IAEA-TECDOC-1398

Records for radioactive waste management up to repository closure: Managing the primary level information (PLI) set

IAEA
International Atomic Energy Agency

July 2004

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The originating Section of this publication in the IAEA was:

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International Atomic Energy Agency
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A-1400 Vienna, Austria

RECORDS FOR RADIOACTIVE WASTE MANAGEMENT
UP TO REPOSITORY CLOSURE: MANAGING THE
PRIMARY LEVEL INFORMATION (PLI) SET

IAEA, VIENNA, 2004
IAEA-TECDOC-1398
ISBN 92–0–107104–3
ISSN 1011–4289

Printed by the IAEA in Austria
July 2004

FOREWORD

The need to protect humans and the environment from the potentially harmful effects of radioactive waste is well recognized. For long lived radioactive wastes, strategies need to explicitly acknowledge the potential long term radiological hazards to ensure that future generations are protected at a level at least equal to that acceptable to the current generation.

IAEA Safety Series 111-F, The Principles of Radioactive Waste Management Safety Fundamentals (1995), states the following:

> "The objective of radioactive waste management is to deal with radioactive waste in a manner that protects human health and the environment now and in the future without imposing undue burdens on future generations…
>
> …It has been a feature of radioactive waste management that special attention has been given to the protection of future generations. Considerations related to future generations may include potential radiation exposure, economic consequences and the possible need for surveillance or maintenance…
>
> …The management of radioactive waste should, to the extent possible, not rely on long term institutional arrangements or actions as a necessary safety feature, although future generations may decide to utilize such arrangements, for example to monitor radioactive waste repositories or retrieve radioactive waste after closure has been effected. The identity, location and inventory of a radioactive waste disposal facility should be appropriately recorded and the records maintained…"

IAEA-TECDOC-1097, Maintenance of Records for Radioactive Waste Disposal (1999) states the following:

> "…Future generations will need information on the repository contents for several reasons. It is important that they are aware of the potential hazards involved to allow them to make informed decisions concerning the safety of the repository to avoid inadvertent intrusion at least in the near term and to assist decision making on the possible reuse of the site, its contents and surrounding controlled areas…
>
> …Many records are produced and maintained during the siting, design, construction, operation and closure of the repository. These records contain a large amount of information, part of which is also of value to society after closure. Maintenance of the relevant records is from the above sources believed to be the most reliable manner to convey information and its efficiency can be assessed from record keeping systems developed and used in the past…
>
> … The basic part of… … all national records management systems is the primary level information set (PLI), which… …must contain all information relevant to the repository during siting, design, construction and closure…"

This TECDOC provides an overview of the various records that could be generated up to repository closure and it describes the need to identify the relevant records that are likely to be of value for future generations. Moreover, this report describes the importance of the early establishment of a coordinated, integrated and well managed primary level information set.

The purpose of this publication is to raise international awareness of the need to identify and manage pre-closure records in a manner that both serves the operational needs of a repository and the need to identify and transfer relevant information to future generations in a systematic manner.

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EDITORIAL NOTE

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1. INTRODUCTION

1.1. Background

IAEA Member States with extensive nuclear programs have accumulated large volumes of radioactive waste [1]. The continued and/or expanded use of nuclear technologies will generate even more radioactive waste. Many Member States have established and implemented programmes to develop near surface or geological repositories. Some repositories have already been realized and are in various stages of their life cycle.

Large quantities of information can be generated during all phases of radioactive waste management. The compilation and management of pertinent information requires careful planning and execution. Experience has shown that information management is a crucial part of a radioactive waste management programme and it should start at the earliest phase of waste generation.

During the preparation of this publication, a contact in a Member State with a large nuclear power programme wrote "*There is a very striking theory versus reality juxtaposition when you put the TECDOC and [our report] side by side. [The] TECDOC lays out a rational, intellectual methodology for why and what to do. [Our] Report demonstrates… …the importance of starting early, coordinating all waste generator records in a consistent system of records, and avoiding paper to the maximum extent possible. One can only hope that in the future we will [be] disciplined enough to start organizing the waste records at the same time that the waste is generated*".

The above comment illustrates that the development and implementation of systems for compiling and maintaining waste management records should begin at the earliest time practicable.

The IAEA has identified the importance of records management and, in particular, the need to ensure that information associated with long term storage facilities and repositories is preserved for future generations. Previous IAEA publications of particular relevance to this subject include:

(1) Maintenance of Records for Radioactive Waste Disposal, IAEA-TECDOC-1097 [2], and

(2) Waste Inventory Record Keeping Systems (WIRKS) for the Management and Disposal of Radioactive Waste, IAEA-TECDOC-1222 [3].

IAEA-TECDOC-1097 first introduced the concept of a three-tier hierarchical model for radioactive waste management information, as illustrated in Fig. 1. The model includes the Primary Level Information (PLI), Intermediate Level Information (ILI) and High Level Information (HLI) sets.

