ERDO Annual Meeting - LWC Project Legacy Waste Characterization

National Repository
Michela Raio

19/10/2022

Legacy Waste

Radioactive Waste generated in past activities (energy production, medicine, research, industry) which have been treated and conditioned according to the rules in force at the time or simply stored pending a suitable management solution

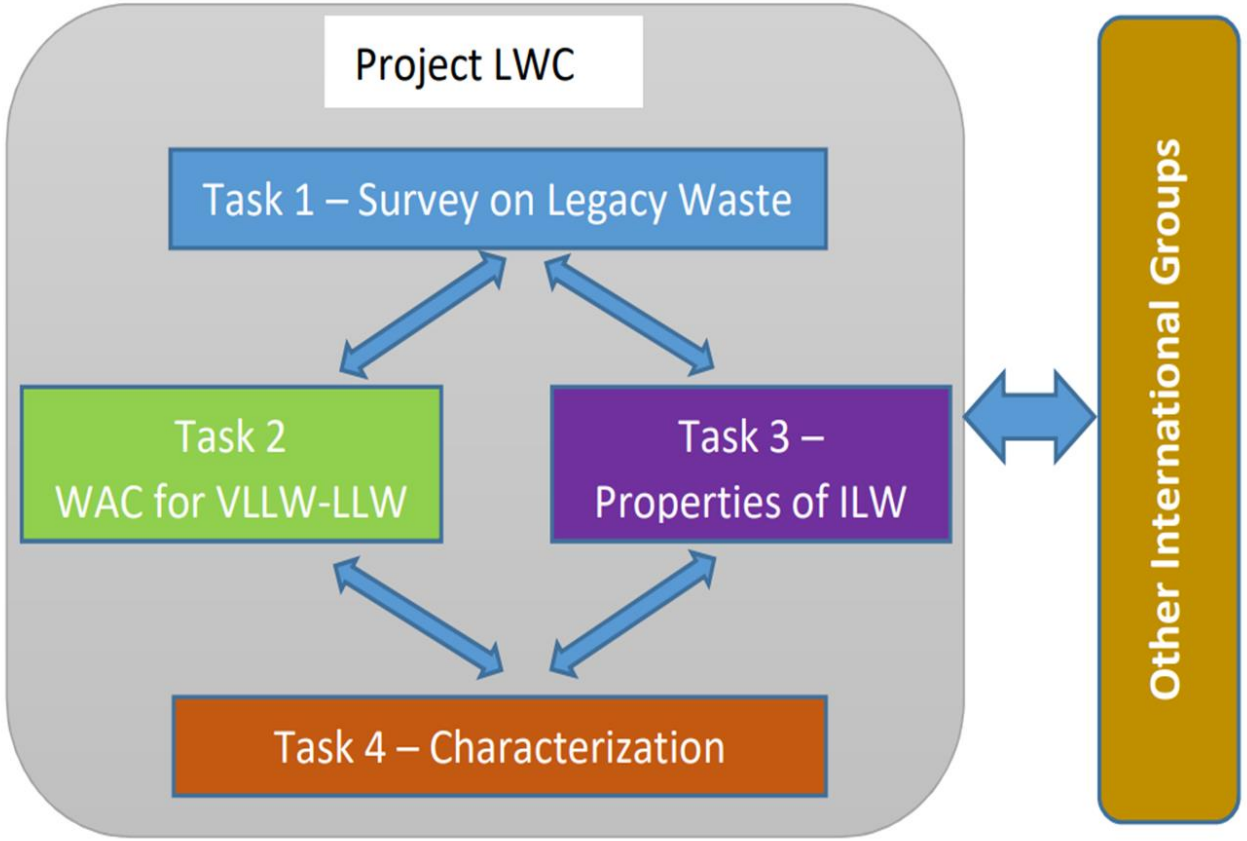
Main Issues:

- Lack of Radiological/Chemical/Physical Characterization data
- Lack of treatment options or need for retreatment/reconditioning
- Possible not compliance with actual storage and/or disposal WAC

Many Countries must deal with Legacy Waste issues, so sharing information can be crucial

ERDO – Legacy Waste Characterization (LWC)

Project Goal: Sharing information and methodologies for a better characterization of Legacy Waste in view of possible future common management activities and acceptance to disposal.



Organizations and Countries involved:

ARAO	(Sloenia)
COVRA	(Netherlands)
DD	(Denmark)
ENEA	(Italy)
FUND-NEK	(Croatia)
NES	(Austria)
NCSR	(Greece)
NND	(Norway)
SOGIN	(Italy)

ERDO Legacy Waste Characterization (LWC)

Expected impacts of the project outcomes:

- Better knowledge of the current situation of Legacy Waste and sharing of the relevant common issues;
- Identify possible future management and acceptance of the Legacy Waste packages for storage or disposal into national/multi-national facility;
- Early indications to producers for treatment and conditioning of waste generated in countries without a well established disposal route and relevant WACs.

