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Radioactive waste categories - current position (1998) in the EU Member States and in the Baltic and Central European countries

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INTRODUCTION

The Community Action Plan in the field of radioactive waste includes a call for “Concerted Action on the safe management of radioactive waste”. This should make it possible to develop a common approach and work towards harmonisation at Community level on radioactive waste management strategies and practices wherever possible.

A Concerted Action Group was set up to examine the subject of European Union harmonisation on classification of solid radioactive waste based on disposal.

A questionnaire was sent out to representatives of participating countries requesting information. The questionnaire included questions on the classification system currently in use, the extent to which it was included in the regulations and other information that is necessary when considering a common approach to the classification of radioactive waste.

Classification of radioactive wastes across the Member States, and indeed, internationally, varies from one country to another. The classification systems used in the Member States and the Central and Eastern European Countries who have applied for membership of the EU are described in this report. The information includes the definition of radioactive waste, the legal basis of the classification system, the details of the system in use, the target group for the classification system and brief details of the waste management system in each country including other waste categories where applicable, e.g. uranium mining and milling tailings.

RADIOACTIVE WASTE CATEGORIES

CURRENT POSITION (1998) IN THE EU MEMBER STATES AND IN THE BALTIC AND CENTRAL EUROPEAN COUNTRIES

POSITION IN THE EU MEMBER STATES

1. BELGIUM

As yet the categories used in Belgium are not included or defined in any legislation or included in any legal documentation. The legal definition of radioactive waste in Belgium is:

> "Every material for which no utilisation is foreseen and which contains radio-nuclides in concentrations greater than thresholds defined by the Authorities as acceptable in materials suitable for unrestricted use or release."

Radioactive waste is classified separately as unconditioned and conditioned waste. The categorisation of unconditioned waste depends on the physical state, the nature of the emitters, the level of activity concentrations and the applicable treatment. These characteristics are summarised by a three position alphanumeric code (e.g. A,3,1 where A= solid waste, 3 = low level alpha contaminated, and 1 = combustible). Each waste category has corresponding criteria for acceptance by ONDRAF.

Conditioned waste is defined according to the disposal route. There are three categories, A, B and C, for conditioned waste.

Category A is defined as low and medium active waste with a strictly limited concentration of long lived emitters, compatible with more than one disposal route. Twenty (11 beta and 9 alpha emitters) medium or long-lived radio-nuclides are considered determinant with respect to surface compatibility and these are defined quantitatively by activity concentration. For each individual waste drum the sum of the ratios of these radio-nuclides' actual activity concentrations to the activity concentration limits may not exceed unity.

Category B wastes are those which do not satisfy the criteria for surface compatibility and hence must be disposed of to a deep geological repository. Their heat generation is negligible.

C*ategory C* are wastes which are heat generating and require cooling time before disposal as well as appropriate interim storage, as with Category B only deep disposal is applicable.

An additional type of waste which is currently being considered for a separate categorisation is radium contaminated waste. The closure and decommissioning of the "Usine de radium" of OLEN resulted in several thousand cubic meters of radium contaminated waste and it is expected that this will require a specific disposal solution.

Categories for raw waste are used in all operations involving the waste producers and treatments but due to their technical nature are rarely used for other purposes. The conditioned waste categories are mainly used for communication with the Government, authorities and public.

Currently spent nuclear fuel is reprocessed at La Hague (France), however a parliamentary debate is planned for 1998 to decide whether to continue reprocessing or abandon it and opt for direct disposal. The three categories of waste are suitable for disposal as described in the categorisations, however, the Belgian Government has yet to make the decision as to what disposal method to adopt. A range of treatment and conditioning methods are being used, including incineration, super-compaction, direct encapsulation and size reduction.

The Classification system is summarised in the following table.

Raw Waste	3 position alpha numeric specifies type of waste	E.g. A,3,1
Conditioned Waste	Category	
	A	20 nuclide specific activity concentrations criteria for surface disposal. Sum of ratios < 1 per drum for specified nuclides.
	B	Does not meet surface disposal criteria, negligible heat generation.
	C	As Category B but heat generating.
Radium Contaminated Waste	R*	Specific disposal route yet to be determined.

* Provisional Category, yet to be decided.

2. DENMARK

There is no legal definition of radioactive waste in Denmark but for ad-hoc purposes radioactive waste is defined as materials with no value which have been contaminated or activated by human use.

Disposal of radioactive waste has not yet been considered in Denmark, hence only storage is taken into account in the categorisation system, this is based mainly on the origin of the waste and to some extent on measurement and sorting. The categorisation system developed for waste stored at Risø has been approved by the safety organisation at Risø and by the Nuclear Regulatory Authorities. On arrival the wastes are roughly categorised according to external radiation, after treatment the resulting waste units are stored according to the following criteria:

For waste stored in the facility for LLW:

- The external dose from the unit must not exceed 5mSv/h measured 1m from the unit
- The maximum content of ^{235}U is 10g per unit and 2g of transuranic isotopes or 30g of ^{235}U and 2g of transuranic isotopes, if the uranium is natural or depleted.

For waste stored in the facility for LILW with long half-lives

- Various limits are applied for the fissile content depending on the geometry and position of the units.

The target group for this system are the operators of the storage facilities at Risø.

Denmark has no NPP but has a research reactor at the Risø National Laboratory; spent fuel from the reactor is returned to the USA. There are no planned disposal facilities for radioactive waste at the moment in Denmark hence only storage facilities for LILW exist currently. New Very Low Level Waste can be sorted and disposed of as inactive waste by the producer according to rules laid down by the Danish Institute for Radiation Hygiene, otherwise it is considered to be LLW and is included in the categorisation system described above. Exemptions are treated on a case by case basis as decided by the Nuclear Authority. Historic arisings of uranium mill tailings from pilot plants are stored at Risø and sealed sources are stored unconditioned.The following table summarises the classification system used for storage.

Storage Category	Limits
LLW	External dose < or = 5 mSv/h, 1m from the unit. Maximum content per unit : 10g ^{235} U and 2g transuranic isotopes, or 30g ^{235}U and 2g transuranic isotopes if the uranium is natural or depleted.
LILW including long lived nuclides	Various limits for fissile content depending on geometry and position of the unit.

3. FINLAND

In Finland the classification and disposal of radioactive waste is regulated by two Acts, the Radiation Act and the Nuclear Energy Act (1988). The legal definition of radioactive waste is:

> "Radioactive waste comprises radioactive materials, and equipment, goods and materials contaminated by radioactive materials, that have no use and must be rendered harmless owing to their radioactivity. Radioactive materials and radiation appliances containing radioactive material whose owner cannot be found shall also be regarded as radioactive waste."

Radioactive waste is firstly classified into two types, radioisotope waste and nuclear waste. Radioisotope waste comes from hospitals, research institutes and industries using radioisotopes, nuclear waste is generated by the nuclear power plants and a research reactor.