Primary Level Information was described in IAEA-TECDOC-1097 as follows:

> "…The basic part of a hierarchical structure and of all national records management systems is the primary level information set… …It therefore must contain all information relevant to the repository during siting, design, construction and closure…"

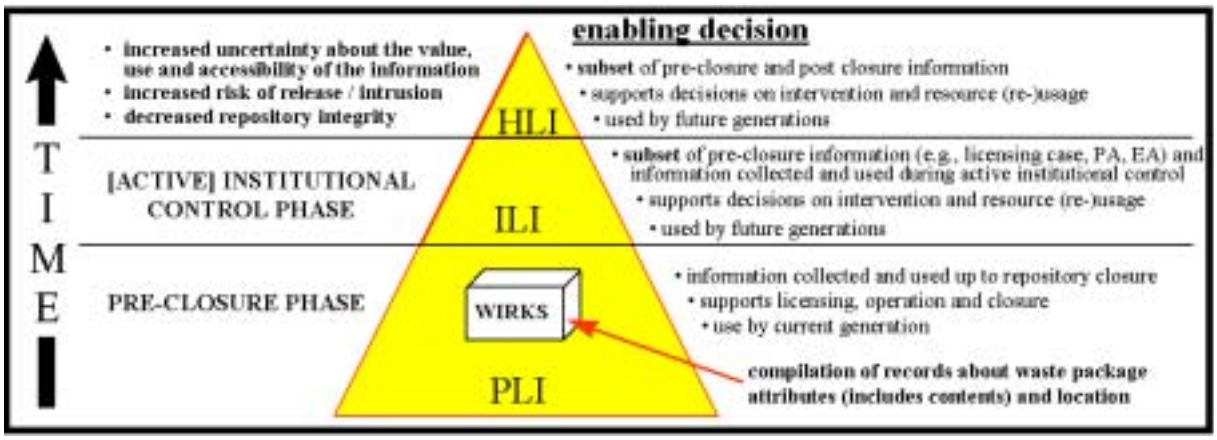

Fig. 1. Hierarchical Records for Radioactive Waste Management.

In the broadest sense, the PLI set may be defined as the information that is generated up to completion of the activities carried out to close a repository. This time period can be divided into three major waste management phases: generation, pre-disposal management and disposal. The last major phase includes planning, site selection, and repository design, construction, licensing, operation and closure.

IAEA-TECDOC-1097 provides some examples of records that may be generated up to and including repository closure and some of the records that may be generated during an active institutional control phase. The TECDOC defines the ILI and HLI sets as follows:

(1) ILI: a condensed set of important documentation to ensure the understanding of the repository system

(2) HLI: the set of information that would give sufficient information to future generations to provide them with a fundamental understanding of the repository system and its contents

IAEA-TECDOC-1222, the 'WIRKS' TECDOC describes a repository's waste inventory records as a well defined subset of PLI that includes radionuclide and hazardous materials inventories, attributes of the waste packages (which includes the waste form), the processing applied to create the waste form, etc. The TECDOC states, "*While this report provides technical advice about the development and implementation of a WIRKS, it does not cover any other aspects of the PLI, which could be the area where most Member State data are compiled and which represents a significant cost to those Member States with large nuclear programmes."* IAEA-TECDOC-1222 further stated that advice on the development and implementation of a comprehensive PLI set should be provided.

1.2. Objective

The objective of this document is to highlight the importance of the early establishment of a comprehensive records system to manage Primary Level Information as an integrated set of information, not merely as a collection of information, throughout all phases of radioactive waste management. The information presented in this document will assist Member States in ensuring that waste and repository records, relevant for retention after repository closure, are generated, identified, reviewed and actively managed during pre-closure phases so that they are available and useable at the appropriate time.

1.3. Scope

This document addresses the establishment and management of the Primary Level Information set up to the point of closure of a repository. Specifically, this report:

(1) describes the importance of establishing a coordinated, integrated and well-managed PLI set,

(2) provides a basic overview of the components of a PLI set, and

(3) provides general guidance on the management of and responsibility for the PLI set.

1.4. Structure

Section 2 discusses the reasons for and the value of implementing an integrated approach for the development and management of a PLI set. Section 3 discusses the various types of information that are generated in the phases of radioactive waste management and that are candidates for inclusion in the PLI set. This includes:

(1) Generation Records,

(2) Pre-Disposal Management Records, and

(3) Disposal Records, where repository records are sub-divided as follows:
   (a) Pre-Operational,
   (b) Operational, and
   (c) Closure.

Section 4 discusses information management considerations for the PLI set. Section 5 contains a summary and conclusions.

2. RADIOACTIVE WASTE MANAGEMENT RECORDS IN PERSPECTIVE

Information about radioactive waste is created in all phases of its management - from its generation, through processing and storage, to disposal. The amount of information can be very large and without a clear appreciation of the 'big picture' (see Fig. 2) it is unlikely that an effective information management system can be created or successfully operated over the prolonged period covered by the pre-operational, operational and closure phases of a repository. The intent of Section 2 is to give the reader an appreciation of this 'big picture' and the benefits to be gained from careful consideration of what information needs to be retained from each major waste management phase and for how long.