Task 1 – Survey of existing main Legacy Waste Streams

Task 1 goal: gathering information about the Legacy Waste streams currently stored in the interested countries in order to highlight possible similarities and common issues.

Task 1 steps were:

- Identifying common waste streams with analogies/differences in classification, characterization, future treatment/conditioning, disposal destination;
- Identifying common issues related to this waste streams and missing data and also relevant aspects which may jeopardize or promote shared management solutions;
- formulating preliminary considerations on characterization of these waste streams for optimizing their management/disposal

Task 1 – Analysis

N	WASTE STREAM	COUNTRY	CLASSIFICATION	Waste Stream Radiological Characterization				EXPECTED DISPOSAL FACILITY TYPE (Near Surface/Other)
				Total Activity (Bq)	Main Radionuclides	Current packaged volume (m3)	Mass (kg)	
1	Disused Sealed Radioactive Sources (DSRS)	CROATIA	LLW/ILW	3,05E+12	Fe55, Co60, Kr85, Sr90, Ir92, Gd153, Kr85, Sr90, Cm247, Ni63,Tl204, Cm247, Ba133, Cd109, Cs137, Pm147, Eu152,154, Ra226, Ra226/Be, Am241/Be	N.A.	N.A.	Near Surface/Other
		DENMARK	No national classification scheme	N.A.	Charcterisation in progress	N.A.	N.A.	Other (DGR)
		ITALY	No national classification scheme	1,22E+15	H3, Cs137, Ra226, C14, Co60, U238, Kr85, Cm244, Ni63, Sr90, Am241, Ra226, alpha sources, beta sources	5,11E+02	1,35E+04	Other
		GREECE	LLW/ ILW	7,70E+09	Am241, Ra226, Co60, alpha sources, beta sources, neutron sources	1,80E+00	N.A.	Other (possibly multi-purposes borehole)
		NORWAY	LLW/ILW	Unknown	Ra226 or Am241	N.A.	N.A.	Near Surface/Other
		AUSTRIA	LILW-SL and LL (in case of Am-241 and Ra-226 sources)	24,8E3 GBq (not decay corrected)	Cs-137, Co-60, Am-241, Kr-85, Sr-90, H-3, Ra-226, Pm-147, Ir-192	130 drums	N.A.	To be determined
2	Solid Mixed Waste	CROATIA	LLW/No classification	N.A.	Ra226, Cs137, Bi207, Pb210, Eu152, U238, Th234, Co57, Co60, Am241, mixture	N.A.	3,06E+03	Near Surface
		DENMARK	No national classification scheme	6,00E+12	Charcterisation in progress	ca 5400 drums	Not compiled	Other (DGR)
		ITALY	ILW	4,37E+11	Cs137, U238, Cm244, Eu154, Pu238, Pu241, Sr90	4,38E+01	8,25E+02	Other
		GREECE	LLW/ ILW	N.A.	Cs137, Co-60, Ag-108m, Eu-152, Tc-99 etc, Ra-226, Am-241, Th232, Sr-90, deU	2,40E+01	N.A.	Near surface/ Other (possibly multi-purposes borehole)
		AUSTRIA	LILW-SL and LL	1,8E3 GBq (not decay corrected)	Sr-90, H-3, C-14, Cs-137, Pu-241, Am-241, Co-60	about 4000 drums	Not available before reconditioning	To be determined (Near Surface)
		NETHERLAND	LILW		Cs-137	not yet available		Other (GDF)
3	Powdery Waste	CROATIA	LLW	N.A.	Eu152	Not available	4,80E+02	Near Surface
		ITALY	VLLW/LLW	2,92E+10	Cs137, Eu154, Sr90, Pu241, C14, H3, U236, U238	1,55E+03	1,84E+06	Near surface
		GREECE	LLW	N.A.	Pu-238, Pu-239, Pu-240, Pu-241	6,00E-01	N.A.	Near surface
		NORWAY	ILW (long lived aplha activity concentration expected to be > 400 Bq/g)	Unknown	Unknown (various radionuclides including Actinides- Pu)	5,48E+01	82200 (dry desity of 1.5 t/m3)	Other
4	Sludges	DENMARK	No national classification scheme	N.A.	Charcterisation in progress	N.A.	N.A.	Other (DGR)
		ITALY	VLLW/LLW	1,33E+09	Ni59, Ni63, Co60, Cs137	1,16E+01	5,12E+03	Near surface
		GREECE	VLLW/ LLW	Unknown	Ni63, Co60, Cs137, Ag-108m, Eu-152	2,00E-01	N.A.	Near surface
		NORWAY	LLW/ILW	N.A.	Activation and fission Products e.g. Cs137, Fe55, Co60, Sr90, Uranium, Actinides (Am241, Pu239, Pu240, Pu241)	N.A.	N.A.	Near surface/Other
		AUSTRIA	LILW-SL and LL (in case of alpha nuclides in the ashes)	173 GBq (not decay corrected)	Co-60, Cs-137, Th-232, Am-241, Ra-226Eu-154, Ag-108m	about 3500 drums	360 kg per drum on average	To be determined (Near Surface)