There are two types of solid radioisotope waste, spent sealed sources and laboratory wastes. The lower limit (or clearance level) for these wastes is an activity concentration < 10kBq/kg beta/gamma emitting radio-nuclides or < 1kBq/kg alpha emitting radio-nuclides. For laboratory wastes etc. above this limit there are additional disposal criteria, these are:

- A maximum $25ALI_{min}$ per month per laboratory
- < 100GBq per year per laboratory
- < 5μSv/h in each package

Nuclear waste is split into three categories on the basis of its origin, high level spent fuel, low and intermediate level waste from the operation of NPPs, and low and intermediate level waste from decommissioning NPPs. The low and intermediate level waste is then split into three different categories for handling and storage according to the activity concentration, these are:

- Cleared waste - $< 10^3$ Bq/kg
- Low Level Waste - 10^3 to 10^6 Bq/kg
- Intermediate Level Waste - 10^6 to 10^{10} Bq/kg

In addition to these there are specific total disposal limits for the repositories. At Olkiluoto these are specific to the emplacement silos and are 10Tbq for the LLW silo and 1000Tbq for the ILW silo. Specific waste acceptance criteria are also defined in the Final Safety Analysis Reports of the disposal facility.

In Finland spent sealed radioactive sources are returned to the manufacturer whenever possible or are stored centrally at the Finnish Center for Radiation and Nuclear Safety. All other radioisotope waste is disposed of to the Refuse Disposal Plant.

Categories are used mainly for communication between the operator and regulators, however, terms such as LLW, ILW, and HLW spent fuel are used in public information.

Spent fuel is currently stored in ponds at the reactor sites, but a deep repository (approximately 500m) for disposal of spent fuel is planned to start operation in 2020. LILW are conditioned, stored and disposed at the reactor sites. Each NPP has its own repository, situated in crystalline bedrock at a depth of 60 - 100m. LILW with predominantly short-lived radio-nuclides is disposed of with minimal engineering whilst long lived radio-nuclides have engineered barriers installed. It is intended to enlarge the repositories at a later date to accommodate decommissioning waste.

The table below summarises the classification system for Radioisotope waste.

Category	Limits
Cleared Waste	< 10kBq/kg beta/gamma, or < 1kBq/kg alpha.
Laboratory Waste	< 25 ALI_{min}/month/laboratory < 100GBq/year/laboratory <5μSv/h/package

The next table summarises the classification system for nuclear waste.

Category	Limits
High Level Spent Fuel	No criteria specified.

LILW from NPP Operation	Storage		Disposal	
	Cleared waste	< 10^3 Bq/kg.	Total disposal limits for silos and disposal facility specific limits.	
	LLW	10^3 - 10^6 Bq/kg	LLW	10 TBq
	ILW	10^6 - 10^{10} Bq/kg	ILW	1000 TBq
LILW from Decommissioning	No criteria specified.			

4. FRANCE

According to law 75-633 on waste elimination and materials recovery, waste is considered to be:

> "all abandoned substances resulting from a production or transformation process or generally speaking any abandoned substance"

According to decree 66-450 on radiation principles a substance is radioactive when:

> "it contains one or several radio-nuclides that can not be neglected from the radiation protection point of view"

The regulations dealing with management of radioactive waste arising from the activities of conventional industrial facilities is regulated by a department of the Ministry for Environment and refer to the above mentioned definitions.

For waste arising from the activities of nuclear facilities regulated by the nuclear safety authority, a distinction is made, for management purposes, between nuclear and conventional waste on the basis of a zoning of the installations. This zoning is achieved taking into account design, operation and history of the installations. Thus, in the French approach to waste management, nuclear waste is defined by its geographic and functional origin rather than its radio-nuclide content.

For nuclear waste the classification system is a matrix linking the toxicity of waste to the disposal routes. Two parameters are distinguished for defining the toxicity of the waste: lifetime of the main radio-nuclides (under or above 30 years), and activity content (very low, low, intermediate or high). On this basis, the classification system presents eight categories of waste, each linked to one or more management pathways. Some of the pathways are still under study.

	Short Lived	Long Lived
VLLW	Under study[1]	Under study[1]
LLW	Surface disposal[2]. Incineration, melting and recycling (1998)	Long term interim storage
MLW	Surface disposal[2]. Incineration, melting and recycling (1998)	Law Dec 30, 1991[3]
HLW	Law Dec 30, 1991[3]	Law Dec 30, 1991[3]

1.Treatment, recycling or disposal of this waste.
2.Presently at Centre de Stockage de L'Aube Waste Repository (CSA)
3.Management solutions are currently under study.

The table with eight blocks created on the basis of the parameters links the categories of waste to a management pathway. Each pathway is designed and assessed specifically to be adapted to the risk incurred. No *a priori* threshold is established to distinguish the different categories. The maximum radioactivity acceptable in a management pathway is derived through the above mentioned assessments taking into account the specifics of each pathway.

The classification is not written into any legislation, its purpose is to enable communication to the experts and the public.

Spent fuel direct disposal is an option, utilities have the choice between this and reprocessing. Disposal routes for all other types of waste are either already established eg. Centre de Stockage de L'Aube, or are being developed.

5. GERMANY

The legal definition of radioactive waste for Germany is:

"Radioactive substances which cannot be harmlessly utilised and which must be orderly disposed of."

The legal basis for the management of all types of radioactive waste is given by the Atomic Energy Act. In Germany the intention is to dispose of all types of radioactive waste in deep geological formations, this includes wastes from spent fuel elements to miscellaneous waste originating from small waste generators. As heat generation is of great importance in a deep repository a basic qualitative classification was introduced to make a distinction between heat generating waste and waste with negligible heat generating capacity. This can be compared with the internationally used categories of HLW, ILW and LLW, HLW corresponding to heat generating waste and ILW and LLW corresponding to negligible heat generating waste.

The basic qualitative categorisation system for all types of radioactive waste as well as the waste acceptance requirements are applied and used in practice. The categorisation system has no legal status, however the waste acceptance requirements in their approved form, i.e. as part of the license of a repository, have a legal status.

In order to prove the safety of a repository in deep geological formations, a site specific safety assessment has to be carried out. To provide the required data, basic information on the waste packages intended for disposal have been compiled by the waste generators. Information is given on the origin and the type of waste, the immobilisation material and the packaging. This information has been used to categorise the waste packages expected to arise in Germany, and data sheets have been produced for all waste streams. On the basis of the results of such a safety assessment it is intended to determine quantitative waste specifications or waste acceptance requirements for all waste packages to be disposed of in the respective repository. Waste acceptance requirements were prepared for the Morsleben repository and the Konrad repository project.

The waste acceptance requirements for the Konrad repository have been established in preliminary form as the licensing procedure is still pending. They provide general requirements and also specific requirements on waste forms, packaging, activity limitations for individual nuclides, documentation and delivery of waste packages to the repository. The various radioactive wastes to be disposed of are condensed into six waste form groups and two waste container classes. The different waste forms must be assigned to one of the following groups:

- Bitumen and plastic products
- Solid matter
- Metallic solid matter
- Compacted waste
- Cemented/concreted waste
- Concentrates

The safety-related requirements on the quality of the wasteforms have been elaborated for thee groups, i.e. specific requirements characterise each wasteform group. They must be fulfilled by each wasteform assigned to a group. In general, the requirements rise from group 1 to 6.

According to the barrier quality of the packaging, a basic distinction is made between containers/packaging without increased barrier properties(Waste container class I) and containers/packaging with increased barrier properties (Waste container type II).Both classes differ in requirements on the quality of a packaging, e.g. mechanical stability, thermal resistance and leak tightness.

The permissible radio-nuclide specific activities per waste package have been limited. They result from each of the individual safety assessments for normal operation of the repository, assumed incidents,

thermal influence upon the host rock, nuclear criticality safety and radiological long term effects in the post-closure phase of the repository. The activity values for individual radio-nuclides depend on the respective wasteform, the waste container class or the size of the packaging. The requirements must be fulfilled individually and independently of one another. Thus compliance with the most restrictive requirement is demanded. The structure of the Morsleben repository waste acceptance criteria is similar to that of the Konrad repository project.