Fig. 2 gives a life cycle overview of the flow of both waste and its associated documentation throughout the major phases of radioactive waste management. It illustrates how waste management tends to operate in 'isolated boxes'. Waste management activities are driven by the immediate needs of whoever holds the waste at any particular time. In addition, the nature of the information that is transferred with waste is typically specified by the receiver. The requirements for what is needed to proceed to the next step are determined by the waste receiver's acceptance criteria, which may change along the waste management chain.

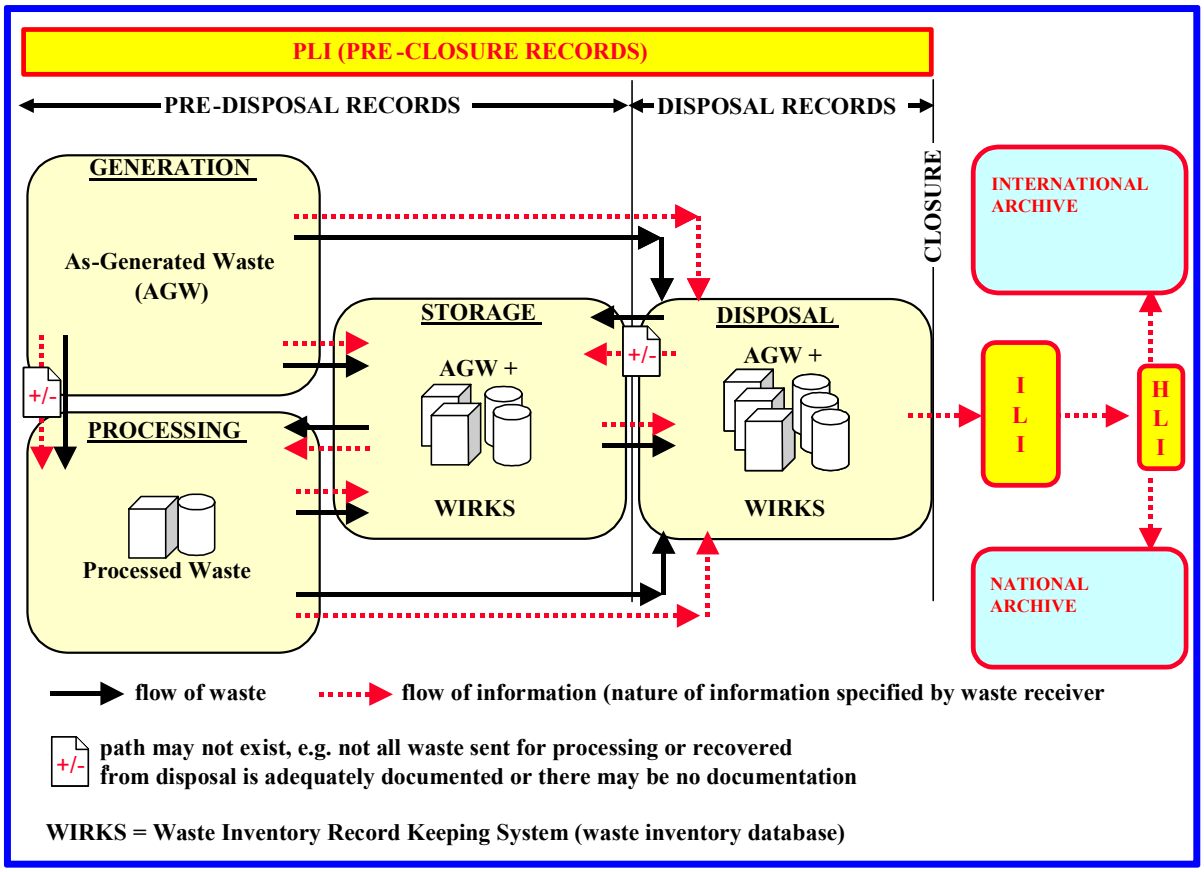

Fig. 2. Paths for Waste and Information Flow.

Waste managers need to appreciate this 'big picture' and to work with each other and their licensing authorities, as early as possible, to ensure that the right information is generated and maintained for the future. A recognition of the value of the information will assure effective management and filtering of this very large, diverse amount of information throughout the waste management chain. In this respect, three drivers should be considered:

(1) Technical (safety, repository performance assessment, environmental and other such cases along with appropriate support information),

(2) Legal (includes regulatory and for the purposes of defence against litigation), and

(3) Public Relations (all information not of a legal or scientific nature, which would enhance public confidence and allow acceptance of a waste management proposal).

The integration of the PLI should be coordinated by a central, responsible organization since this will promote overall consistency and will help ensure that the appropriate information is available for future generations. The implementation and long term management of a Records Management System (RMS) should be coupled with a legally enforceable financial guarantee. At all times, there should be an identifiable entity with a legally enforceable financial and management responsibility to sustain operation of the RMS in order to prevent any interruption of information flow between the hierarchical information sets. Moreover, the responsibilities of all parties involved in the waste management chain and Regulatory Bodies regarding to the financial and management of the RMS should clearly be stated in the corresponding act(s), decree(s) and/or legislation of the country.

