management plans and potential future safeguards requirements. States can use such information to plan waste facilities, including size and type. The IAEA can use these data in agency reports and products for the benefit of Member States.

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[2] NEWMDB can be accessed at https://newmdb.iaea.org/default.aspx.

[3] INTERNATIONAL ATOMIC ENERGY AGENCY, Status and Trends in Spent Fuel and Radioactive Waste Management. IAEA Nuclear Energy Series No. NW-T-1.14, IAEA, Vienna (2018).

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