The target groups for the categorisation system are the waste generators and conditioners, the manufacturers of waste containers, the authority/company responsible for radioactive waste disposal including its experts on waste package quality assurance and the respective authorities and institutions.

In Germany, the operators of NPP's, material test reactors or prototype reactors have the choice of whether or not to reprocess spent fuel or send it for direct disposal. Whichever is chosen all radioactive waste, including spent sealed radioactive sources and radioactive waste originating from outside the nuclear fuel cycle, is to be disposed of in deep geological repositories.

6. GREECE

The legal definition of radioactive waste in Greece is:

> "Those radioactive substances according to the Council Directive 96/29/EURATOM, for which no further use is foreseen."

There is no official classification system for radioactive waste, as the only radioactive waste produced is from research institutes, hospitals and industry. However, producers have to have a licence granted by the regulatory authorities (if they produce radioactive waste).

Spent fuel from the one research reactor is stored at the reactor pending return to the USA. Short lived low level waste generated by radioisotope users is managed according to the National Radiation Protection Regulations which conform to the Council Directive 96/29/EURATOM. Since 1992 the Greek Atomic Energy Commission requires spent sealed sources to be returned to the manufacturers.

7. IRELAND

As there are no nuclear reactors or fuel cycle facilities in Ireland, radioactive waste is classified simply by half-life, less than or over 6 months, and then according to whether it is in a sealed or unsealed form. The categorisation has no legal status and is used primarily for regulatory purposes and secondly for communication with the public.

Short-lived material is stored for five years and after confirmatory measurements it can be disposed of as normal waste. All other waste (except for defined minimal quantities of C^{14}, H^{3}, I^{125} and Co^{57}) must be stored indefinitely.

8. ITALY

The definition of radioactive waste, according to the Presidential decree of 1995 No. 230 on the Safety and Protection of Workers and Population against the Risk of Ionising Radiation, is:

> "whatever radioactive material, even if it is generally contained in an apparatus or device, is not foreseen any further use."

The categorisation system used for conditioned radioactive waste is defined in the Technical Guide No. 26 which is issued by the Italian Nuclear Regulatory Authority, but which is not incorporated into the legislation. The basis of the categorisation system for conditioned waste is the disposal route.

According to the radioisotopes' characteristics and concentrations, radioactive wastes are categorised into three categories:

Category I — Wastes which decay in a few months to radioactivity levels below safety concern thresholds (mainly hospital wastes with a half-life < 1 year)

Category II — Wastes which decay to radioactivity level of about 370 Bq/g within a few centuries. Activity of certain specific nuclides shall not exceed given values.

Category III Long lived wastes not included in Category I and II, high level wastes from reprocessing of spent fuel and alpha bearing wastes from the nuclear fuel cycle and R&D activities.

Within Category II, two subcategories are defined:

- Solid waste whose activity concentration is below the established limits, which can be disposed of without further conditioning process.
- Wastes with activity concentrations above the established limits which need to be conditioned and must fulfil further technical requirements to be accepted for disposal.

The established limits referred to are:

Radio-nuclides with $T_{½}$ > 5 years	370 Bq/g	10 nCi/g
^{137}Cs and ^{90}Sr	740 Bq/g	20 nCi/g
Radio-nuclides with $T_{½}$ < or = 5 years	18.5 kBq/g	500 nCi/g
^{60}Co	18.5 kBq/g	500 nCi/g

Approximately three quarters of Italy's spent fuel has been sent for reprocessing in other countries, the remainder is stored pending a decision on the disposal route. Category I waste is disposed of according to toxic waste regulations, Category II is destined for near surface disposal and Category III for deep geological disposal. Spent sources, institutional waste and very low level waste are categorised using the Technical Guide No. 26.

The following table summarises the classification system for Italy.

Categories	Limits	
Category I	Wastes which decay in a few months to radioactivity levels below safety concern thresholds.	
Category II	Wastes which decay to activity levels of ~ 370 Bq/g within a few centuries. Activity of certain specific nuclides shall not exceed given values.	Subcategories Wastes with activity concentrations below specified limits - no conditioning necessary (see above for limits). Wastes which exceed specified limits - further conditioning necessary (see above for limits).
Category III	Long lived wastes not included in Categories I &II. High level waste from reprocessing. Alpha bearing wastes from fuel cycle and R&D.	

9. NETHERLANDS

At present the national legislation for the Netherlands does not contain a definition of radioactive waste, however it is planned to include a definition in forthcoming legislation. A current proposal from the IAEA's Draft Joint Convention on the Safety of Spent Fuel Management and on the Safety of Radioactive Waste Management is:

> "Radioactive waste means radioactive material in gaseous, liquid or solid form for which no further use is foreseen by the Contracting Party or by a natural or legal person whose decision is accepted by the Contracting Party, and which is controlled as radioactive waste by a regulatory body under the legislative and regulatory framework of the Contracting Party."

The legal basis for the categorisation system is the Nuclear Energy Act and its enacting decrees which require a license for the construction and the operation of a radioactive waste management facility. As the basis for the categorisation system is mainly derived from operational considerations the detailed categorisation is appended in the form of acceptance criteria to the contract between the operator of the radioactive waste management facility and its customers.

As no decision has yet been taken on the disposal of radioactive waste the categorisation system concentrates on the treatment and conditioning of radioactive waste without foreclosing any disposal options. The categorisation system is as follows.

There are three waste categories:

Category 1: Low and intermediate level waste with a surface dose rate of 2mSv/h, and has the following four sub-categories:

a. Alpha containing waste from hospitals, industry and research.
b. Beta/gamma containing waste from nuclear power stations.
c. Beta/gamma containing waste from hospitals, research or industry with a half life of more than 15 years.
d. Beta/gamma containing waste from hospitals, research or industry with a half life of less than 15 years.

Category 2: Non heat producing high level waste, to be sub-divided into:

a. Reprocessing waste

b. Waste from decommissioning of nuclear facilities

c. Other high level waste

Category 3: Heat producing high level waste, or equivalent, to be sub-divided into:

a. Irradiated fuel

b. Vitrified reprocessing waste

The target groups for this categorisation system are the waste producers, to ensure consistency of approach to categorisation and waste management, and the general public for information.

Spent nuclear fuel is reprocessed and the waste vitrified, this will then be stored for a period of about 100 years in an engineered surface storage facility, along with all other radioactive waste.

Irradiated fuel from research reactors will be stored directly in adequate transport/storage flasks at the same facility.

Three additional types of waste have been identified which fall into Category A waste which will either require special treatment or will be stored in an unconditioned form, these are decommissioning waste, depleted uranium oxide from the uranium enrichment process and Naturally Occurring Radioactive Materials (NORM) waste with an activity concentration in excess of regulatory limits.

The table below summarises the radioactive waste classification system for the Netherlands.

Category	Limits/Description	
Category 1	LILW, Surface dose rate < 2mSv/h.	
	Sub-categories	
	a	Alpha containing waste from hospitals etc.
	b	Beta/gamma waste from NPP's.
	c	Beta/gamma waste from hospitals etc. with half

		life > 15 years.
	d	Beta/gamma waste from hospitals etc. with half life < 15 years.
Category 2	Non-heat producing HLW.	
	Sub-categories	
	a	Reprocessing waste.
	b	Waste from decommissioning nuclear facilities.
	c	Other HLW
Category 3	Heat producing HLW or equivalent.	
	Sub-categories	
	a	Irradiated fuel.
	b	Vitrified reprocessing waste.