Table 1 provides examples of consequences of not adopting a holistic or integrated approach to identifying and managing pre-closure records. In the first case (No Filtering), present day requirements for documentation may actually impede the selection and transfer of information to future generations. In the second case (Wrong Filtering), the lack of integration can result in the loss of valuable records that could be costly and difficult to recreate. In the third case (Information not Generated), incomplete planning for the whole life cycle of waste management could result in not generating the required records at the appropriate time.

3. INFORMATION GENERATED AT VARIOUS STAGES OF RADIOACTIVE WASTE MANAGEMENT

As indicated previously, Primary Level Information includes all information generated in association with radioactive waste management prior to the completion of closure of a repository. It is useful to assess this potentially vast amount of information according to where and when the information is generated along the waste management chain.

The two major sources of information are the waste generators and the waste management facility operators. Waste generation — and consequently the generation of important information — may precede the start of a planned, organized waste management programme and it could last up to repository closure (or beyond closure in cases where multiple repositories are needed). This section provides an overview of waste management records from generation (subsection 3.1), pre-disposal management, (subsection 3.2), and disposal (subsection 3.3).

Fig. 3 provides another perspective of the flow of waste and information from generator to disposal (and beyond for documentation). The figure indicates that when waste is transferred from a generator to a processing, storage or disposal facility, the waste does not change (except for radioactive decay), therefore, the associated documentation that describes the waste does not change (except for decay correction calculations of the radionuclide contents). While in storage, waste packages could degrade and would need to be processed. Waste is changed between entry to and exit from a processing facility, therefore the documentation also changes between entry and exit.

3.1. Generation records

During the performance of day-to-day activities with radioactive substances, such as operating reactors, conducting research and performing medical treatments/diagnoses, radioactive wastes are generated. The organizations conducting these activities are the waste generators. Historically, waste generators did not adequately segregate, characterize or document their wastes. In addition, historically, wastes stored or disposed were not adequately segregated, characterized or documented. The result was that, in some IAEA Member States, some radioactive waste in storage and disposal facilities has/had to be recovered and processed (as indicated by the dotted lines in Fig. 3). In the context of information flow, waste processing facilities can be considered to be waste generators since the waste and documentation that exit these facilities are different from what enters.

Table 1. Possible consequences of a non-integrated Approach to managing waste management records

Case	Problem	Possible consequences	Example
No filtering	Each party in the waste management chain may keep information that may not be required later in the waste management chain.	Too much information can be retained — this complicates the process of managing and selecting records that could be relevant to future societies (and even for later stages in the waste management chain)	The emplacement of a single package of transuranic (TRU) waste from the Rocky Flats site, Colorado, USA, into the WIPP disposal facility in New Mexico, USA, requires up to 400 paper pages of information for each package and there are roughly 60,000 waste packages, where a waste package is a 55 US gallon (200L) drum [4]. This is but a small subset of the total information that will be required and/or available about the facility itself. Even with the use of modern information technologies, the management of this information would be a formidable task
Wrong filtering	Some parties may discard information that they deem no longer needs retention, however, this information may be needed later in the waste management chain.	Valuable records are lost and therefore information is missing that may be very expensive and difficult to recreate.	The operator of a research reactor discarded fuel burn up records once the fuel was transferred to a storage facility. The reactor operator had concluded that the records were no longer needed since the fuel was no longer its responsibility. The result was that the storage facility operator was left with records that may be inadequate to support the transfer of the fuel to a repository.
Information not generated	Information requirements or standards have changed over time.	Valuable records do not exist and therefore information that may be very expensive and difficult to generate is missing.	Waste Acceptance Criteria change, including changes to the information that is required for the waste to be accepted into the disposal facility.

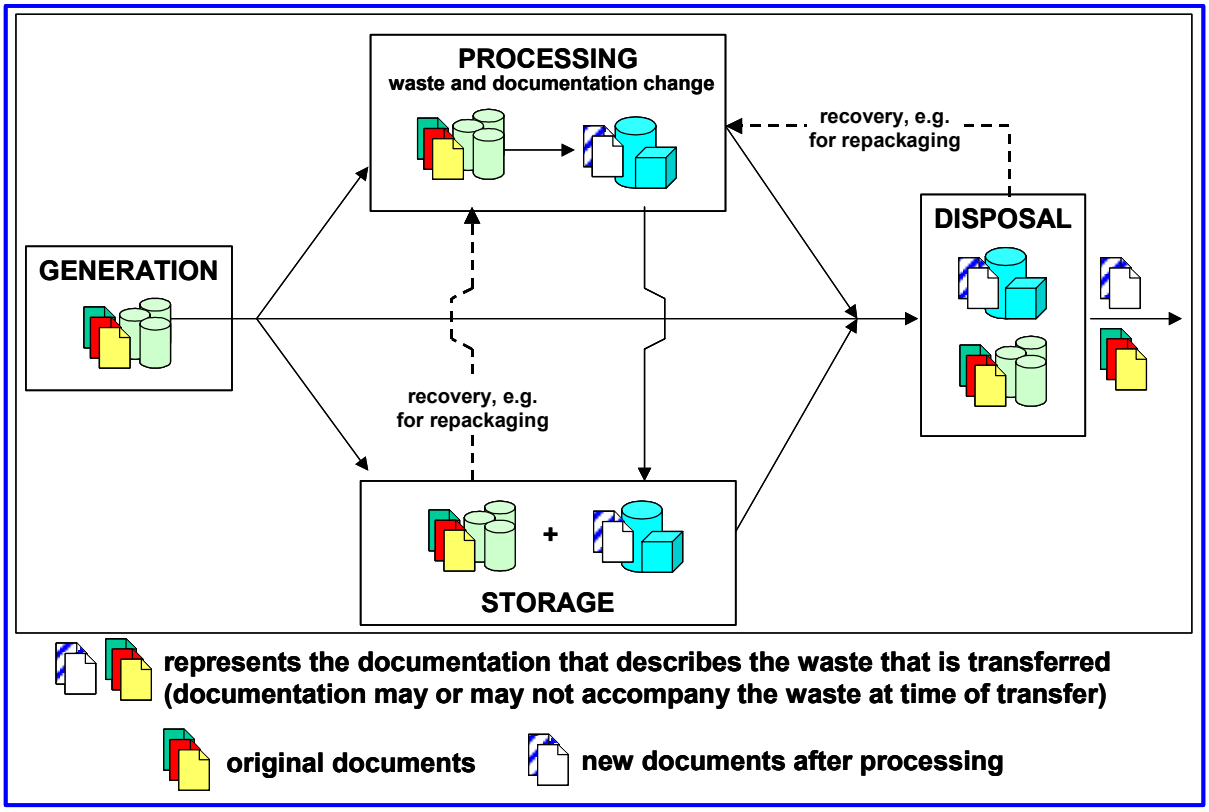

Fig. 3. The Flow of Waste and Documentation.

By current standards, waste generators segregate and characterize their wastes in accordance with criteria specified by waste receivers, such as the operators of storage or disposal facilities. Generators rely upon both process knowledge and waste characterization to infer or measure the chemical, biological, physical and radiological characteristics of their wastes. Wastes are properly segregated into 'streams' and quality assurance / control measures ensure that the wastes are properly documented. The waste management activities carried out by generators result in the creation of a variety of records.

Waste generators transfer two important items to waste receivers: the waste packages and the waste package records that describe the properties and characteristics of the packages. The waste receiver specifies the format and content of waste package records as part of its waste acceptance criteria (WAC). Generators may be required by law, regulation or agreement with the waste receiver to retain certain records (such as the characterization records and descriptions of characterization methods used) for a specified time period. However, it is unlikely that generators will be relied upon to retain copies of waste package records for long periods of time after they are transferred to the receiver. The most likely scenario is that the **waste receiver** will bear sole responsibility for the retention of waste package records while the waste is in its possession.

In some cases, the waste receiver requires wastes to be pre-qualified before they are shipped by the generator. In these cases, the waste package records could be transmitted to the receiver prior to the wastes. In cases where wastes are not pre-qualified, the receiver may reserve the right to audit specified generator records upon or after receipt of the waste.

In some cases, waste generators also operate waste processing, storage and/or disposal facilities. In these cases, the generators also assume the responsibilities of waste receivers.

If waste generators transfer their wastes to receivers on an on-going basis, i.e., they do not maintain a significant inventory of waste, they may not use an electronic waste inventory record keeping system, a WIRKS, to manage their inventory. However, if they transfer their wastes in batches, which involves the build up of an inventory prior to the transfer, or if they are required to retain waste package records for significant time periods, generators may implement a WIRKS to manage their records. It is unlikely that the information in a generator maintained WIRKS will be relied upon to support the long term management of waste package records.

3.2. Pre-disposal management records

As indicated in the previous subsection, the operators of waste processing and/or storage facilities receive waste packages and waste package records from waste generators. In addition to the records they receive, processing and storage facility operators create various additional operational records.

The most important fact is that new waste packages and waste package records are created by processing facilities. In addition, changes occur to wastes in storage, such as radioactive decay and, to varying degrees, waste package degradation. Some waste in storage may have to be repackaged or further processed, which again leads to new waste package records.

Processing and storage facilities rely upon a combination of a knowledge of the waste they receive, a knowledge of the impacts that activities such as processing and re-packaging have (process knowledge) and waste characterization to create the new waste package records.

Pre-disposal waste managers may be required by law, regulation or agreement with repository operators to retain certain records for a specified time period (such as the characterization records and descriptions of characterization methods used). It is unlikely that pre-disposal waste managers will be relied upon to retain copies of waste package records for long periods of time after they are transferred to a disposal facility. As such, it is unlikely that the information in a pre-disposal manager's WIRKS will be relied upon to support the long term management of waste package records. The most likely scenario is that the **repository operator** will bear sole responsibility for the retention of waste package records while the waste is in its possession.