10. PORTUGAL

The categories used by Portugal are not yet implemented in law, however the legal definition of radioactive waste is as follows:

> "Substances whose activities are greater than the values fixed by Directive 80/836 EURATOM as needing prior authorisation."

The categorisation of radioactive waste is defined according to the disposal route. There are three categories; low level waste - short lived with half-life's of less than 30 years, alpha waste which consists mainly of Radium and Americium sources, and uranium mining and milling waste. The categorisations are intended for use by experts.

Spent fuel from the 1 MW research reactor (swimming pool type reactor) is stored at the reactor site pending return to the USA.

The issue in Portugal is waste management rather than disposal, this is controlled by the Department of Radiological Protection and Safety (DPSR) of the General Directorate of Environment.

Radioactive wastes which cannot be disposed of, incinerated or left to decay at source are transported to the DPSR's site at Sacavem, where there is a treatment and interim storage facility.

All sealed sources are imported and returned to the manufacturer when spent, if this is not possible they are conditioned and stored at DPSR. Uranium mining and milling wastes are treated and stored at the owner's company premises.

The following table summarises the classification system used in Portugal.

Categories	Description
LLW	Short lived, half life < 30 years.
Alpha waste	Mainly Ra and Am sealed sources.
Uranium mining and milling wastes	

11. SPAIN

The Spanish waste categorisation system is not established in legislation, however it is supported by the authorities in two ways, namely:

- The Spanish Government's approval of the National Radioactive Waste Management Plan.
- The Licensing Authority's approval and issuing system, e.g. the approval and issuing of the waste acceptance criteria for the near surface disposal facility, El Cabril, in the "Official Journal".

The legal definition of radioactive waste is:

> "Any waste product or material for which no further use is foreseen and which contains or is contaminated with radio-nuclides in concentrations or activity levels higher than clearance values as defined by the Regulatory Authorities."

The categorisation system has two different radioactive waste categories based on the applied or planned disposal option, although other categorisation systems are used for operational purposes. Direct disposal is the route defined by the Spanish Government for spent nuclear fuel, therefore it belongs to the second of the two categories. The main categorisations are:

- Waste acceptable for the near surface disposal facility, which is basically low and intermediate level waste with a very low long-lived radio-nuclide content.
- All other waste which is either high level waste, including heat generating, or has a high long lived radio-nuclide content, or both.

In addition to technical requirements, specific radiological criteria are set for acceptance to the El Cabril disposal facility. There are two different groups of waste acceptable according to the requirements for conditioning as well as the properties of the waste package and the rest of the disposal unit components (see table below).

In addition, there are site limits for the total activity acceptable within the repository (Reference Inventory), as well as some other more operational constraints. Different methods are allowed to keep the facility's record of radio-nuclide content up to date (direct measurement, standard spectrum analysis of "key nuclides"). Special attention is given to long-lived radio-nuclides.

The Categories are used for communication with both expert groups and the public.

As mentioned earlier direct disposal is the route defined by the Spanish Government for spent nuclear fuel. Two types of disposal facility have been planned, a near surface disposal facility for LILW with a very low long-lived radio-nuclide content (El Cabril, already in operation), and a deep repository for all other wastes.

Return of spent sealed sources to their country of origin is favoured, however where this is not possible they are managed in the same way as institutional waste, within the categorisation system.

Uranium mining and milling are dealt with on an ad-hoc basis according to their volume and activity content, and they are not considered to be part of the categorisation system described.

There is no category of very low level waste, it is either radioactive waste or residual material which can be cleared from the regulatory control system.

The following table summarises the radioactive waste classification system for Spain.

Category	Limits	
Waste acceptable for near surface disposal	LILW with very low long lived radio-nuclide content . Specific criteria for disposal facilities.	
	El Cabril Disposal Criteria	
	Level 1	Maximum activity per unit mass for different radio-nuclides: $< 1.85 \times 10^2$ Bq/g alpha $< 1.85 \times 10^4$ Bq/g per individual radio-nuclide for

		beta/gamma, half life > 5 years (except tritium) < 7.40×10^3 Bq/g tritium < 7.40×10^4 Bq/g total beta/gamma activity, half life > 5 years
	Level 2	More detailed limits and limits per package for those nuclides in the Reference Inventory (< or = 3.7×10^3 Bq/g alpha per "disposal unit").
	Site limits	For the total activity content of the site for specific nuclides (On average < or = 3.7×10^2 Bq/g alpha).
All other waste	High level waste, including heat generating, or high long lived radio-nuclide content, or both.	

12. SWEDEN

There is no legal definition of radioactive waste in Sweden, but for general purposes radioactive waste may be defined as:

> "Radioactive waste means any material which contains or is contaminated by radio-nuclides and for which no use is foreseen."

This definition is consistent with Council Directive 92/3/EURATOM, and has been implemented in a Swedish regulation concerning shipment of radioactive waste. Furthermore, in Sweden the term nuclear waste is used. This is defined as:

- Spent nuclear fuel that has been placed in final storage
- A radioactive substance formed in a nuclear plant and which has not been produced or removed from the plant to be used in education or research, or for medical, agricultural or commercial purposes
- Material or other items from a nuclear plant and have become contaminated with radioactive substances, and are no longer to be used in such a plant
- Radioactive parts of a nuclear plant that is being shut down

The basis for the Swedish categorisation system is the disposal route, and the regulatory criteria concerning radioactive waste are managed via two Acts: the Act on Radiation Protection (1 July 1988); and the Act on Nuclear Activities (1 January 1993). Nuclear waste can be cleared from the regulatory system if it meets certain criteria, these are:

- Surface contamination must be < 40 kBq/m^2 for beta/gamma emitting nuclides and 4 kBq/m^2 for alpha emitting nuclides
- Specific activity must be < 500Bq/kg for unrestricted use (with a maximum of 100Bq/kg for alpha emitting nuclides)
- Material which is cleared for disposal on a municipal refuse dump is not allowed to contain more than 5 kBq/kg for beta/gamma emitting nuclides and 0.5kBq/kg for alpha emitting nuclides
- The total activity limit for waste cleared for disposal is 1GBq/year for the entire site

Non-nuclear waste can be exempted from the regulatory system if it meets certain criteria. For solid waste going to a municipal treatment facility, these are:

- < 10 $ALI_{(min)}$ per month and laboratory
- < 1 $ALI_{(min)}$ per single waste package
- < 50 kBq per sealed source

All other radioactive waste is categorised into 4 different disposal routes, these are as follow:

Above ground disposal:- This is for very low level waste from the operation of nuclear installations, the following restrictions apply: the total activity in the disposal facility must be < 100 GBq, the specific activity of individual waste packages must be < 300 kBq/kg for radio-nuclides with half-lives greater than 5 years and the surface dose rate of each package shall be below 0.5 mSv/h.

A rock repository for operational wastes: The repository accepts low and intermediate level radioactive waste from nuclear power plants and other nuclear applications. Total inventory limits regarding the physical, chemical and radiological properties of the waste are specified in the final safety report.

Rock repository for decommissioning waste: Accepts radioactive waste from the future dismantling of the Swedish nuclear power plants.

Spent fuel and other long lived wastes - These wastes are currently stored at an interim central storage facility for spent fuel, future disposal is planned.

The target groups for these categories are the industry and the authorities.

The following table summarises the radioactive waste classification system for Sweden.

Category	Limits	
Exempt Waste	< 10 $ALI_{(min)}$ per month and laboratory < 1 $ALI_{(min)}$ per single waste package < 50 kBq per sealed source	
Cleared Waste	Surface contamination Specific activity levels Municipal dump disposal Total activity for site	< 40 kBq/m^2 beta/gamma and < 4 kBq/m^2 alpha. < 500 Bq/kg (< 100 Bq/kg for alpha emitters). < 5 kBq/kg beta/gamma, or < 0.5kBq/kg alpha. < 1 GBq/year.
Above Ground Disposal	Very low level waste from the operation of nuclear installations. Total activity in facility < 100 GBq Specific activity of a waste package < 300kBq/kg for radio-nuclides with a half life > 5 years. Surface dose rate of a package < 0.5 mSv/h.	
Rock repository for Operational Waste	LILW from NPP's and other applications. Inventory limits for repositroy are specified in the Final Safety Report.	
Rock Repository for Decommissioning Waste	Planned.	
Category	Limits	
Spent Fuel and Other Long Lived Wastes	Currently stored, disposal planned.	

13. UNITED KINGDOM

The legal definition of radioactive waste in the UK is:

> "Waste which consists wholly or partly of -
>
> a) a substance or article which, if it were not waste, would be radioactive material, or
>
> b) a substance or article which has been contaminated in the course of the production, keeping or use of radioactive material, or by contact with or proximity to other waste falling within (a) or this paragraph."

The classification system is used primarily for communication with the public and other interested groups, e.g. politicians, and is not mentioned in any legislation or regulatory context. Only Very Low Level Waste is referred to in disposal authorisations issued by the UK regulatory authorities.

The United Kingdom have four broad categories of radioactive waste, categorised according to the heat generating capacity and the activity content of the waste, these are:

Very low level waste is material which may be disposed of with common or household refuse under general authorisation providing it is within the following limits. There must be less than 400 kBq beta/gamma activity in 0.1 m^3 (about 4 Bq/g), no more than 40 kBq/g beta/gamma activity per single item. Alpha activities a factor of ten below those given for beta/gamma wastes are sometimes allowed in disposal authorisations.

Low level waste contains radioactive material other than those acceptable for disposal with ordinary refuse, but not exceeding 4 GBq/tonne (4 10^3 Bq/g) alpha radioactivity and 12 GBq/tonne (1.2 10^4 Bq/g) beta/gamma radioactivity.

Intermediate level waste is all waste that exceeds the upper boundaries for low level waste, but which do not require heating to be taken into account in the design of storage or disposal facilities.

High level waste is waste in which the temperature may rise significantly as a result of their radioactivity, so that this factor must be taken into account in designing storage or disposal facilities.

In the UK there are a number of types of spent nuclear fuel and each have a different management system. Magnox fuel is reprocessed advanced gas cooled reactor fuel has been reprocessed but some future arising will be stored at Sellafield awaiting a decision regarding disposal, and pressurised water reactor fuel is a candidate for direct disposal. Intermediate level waste is treated, conditioned and stored pending disposal. Low level waste is treated and conditioned prior to disposal at BNFL's Drigg site or the UKAEA's site at Dounreay.

The following table summarises the radioactive waste classification system used in the UK.

Category	Limits
VLLW	< 400 kBq beta/gamma in 0.1m^3 (~ 4 Bq/g). < 40 kBq/g beta/gamma per single item.
LLW	Not acceptable for disposal with ordinary refuse. < 4 GBq/tonne (4 E+3 Bq/g) alpha. < 12 GBq/tonne (1.2 E+4 Bq/g) beta gamma.
ILW	Exceeds upper boundaries of LLW. Not heat generating.
HLW	Heat generating.

14. SUMMARY OF EUROPEAN UNION MS CLASSIFICATION SYSTEMS

Member State	VLLW and Special Wastes	LLW or LILW (Short Lived)	ILW or LILW (Long Lived)	HLW
Belgium	**R** Radium contaminated waste.	**A** 20 nuclide specific criteria for surface disposal.	**B** Does not meet surface disposal criteria. Negligible heat generation.	**C** Heat generating.
Denmark		**LLW** Dose rate 1m from unit < 5mSv/h. Activity content limits.	**LILW(LL)** Limits for fissile content depending on geometry and position.	
Finland		**LILW from NPP operations** Site specific limits. **LILW from decommissioning** No criteria specified yet.		**High Level Spent Fuel** No criteria specified yet.
France	**VLLW(SL/LL)** Split between SL and LL (30 years). Disposal route under study.	**LLW(SL/LL)** Split between SL and LL (30 years). Disposal route specified, site specific criteria.	**ILW(SL/LL)** Split between SL and LL (30 years). Disposal route specified, site specific limits.	**HLW(SL/LL)** Split between SL and LL (30 years). Disposal route specified, site specific limits.
Germany		All waste disposed of to deep repository. Site specific limits set.		
Greece		No official classification system. Waste producers must obtain a licence.		
Ireland	Half-life < 6 months, sealed or unsealed.	All other waste, half-life > 6 months. Some nuclide specific limits.		
Italy	**Cat I** Waste decays in a few months to levels below safety concerns.	**Cat II** Decays to ~370 Bq/kg in a few centuries. Specific limits also set.	**Cat III** LL waste not in Cat I or II. High level reprocessing waste, alpha bearing waste.	
Netherlands		**Cat I** LILW with surface dose rate <2mSv/h.	**Cat I** LILW with surface dose rate <2mSv/h.	**Cat II & III** Cat II non-heat generating HLW. Cat III heat generating HLW.

Member State	VLLW and Special Wastes	LLW or LILW (Short Lived)	ILW or LILW (Long Lived)	HLW
Portugal	**Alpha waste.** **Uranium mining and milling waste.**	**LLW** Half-life < 30 years.		
Spain		Waste acceptable for near surface disposal. Site specific disposal criteria set.		All other waste. High level waste and waste with high LL radionuclide content.
Sweden	**Cleared waste**	**Above Ground Disposal** Facility total < 100GBq. Surface dose rate <0.5 mSv/h. < 300 kBq/kg per package with half-life > 5 years.	**Repository for Operational Waste** Site specific limits. **Repository for Decommissioning Waste** Planned.	Spent fuel and other long lived waste.
UK	**VLLW** < 400kBq beta/gamma in 0.1m³. < 40kBq/g beta/gamma in a single item.	**LLW** Exceeds VLLW limits. < 4 GBq/tonne alpha. <12 GBq/tonne beta/gamma.	**ILW** Exceeds LLW limits. Not heat generating.	**HLW** Heat generating.

POSITION IN THE CENTRAL AND EASTERN EUROPEAN COUNTRIES

15. BULGARIA

The basis of the classification system used in Bulgaria is ORDERNo7/1992,"Regulations for collection, treatment, transportation and final disposal of radioactive waste on the territory of the Republic of Bulgaria", issued by the Committee on the Use of Atomic Energy for Peaceful Purposes, under the Law for Atomic Energy.