3.3. Disposal records

3.3.1. The pre-operational phase of a repository

The pre-operational phase of a repository can be subdivided into planning, siting, design, construction and licensing phases. Each phase may last for years and phases can overlap. Much information is generated; however, most has no long term technical benefit since it supports near term decision-making for repository implementation (screening data, legislative requirements, public debate). However, some information may have historical or other non-technical benefits.

Planning: Repository planning typically includes forecasting the quantity and properties of radioactive waste to be disposed (to plan the appropriate capacity). These forecasts are based upon anticipated waste disposal requirements (volumes, activities etc). Planning can also

include preliminary design options (not very detailed), basic siting options, assessments of facilities implemented by other organizations or countries, etc. Planning information may be worth maintaining until closure of the repository but it may not be valuable for transfer to future generations, except for historical or non-technical purposes. Typical records generated could include:

(1) design statements and philosophy,

(2) option studies and comparison,

(3) development of siting criteria, and

(4) research and development.

Siting: In the site selection process, data about candidate disposal sites are collected in support of the decision to further investigate one/more site(s) and to collect more detailed data for site characterization. These data are essential to keep until the final decision on the actual site has been reached. From that point onwards, only the records related to the selected site may be essential for long term retention, except for non-technical purposes. However, if multiple sites are likely, the data for the non-selected site may be retained in support of additional site selection. Typical records generated could include:

(1) site characterization reports,

(2) site selection reports, review, and approval,

(3) biosphere, geological, hydrological (groundwater), geochemical, geomechanical and seismic characterization,

(4) climate history and predictions,

(5) public hearing documents, and

(6) legal documents such as deeds, restrictive covenants (including mineral rights), and land withdrawal documents.

It is essential that the siting data be retained as they would likely become part of the ILI and HLI sets at an appropriate future date.

Design: Prior to site selection, various generic facility designs may be prepared. Once a site has been selected, the facility design will be finalized. For historical purposes, the various design options that were not selected for final implementation may be retained for the future. Typical records generated could include:

(1) performance assessment report,

(2) engineering calculations,

(3) specifications for construction,

(4) research and development reports on waste packages and engineered barriers,

(5) sealing, cover (shallow land) and closure design reports, and

(6) peer reviews (science and technical) by outside organizations.

Licensing for construction: To obtain a license to construct a repository, licensees may be required to provide or commit to provide some or all of the following records (some, such as as-built drawings, would, by necessity, be provided after the license is granted):

(1) Preliminary Safety Assessment, review, and approvals by the Competent Authority,

(2) layout and as built drawings,

(3) construction documents,

(4) date of construction and of completion of units,

(5) project management reports,

(6) contracts, procurement and acceptance documents,

(7) compliance records,

(8) quality assurance documents, and

(9) public hearing documents.

In the long term, it is likely that these licensing records, notably the 'as built' construction records, will require retention.

Licensing for operation: Activities such as performance, safety and environmental impact assessments are likely to be conducted in support of obtaining a license to operate a repository. These activities would likely generate much of the information that would become part of the ILI and HLI sets. The license for repository operation should reflect the thinking and views of the current society towards future societies and should encompass the need to transfer relevant records to the future. Typical records generated could include:

(1) Final Safety Assessment, review, and approvals by the Competent Authority,

(2) Environmental Impact Assessment, review, and approval by the Environmental Authority, license/permit application, submittal, and approval records (environmental, waste water, toxic/hazardous waste, air emission),

(3) the license and permits,

(4) public inquiry records,

(5) licensing correspondence, and

(6) peer reviews (technical and scientific) by outside organizations.

3.3.2. The operational phase of a repository

The records generated during the operational phase fall into three distinct sets. The first record set is related to the data specific to the waste transferred to the repository. This is a key record set and deserves appropriate attention. The second record set covers data specific to the physical facility and the site. Most of these data would be essential for the closure of the repository and some of them could be essential for further use (ILI and HLI). The third record set is related to the daily operation of the facility and may be relevant only during the operational period itself.

Waste specific data: As mentioned previously, key information that is needed for repository operation and closure is the waste inventory records. This subset of the operating records contains the radionuclide and hazardous waste inventory, waste form/package information and location in the repository. Typical records generated could include:

(1) waste inventory records managed by a WIRKS (see TECDOC-1222),

(2) waste acceptance criteria,

(3) waste package procurement and quality control,

(4) generator technical reports,

(5) waste profiles prepared by generators (pre-qualification records, see page 7),

(6) approval of waste profiles by the repository operator and/or regulators,

(7) waste characterization procedures and approvals,

(8) shipping manifests - paperwork that arrives with a shipment, and

(9) contracts and correspondence with waste generators.