Solid waste is considered to be radioactive if it meets one of the following criteria:

- the equivalent dose rate of gamma emission at a distance of 0.1m from the surface of the waste is over 1μSv/h
- specific beta activity is over $7x10^4$Bq/kg
- specific alpha activity is over $7x10^3$Bq/kg
- specific gamma activity is over 50fGy/m^2

The solid radioactive waste is then classified into three categories depending on the equivalent dose rate of gamma emission at a distance of 0.1m surface, value of specific alpha and beta activity, according to the limits given in the following table.

Solid radioactive class	Equivalent dose rate gamma emission at a dose at a distance 0.1m from their surface, mSv/h	Specific beta activity, Bq/kg	Specific alpha activity, Bq/kg
I	$1x10^{-3}$ to $3x10^{-1}$	$7x10^4$ to $3.7x10^6$	$7x10^3$ to $3.7x10^5$
II	$3x10^{-1}$ to 10	$3.7x10^6$ to $3.7x10^9$	$3.7x10^5$ to $3.7x10^8$
III	over 10	over $3.7x10^9$	over $3.7x10^8$

The target group for the classification system are the experts but it is also used for communication with the public.

Spent nuclear fuel from NPPs has previously been stored in wet storage for three years followed by return to Russia.

As this is no longer possible a dry storage facility is to be built to store the fuel for 50 years. Institutional wastes and spent sealed sources are classified under the "Regulations" and uranium mining and milling tailings are managed under the instruction of the Ministry of Environment.

16. CZECH REPUBLIC

In the Czech Republic the definition of radioactive waste is:

> "waste substances, items or equipment unusable by their owner, with a radio-nuclide content or surface radioactivity contamination exceeding limits for their discharge into the environment, these limits shall be laid down by an implementing regulation."

This is taken from the Atomic Law No. 18/1997, Article 2, Point O. There is no classification system specified in the Regulations for the Czech Republic. The general classification of radioactive waste is based on the acceptance criteria of the repository. Radioactive waste which is within the acceptance criteria is sent for disposal, and waste which exceeds the criteria is stored until a suitable repository is available. The acceptance criteria are based on a safety assessment and an Environmental Impact Assessment and are approved by the State Office for Nuclear Safety (SONS) and are part of the licence for the repository.

For the purposes of treatment and conditioning the regulators require the waste generators to establish their own classification system, according to the technology used and safety criteria approved by the SONS. For communication to the public the classifications low/intermediate level waste, high level waste and spent nuclear fuel are used, although these are not defined.

Spent nuclear fuel is not considered as waste (although all requirements of law are adhered to as if it were waste) and it is stored for ~40 years pending a decision by either the owner or the SONS as to whether it will be reprocessed or sent for direct disposal. Uranium mining and milling waste is differentiated from other LILW and a specific management regime is applied to this waste. Two near surface repositories exist for institutional waste, both in abandoned mines (one of which was closed in 1964 and sealed in 1997), and one shallow land repository for LILW operational waste from NPP's. There are no new surface disposal facilities planned as it is possible to enlarge the existing ones.

17. ESTONIA

The Radiation Act came into force in Estonia on 16 May 1997, it defines radioactive waste as:

> "Materials containing radioactive substances or materials contaminated with radioactive substances where the content of radioactive substances exceeds the limits stipulated in this Act (the Government of Estonia shall establish by ordinance the maximal limits of total amounts of radioactive substances and the maximal limits of specific activity), and for which there is no intent of future use."

The regulation for radioactive waste management is due to be prepared in 1998 and this will include a revised waste categorisation system (recommendations have been taken from the IAEA, EC, Finland and Sweden), until this comes into force Estonia continues to use the old USSR categorisation system (SPORO-85).

The categories specified by SPORO-85 are as follows:

Solid waste is considered to be radioactive if the specific activity exceeds:

- 7.4 kBq/kg for alpha emitters
- 0.37 kBq/kg for transuranic elements
- 74kBq/kg for beta emitters
- 0.2 $pGym^2/s$ for gamma emitters

In addition solid waste is considered to be radioactive if the surface contamination exceeds:

- 5 alpha particles per cm^2 per minute
- 50 beta particles per cm^2 per minute

Solid radioactive waste is then divided into three groups; items, biological waste and spent radiation sources, and these are then categorised into a further three groups according to the dose rate at 10 cm from the surface. The limits are:

- Group I < 0.3 mSv/h
- Group II 0.3 - 10 mSv/h
- Group III > 10 mSv/h

The target groups for this categorisation system are service staff connected with radiation work, the public and environmentalists.

Estonia has no nuclear power generation and no nuclear industry hence the only waste producers are industry, research institutes and medical centres.

There are some historic uranium mill tailings originating from a now closed uranium processing facility.

The Radiation Protection Section and Company are responsible for waste management.

One nuclear repository is going through the design process, and a new interim repository for Estonia is planned; a further repository has been closed with the addition of concrete plinths.

The following table summarises the radioactive waste classification system for Estonia.

Category	Limits	
Clearance Levels	Specific Activity	< 7.4 kBq/kg alpha. < 0.37 kBq/kg transuranic elements. < 74 kBq/kg beta. < 0.2 $pGym^2/s$ gamma.
	Surface Contamination	5 alpha particles per cm^2 per minute. 50 beta particles per cm^2 per minute.
First Grouping	Items Biological waste Spent radiation sources	
Second Grouping	 Group I Group II Group III	Dose rate 10 cm from the surface: < 0.3 mSv/h 0.3 - 10 mSv/h > 10 mSv/h

18. HUNGARY

The definition of radioactive waste in Hungary is :

> "Radioactive waste is a waste that cannot be handled like normal waste because of its radioactivity."

The categorisation of radioactive waste is laid down in a "standard" which is supported by a ministerial order. The waste categorisation system is based on the source of the waste and categorised according to activity concentration. The main categorisation system is:

- Low Level $< 5 \times 10^5$ kBq/kg
- Intermediate Level 5×10^5 - 5×10^8 kBq/kg
- High Level $> 5 \times 10^8$ kBq/kg

If the determination of the activity concentration of solid waste could not easily be applied, for instance with reactor and accelerator facilities, and providing there are no alpha emitters present, then the following criteria may be used to categorise the waste. The categorisation is based on the surface dose rate with the following categorisation:

- Low Level < 300 µGy/h
- Intermediate Level 300 µGy/h - 10 mGy/h
- High Level > 10 mGy/h

There are no specific categories for wastes such as sealed sources, institutional waste etc., hence these are dealt with within the overall categorisation process.

The main target group for this categorisation system are the experts who are dealing with the radioactive waste.
Spent fuel is initially cooled in the pond at the reactor for 4-5 years, and until September 1997 was then transported back to Russia. From September 1997 spent fuel will be stored in an interim storage facility on the NPP Paks site for approximately 50 years. One disposal site exists for LILW and hospital waste etc. There are two current disposal projects, one shallow disposal repository and one for a deep geological repository. The Nuclear Energy Act established a nuclear fund, and an agency will be established on 1 January 1998.

The following table summarises the radioactive waste classification system in Hungary.

Category	Limits	
	Activity Concentration	Surface Contamination
Low Level Radioactivity	$< 5x10^5$ kBq/kg	< 300 µGy/h
Category	Limits	
	Activity Concentration	Surface Contamination
Intermediate Level Radioactivity	$5x10^5$ - $5x10^8$ kBq/kg	300 µGy/h - 10 mGy/h
High Level Radioactivity	$> 5x10^8$ kBq/kg	> 10 mGy/h

19. LATVIA

In Latvia the legal definition of radioactive waste is:

> "materials, equipment and goods which contain radioactive substances or the surfaces of which are contaminated by the said substances, and which have no further use or for which the owner cannot be identified."

The Latvian Authorities are in the process of drafting the new Regulations on radioactive waste management, therefore only a brief description of the proposed classification system can be given. The new regulation will be incorporated into the Cabinet Regulations when it is finalised. The basis for the classification system is to be the disposal route, with wastes categorised according to their half-life (< or > 30 years) and activity content (heat generating or low/intermediate level waste). Short lived waste will then be disposed of to a near-surface repository and it is planned to send long lived radioactive waste to an intermediate depth repository. There are no plans to dispose of high level waste. Spent sealed radioactive sources are considered as a separate group, mainly due to their planned conditioning route.

Waste already disposed of can be categorised according to its type or storage/disposal location, the groups of waste are:

- Waste already disposed of in the old vaults
- Waste stored in the new vaults
- Sealed sources held in interim storage

The target group for the new classification system is experts from radioactive waste disposal facilities and the research reactor.

Latvia has only one research reactor, most of the spent fuel has been returned to Russia and negotiations are ongoing for the return of the remaining fuel, the research reactor is no longer operating and is to be decommissioned. All other radioactive waste is from scientific laboratories and industrial enterprises, the majority of the waste is stored in the centralised facility Radons which is a subordinate to the Ministry of environmental protection and regional development.

20. POLAND

The categories of radioactive waste for Poland are laid out in the Regulation of the National Atomic Energy Agency's President (1989) on the principles of defining waste as radioactive, classifying it and keeping records of and conditioning, storing and disposal of waste. The legal definition of radioactive waste in Poland is:

> "Objects or materials, solid, liquid or gaseous in their consistency, containing radioactive substances or contaminated by them in excess of the levels stipulated in App. 1 to the Regulation that makes any further use of them purposeless or impossible will be numbered under radioactive wastes"

The levels referred to (for solid radioactive waste) are an activity concentration above 100 ALI_P/m^3, or if this cannot be determined then 100kBq/kg beta/gamma or 10kBq/kg alpha can be used. It should be noted that a higher limit (500kBq/kg beta/gamma) is given for materials containing naturally occuring radioactive materials. Formulae are given for calculating these figures and also for cases where the material contains a number of radio-nuclides. The categories are then grouped as follows:

I. Beta and gamma emitters of:

   A. low level radioactivity,

   B. intermediate level radioactivity,

   C. high level radioactivity.

II. Alpha emitters

III. Spent closed radioactive sources.

Low, intermediate and high level radioactivity is categorised according to the limits indicated in the table below.

Low active	Intermediate active	High active
$<10^6$ ALI_p/m^3 or $<10^4$ kBq/kg	$10^6 - 10^9$ ALI_p/m^3 or 10^4-10^7kBq/kg	$>10^9$ ALI_p/m^3 or $>10^7$ kBq/kg

A criterion is set for storage that the maximum dose on the container surface should not exceed 2mGy/h (200mrad/h), and at a distance of 1m from the container should not exceed 0.1mGy/h (10mrad/h).

The acceptance criteria for disposal are the same as those for storage of sealed sources with an additional limit for loose contamination, i.e. contamination not bound to the surface of the container, of 40kBq/m^2 for beta/gamma emitting radio-nuclides and 4kBq/m^2 for alpha bearing nuclides.

The categorisation of radioactive waste is carried out initially by the producer and if a different organisation is immobilising, storing or disposing of the radioactive waste then they also have to categorise it.

Spent fuel from Poland's two research reactors is currently stored in ponds at the reactor sites, and no final disposal route has yet been decided. In the meantime a dry storage facility is under investigation. All LILW is disposed of in the Rozan near surface repository, and investigations are underway into the siting of a new near surface repository. No high level waste is produced in Poland, but high level spent closed radioactive sources up to 10 Ci are either returned to the manufacturer or stored at Rozan.

The following table summarises the radioactive waste classification system in Poland.

Categories	Limits	
Clearance levels	Activity Concentration < 100 ALI_p/m^3, or < 100 kBq/kg beta/gamma, or < 10 kBq/kg alpha, or < 500 kBq/kg beta gamma for naturally occuring radioactive materials.	
Beta/Gamma Emitters	Sub-categories	Limits
	Low Level Radioactivity	$<10^6$ ALI_p/m^3 or $<10^4$ kBq/kg
	Intermediate Level Radioactivity	10^6 -10^9 ALI_p/m^3 or 10^4-10^7kBq/kg
	High Level Radioactivity	$>10^9$ ALI_p/m^3 or $>10^7$ kBq/kg
Alpha Emitters	No criteria specified.	
Storage	Surface Dose Rate Dose Rate at 1m Surface	< 2 mGy/h < 0.1 mGy/h

	Contamination	< 40 kBq/m^2 beta/gamma, or < 4 kBq/m^2 alpha

21. ROMANIA

The legal definition of radioactive waste in Romania is:

> "Those materials resulting from nuclear activities for which no use was provided and which contain radio-nuclides or are contaminated therewith in concentrations superior to the exemption limits."

The basis for the classification system is given by the Law No 111/1996 of the National Nuclear Safety Regulations, and the "Instructions regarding the Radioactive Waste", Revision 1, issued in 1982 by the former State Committee for Nuclear Energy. The classification is based on activity content, exposure rate, physical state and treatment route. It applies to beta/gamma waste, alpha bearing waste being considered separately.

The radioactive waste is first classified according to activity content and exposure rate into one of the three categories below.

- Low level radioactive waste, having specific activity less than 37MBq/m^3 and exposure rate at the package surface less than 200mR/h.
- Intermediate level radioactive waste, with specific activity in the range of 37MBq/m^3 to 370TBq/m^3 and the exposure rate at unshielded package surface exceeding 200mR/h.
- High level radioactive waste, with specific activity exceeding 370TBq/m^3.

The low level radioactive waste is then subdivided according to physical state, treatment method, volume reduction technique and biological properties into the following groups.

- Solid, liquid or gaseous
- Combustible, non-combustible or special waste (explosive, phyrophoric, etc)
- Compactible or non-compactible
- Biodegradable or non-biodegradable

Intermediate level waste and high level waste are simply divided according to physical state.

The target group for the classification system is experts.

Spent fuel is stored at the reactor site in an interim storage facility. No decision has yet been made as to the management route but the most likely option is a long-term interim dry storage facility. Spent fuel from research reactors is either stored as above or returned to the USA. Low and intermediate level radioactive waste is collected from originators, transported, treated and disposed of by the Romanian Institute for Physics and Nuclear Engineering at the Bihor Repository. Uranium mining and milling waste is the responsibility of the originator and is classified according to its origin and activity content, these are:

- milling waste, not exceeding 37MBq/m^3
- low grade ore heaps stored near exploration works, which do not exceed and average of 1 to 3 MBq/m^3
- waste rock piles, resulting from mining activities, having less than 1MBq/m^3

The following table summarises the classification system used in Romania

Category	Limits	Sub-category
Uranium Mining and Milling waste	< 1 MBq/m^3	Waste rock piles
	1 - 37 MBq/m^3	Low grade ore heaps
	<37 MBq/m^3	Milling waste

Category	Limits	Sub-category	
Low Level Waste	Specific activity <37MBq/m^3 or, dose rate at package surface <200mR/h	Combustible	Biodegradable
			non-biodegradable
		Non-combustible	Compactible
			non-compactible
		Special waste	
Intermediate level waste	Specific activity 37MBq/m^3 - 370TBq/m^3 or, dose rate at package surface >200mR/h		
High level waste	Specific activity >370TBq/m^3		

22. SLOVAK REPUBLIC

The legal definition of radioactive waste in the Slovak Republic is:

> "Radioactive material in gaseous, liquid or solid form for which no further use is foreseen and which cannot be released to the environment owing to its content of or contamination with radio-nuclides."