Facility and site specific records: In addition to data that are directly linked to repository operation such as facility extensions, the cover material applied over the waste, backfilling and corrective actions, more detailed information about the repository may be collected during operation by ongoing site characterization, monitoring and surveillance. Typical records generated could include:

(1) commissioning and start up records,

(2) modifications to approved design and authorization for implementation of modifications,

(3) buffer / backfill emplacement,

(4) reports to the regulatory authority,

(5) changes in geology or hydrology (e.g. due to earthquakes, erosion, human activities),

(6) seismic activity during operation,

(7) environmental monitoring and surveillance program (water table level, radionuclide sampling, air samples, meteorological data, crop samples, biota (flora and fauna),

(8) remedial actions if carried out,

(9) releases of radionuclides or other contaminants to the environment,

(10) operating conditions including experimental testing,

(11) emergencies and non-routine occurrences,

(12) periodic reviews of procedures,

(13) updated safety assessment, review, and approvals by the Competent Authority,

(14) quality assurance program plans, audit plans and audit reports, and

(15) non-conformance and corrective actions reports.

General operational records: These records relate to general operations. They are not specifically related to long term radioactive waste management. Typical records generated could include:

(1) emergency planning documents - hazards assessment and emergency (non-radiological obligation remains after closure),

(2) operational event reports (occurrence reports),

(3) periodic reports (monthly, annually, etc.),

(4) operating procedures (development, revision, review, approval),

(5) safeguards and security reports, and

(6) operational logs and records.

3.3.3. The closure phase of a repository

During the closure phase of a repository, the facility may be backfilled, covered, capped and/or sealed. In addition to data collected for the cited closure activities, this phase may include data collected from the benchmarking of environmental radioactivity levels, the identification of exposure pathways, emplacement of monitoring systems (barrier degradation, leakage, ...), and general environmental surveillance. Most or all of the information created during closure may become part of the ILI and would input to the HLI. Typical records generated could include:

(1) cover and sealings
- specifications
- description
- as built drawings
- samples and tests
- historic (dates, incidents ….)
- control and maintenance procedures
- repair procedures etc.

(2) monitoring and environmental controls
- program
- equipment
- procedures (observations, sampling, analysis …)
- predicting models (cover, radionuclide transportation) = conceptual model, geometry, data, description of the codes
- results before and after closure.

4. INFORMATION MANAGEMENT CONSIDERATIONS FOR THE PLI SET

IAEA-TECDOC-1097 discusses and provides technical guidance to IAEA Member States for the establishment of an RMS with the objective of ensuring the availability and retention of necessary information for use by future societies following closure of a repository. IAEA-TECDOC-1097 also identifies a methodology for the compilation and long term management of such records. Section 4 of the current technical document focuses on the importance of an RMS with particular attention to Primary Level Information.

It is essential that an RMS be developed as early as practicable within the life cycle of radioactive waste management. Stakeholders should take appropriate responsibility for the collection, maintenance and preservation of information that is required for the long term.

All records generated during any phase of the waste management life cycle must be identified, captured and organized progressively in a timely and systematic manner in the RMS to ensure that the PLI records that will be required in the post-closure phase of a repository are available when needed. To accomplish this goal, it is important that those managing a repository develop and maintain a culture that understands and values the significance of maintaining intellectual control over all information related to the facility. Fostering such an information/records management culture should be a high priority and a permanent goal of any organization involved with a radioactive waste repository. At all times in the life cycle of a waste repository, the ownership and responsibility for financing and maintaining the RMS must be unambiguously clear.

A key factor to consider is that, historically, information flow for radioactive waste management was front-end driven whereas, in reality, it should have been back-end driven. Historically, generators provided the information required of them by pre-disposal waste managers, often in the absence of repository development. Subsequently, pre-disposal managers provided information required by repository operators. This front-end driven process sometimes resulted in information required at the back-end not being generated or retained at the front-end. Member States without disposal programmes or programmes that are not well advanced can learn valuable lessons about the need for a back-end driven information flow from Member States with advanced disposal programmes. The key guidance that can be given to Member States is to identify an Authority that will oversee the management of PLI throughout all phases of the radioactive waste management life cycle. The key element of this management role is the identification of records to be retained for the long term (along with a classification as to why these records are needed). A key recommendation is that waste managers should work hand-in-hand with information managers to ensure that the best expertise from both disciplines is utilized.

An RMS is essential for the long term maintenance of records and it needs to be established in a comprehensive, written plan that clearly defines roles, responsibilities and accountability. The primary focus of an RMS for PLI is the preservation of necessary information up to the completion of repository closure. This information would then form the basis of the ILI and HLI sets.

Based on the record format(s), appropriate controls need to be established to protect them from deterioration due to temperature, humidity, light, microbes, etc. Methods of controlling access to records need to be established and documented to prevent loss, destruction or unauthorized alteration of records. Moreover, controls need to be established to identify the personnel authorized to make modifications to records, and the conditions under which modifications may be made.

An RMS should, as a minimum, address the following subjects.

4.1. The identification of records to be included in the RMS

The RMS must encompass all records relevant to any aspect of the repository to ensure that relevant PLI is collected. Only in this way can the retention, indexing and preservation of ILI and HLI be assured. As described previously, the development of an information/records management culture that never loses sight of the long-term relationship of PLI to HLI is critically important. Refer to Section 3 for discussion of the categories of records that are appropriate for a PLI RMS. When identifying PLI records, it must be remembered that the records will be in a variety of forms such as paper, microfilm, audio and video tape, digital form and physical material, such as core samples and weld radiographs, etc.