There is no formal classification system as yet in the Slovak Republic. A qualitative system is widely used which has low, intermediate and high level waste categories, but these have no specific activity limits for each category. The current system is based mainly on the source of the radioactive waste but a revision of the system is underway and the new system is likely to be based on the disposal route. The current Regulation No 67/1987 on ensuring nuclear safety for radioactive waste management does not include the classification system, however the new regulation which is expected to be in place in 1998 is expected to include a formal classification system. The target group for the new classification system will be experts.

Spent fuel is currently stored in a wet interim storage facility; the final decision on whether to reprocess or directly dispose of the fuel has yet to be made. Waste is segregated with regard to treatment and disposal route, i.e. waste suitable for near-surface disposal, waste only suitable for deep disposal and very low level waste which can be disposed of in a simple repository. Institutional waste from medicine, industry and research is dealt with in the same way as radioactive waste from the NPPs.

23. SLOVENIA

The legal definition of radioactive waste is included in the Act on Environmental Protection (Zakon o varstvu okolja, Off Gazette RS, 32/92), and reads:

> "Radioactive waste is hazardous waste with one or more radioactive isotopes and can be low level, intermediate level or high level radioactive waste. Because of its characteristics the waste needs special treatment"

The categorisation system is defined by the Regulations on the mode of collection, accounting, processing, storing, final disposal and release of radioactive waste into the environment - Z3 and is part of the Act on protection against ionising radiation and special safety measures in the use of nuclear energy. The system was established at the time of construction of the Krško NPP and is based on the source of the radioactive waste.

Solid radioactive wastes are defined as substances having specific activities greater than 10^8 Bq/m^3 for beta gamma emitters, or greater than 10^7 Bq/m^3 for alpha emitters as well as substances with a surface contamination greater than 5000 Bq/m^2 for beta/gamma emitters or greater than 500 Bq/m^2 for alpha emitters. Categorisation of solid radioactive waste is according to specific activity and is as follows:

Category	Specific Activity A_{sp} (Bq/m^3)	Description of the Category
High Level Waste	$A_{sp} > 5 \times 10^{14}$	• High beta/gamma activity • High radio-toxicity • High heat generation (cooling is necessary)
Intermediate Level Waste with alpha emitters	$5 \times 10^{14} > A_{sp} > 5 \times 10^7$	• Intermediate beta/gamma and significant alpha activity • Intermediate radio-toxicity • Low heat generation
Intermediate Level Waste with beta/gamma emitters	$5 \times 10^{14} > A_{sp} > 5 \times 10^9$	• Intermediate beta/gamma and insignificant alpha activity • Low/intermediate radio-toxicity • Insignificant heat generation
Low Level Waste with alpha emitters	$5 \times 10^7 > A_{sp}$ $\frac{A_i}{} > \text{or} = 1$ Ik_I	• Low/intermediate beta/gamma and low alpha activity • Low/intermediate radio-toxicity • Insignificant heat generation
Low Level Waste with beta/gamma emitters	$5 \times 10^9 > A_{sp}$ $\frac{A_i}{} > \text{or} = 1$ Ik_I	• Low beta/gamma and insignificant alpha • Low radio-toxicity • Insignificant heat generation

A_i = measured specific activity of a single radio-nuclide.

Ik_i (Bq/m^3) = derived radio-nuclide concentration in drinking water for the critical group.

The target group for the categorisation system are regulatory bodies, waste producers and experts from the nuclear field.

Spent nuclear fuel from the TRIGA research reactor is currently stored pending return to the USA. All other spent nuclear fuel is to be stored in an interim dry store with the decision on the final disposal route deferred until 2020. Radioactive waste from industry, research and medicine is stored in an interim storage facility for small producers and is categorised using the same system as for NPP waste.

24. SUMMARY OF THE CENTRAL AND EASTERN EUROPEAN COUNTRIES RADIOACTIVE WASTE CLASSIFICATION SYSTEMS

Country	VLLW and Special Wastes	LLW or LILW (Short Lived)	ILW or LILW (Long Lived)	HLW
Bulgaria	**Uranium Mining and Milling Wastes**	**Cat I** Dose rate at 0.1 m from surface $1x10^{-3}$ - $3x10^{-3}$ mSv/h, alpha and bate limits also.	**Cat II** Dose rate at 0.1 m from surface $3x10^{-3}$ - 10 mSv/h, alpha and beta limits also.	**Cat III** Dose rate at 0.1 m from surface > 10 mSv/h, alpha and beta limits also.
Czech Republic	**Uranium Mining and Milling Waste**	Site specific classification systems. For communication purposes LILW, HLW and Spent Nuclear Fuel used, but no definitions.		
Estonia	**Uranium Mill Tailings**	**Group I** Dose rate at 0.1m from surface < 0.3mSv/h.	**Group II** Dose rate at 0.1m from surface 0.3 - 10 mSv/h.	**Group III** Dose rate at 0.1m from surface > 10 mSv/h.
Hungary		**LLW** Activity concentration $<5x10^5$kBq/kg. Dose rate <300µGy/h.	**ILW** Activity concentration $<5x10^5$ - $5x10^8$ kBq/kg. Dose rate 300µGy/h - 10mGy/h..	**HLW** Activity concentration $>5x10^8$ kBq/kg. Dose rate 300µGy/h - 10mGy/h.
Latvia		**LILW Short Lived** No criteria specified yet.	**LILW Long Lived** No criteria specified yet.	**HLW** Heat generating
Poland	**Spent Sealed Radioactive Sources**	**Category 1A** Beta/gamma emitters $<10^6 ALI_p/m^3$ or $<10^4$kBq/kg. **Alpha Emitters**	**Category 1B** Beta/gamma emitters 10^6 -10^9 ALI_p/m^3 or 10^4-10^7kBq/kg. **Alpha Emitters**	**Category 1C** Beta/gamma emitters $>10^9$ ALI_p/m^3 or $>10^7$kBq/kg. **Alpha Emitters**
Romania	**Uranium Mining and Milling Waste**	**LLW** Specific activity <37MBq/m³. Exposure rate on surface <200mR/h.	**ILW** Specific activity 37MBq/m³-370TBq/m³. Exposure rate on surface >200mR/h.	**HLW** Specific activity >370TBq/m³.
Slovak Republic		No formal classification system, qualitative system with LLW, ILW and HLW but no criteria given.		
Slovenia		**LLW(alpha, beta/gamma)** Specific activity alpha $<5x10^7$Bq/m³. Specific activity beta/gamma $<5x10^9$Bq/m³.	**ILW(alpha, beta/gamma)** Specific activity alpha $5x10^7$ -$5x10^{14}$ Bq/m³. Specific activity beta/gamma $5x10^9$-$5x10^{14}$Bq/m³.	**HLW** Specific activity $>5x10^{14}$Bq/m³.