4.2. Inventory and indexing

Direction and guidance should be established and documented at the earliest point in the repository program to assure that records are inventoried and indexed for retrievability. The ability to promptly locate and retrieve records relevant to a current or future issue is the fundamental purpose for the RMS. Indexing systems link a record's attributes (e.g., title, date, subject and keywords) to the location of the records and to other information. The inventory and indexing should be to a fine enough level to assure fast and economical retrieval of records — it should not be implemented at such a fine a level that it could actually impede

information retrieval. Information retrieval implies that once a record is located, it can be accessed and read with existing tools. The effective retrieval of information is highly dependant on the effectiveness of the indexing system used. The discussion of PLI records contained in Section 3 may provide a good starting point for the creation of indexes and schedules for organizing PLI records in an RMS.

4.3. Classification, retention and destruction

It is important to understand that an effective RMS not only ensures that all PLI is captured and indexed, it also ensures that, over time, only the most significant and essential records are retained for inclusion in the ILI and HLI sets. A principal purpose of the RMS is to provide for the timely destruction of records whose value diminishes over time. An unnecessarily large volume of records is not evidence of an effective RMS. All PLI records will be subject to varying periods of retention based on Member States' laws and regulations. Some will be deemed permanent records because of their historic or ILI/HLI value. Such value needs to be considered when assigning retention periods to PLI records. Each Member State is responsible for establishing adequate retention policies to ensure future access to and usability of both ILI and HLI. The classifications and controls for assigning retention periods need to be documented in the RMS. Controls should include periodic reviews to evaluate established classifications and to reclassify records if necessary. The purging of records needs to be subject to explicit, written procedures and controls to minimize the risk of losing important information. An alternative to record destruction may be to segregate low value records and retain them separately to handle 'just in case' scenarios.

4.4. Storage format (media)

The RMS must establish documented direction and guidance at the earliest practical time to specify the format(s) to be used to control the identification, collection, and preservation of records. Retrievability and usability of records will be dependent on the continual migration or conversion to new technologies. The choice of the media used to store the information is irrelevant, ***provided*** that it meets the following requirements:

(1) It must be capable of capturing and storing the required information.

(2) It must be physically and chemically stable, so that the legibility is preserved for a long period of time.

(3) It must be capable of being easily copied or transferred to another medium, without loss of information.

(4) It must be retrievable over very long periods of time.

(5) It must be readable and understandable for the entire period of its retention.

(6) It must be resistant to tampering, i.e., to alteration by unauthorized individuals.

4.5. Periodic renewal or transfer of record format(s)

Provision for periodically ensuring the durability and integrity of the information contained in the RMS needs to be established based upon the respective format of a record. The expected life for each record format needs to be established and controlled to ensure that records are reproduced or the information transferred to another form prior to the end of its expected life.

Controls to ensure and verify the legibility and integrity of reproduced or transferred information must also be established. Appropriate remedial actions should be taken to restore

deteriorated records. For long term retrievability, procedures must be established to ensure that the tools necessary for reading records (for example, microfilm readers, computer software and systems) continue to be available. Any loss of information during reproduction of records must be documented. The document may determine or estimate the extent and contents of the lost data.

4.6. National and international archive requirements

In some Member States, requirements exist that records from national Bodies fall under the jurisdiction of a National Archive, both during the functioning of the body and at its termination. The RMS needs, therefore, to incorporate these archive requirements into its instructions, procedures and plans. Those records identified for inclusion in the ILI and HLI sets are to be maintained at the highest requirement level. In the event that an international archiving body is established, that body might also produce specific requirements to be incorporated into the RMS.

5. SUMMARY AND CONCLUSIONS

Early establishment of a comprehensive records system to manage Primary Level Information as an integrated set of information throughout all phases of radioactive waste management is important.

In addition to the information described in the waste inventory record keeping system (WIRKS), the PLI of a radioactive waste repository consists of the entire universe of information, data and records related to any aspect of the repository's life cycle.

It is essential to establish PLI requirements based on integrated set of needs from Regulators and Waste Managers involved in the waste management chain and to update these requirements as needs change over time.

Information flow for radioactive waste management should be back-end driven. Identification of an Authority that will oversee the management of PLI throughout all phases of the radioactive waste management life cycle would guarantee the information flow to future generations.

The long term protection of information essential to future generations can only be assured by the timely establishment of a comprehensive and effective RMS capable of capturing, indexing and evaluating all PLI.

The loss of intellectual control over the PLI will make it very difficult to subsequently identify the ILI and HLI information sets.

At all times prior to the closure of a radioactive waste repository, there should be an identifiable entity with a legally enforceable financial and management responsibility for the continued operation of a PLI Records Management System.

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Consultants Meetings

Vienna, Austria: 25–27 June 2001
Vienna, Austria: 2–6 September 2002

Technical Meeting

Vienna, Austria: 22–24 September 2003