Task 1 – Results

The survey and the analysis revealed many similarities:

- 93 waste streams have been gathered in 13 homogeneous groups of streams;
- Many similarities in waste streams (possible management synergies);
- Classification is always defined (except for one country and for Disused Sealed Sources);
- 40% of these streams need radiological characterization methodology;
- Chemical characterization is missing or poor;
- The current status is Raw or in some cases inadequately conditioned and the re-treatment process is not always defined or in concept phase

Task 2 – Minimum set of WACs for near-surface disposal of VLLW-LLW

Task 2 goal: deriving a common minimum set of WACs to be respected by the legacy VLLW-LLW streams for a near-surface disposal

Task 2 steps were:

- Gathering information about WACs of near-surface disposal facilities (by questionnaire and free documents);
- Establishing a minimum set of WACs for the legacy VLLW-LLW streams

Task 2 – Results

WAC Information gathered on 18 countries divided in 4 cathegories:

- Radiological;
- Chemical;
- Mechanical;
- Physical.

Survey and Research revelead:

- Many points in common in the declared data of WACs;
- Main concern is control and limitation of the radiological and chemical content of waste;
- Minimum set required for mechanical characteristics;
- Need to ensure waste recognizability.

A set of possible WAC/Safety Aspect to be verified for Legacy Waste has been proposed

Task 3 – Main properties of ILW packages potentially suitable for geologic disposal

Task 3 goal: collecting the main properties of typical ILW stream packages potentially suitable for geologic disposal on the basis of available conceptual Disposability Assessments

Project is closed, report has not yet been submitted for approval, results will be given in final report planned for december 2022

Task 4 – Characterization of main Legacy Waste Streams

Task 4 goal: Determining the necessary characterization data of the main Legacy Waste streams. In other words, define a Legacy Waste characterization methodology.

Task 4 steps were:

- Checking the availability of characterization data of the Legacy Waste for acceptance to disposal;
- Looking at technologies and approaches for deriving the missing characterization data;
- Formulating early indications to waste producers in order to allow the implementation of treatment/conditioning processes for generating waste packages in line with WACs and properties defined in Task 2 and 3.

Task 4 – Results

Legacy Waste streams were analyzed and most suitable characterization techniques were suggested

Characterization purpose	Quantity	Characterization type	Applicability	Technique
Radiological	Gamma-emitter radionuclides	Non destructive	All waste	ISOCS
	Gamma-emitter radionuclides	Non destructive	All small size waste	LabSOCS
	Pu and U isotopic ratios	Non destructive	All waste	MGA
	Gamma-emitter radionuclides	Non destructive	Drums	OG, SGS, TGS
	Fertile material	Non destructive	All waste	Passive neutron counting
	Fissile material	Non destructive	All waste	Active neutron counting
	ha-emitter radionuclides	Destructive	All waste potentially contaminated by alpha-emitters; not applicable to sealed radioactive sources	Alpha spectrometry
	Alpha- and beta-emitter radionuclides	Destructive	All waste potentially contaminated by alpha- and beta-emitters; not applicable to sealed radioactive sources	LSC
	X-ray emitters; EC-decaying radionuclides (e.g., ^{55}Fe, ^{59}Ni, ^{99}Mo)	Non destructive	All waste	X-ray spectrometry
Physical	Density	Non destructive	All waste	Mass and volume
	Density distribution	Non destructive	All waste	Radiography, gammagraphy
	Density distribution	Non destructive	Drums	Transmission tomography
Chemical	Water content	Destructive	All waste; not applicable to sealed radioactive sources	Karl-Fisher
	Elements	Destructive	All waste; not applicable to sealed radioactive sources	AES
	Isotopes	Destructive	All waste; not applicable to sealed radioactive sources	MS

Conclusions – Lesson Learnt

Main points highlighted:

- Legacy waste are a common issue in ERDO countries;
- We have now better knowledge of the current situation of Legacy Waste in the interested countries and shared the relevant common issues;
- Characterizations and Treatment options are main Legacy Waste Issues;
- Lack of knowledge, especially in the chemical characteristics of the Legacy Waste.

3 deliverables documents were published

Conclusions – Suggestions

- For waste management some main points are crucial:
  - ✓ Classification;
  - ✓ characterization and treatment procedures;
  - ✓ reference WAC (Having a list of shared, internationally recognized WACs available is useful for radioactive waste management in those countries that have not yet developed a disposal program).
- It is advisable to carry out the characterization operations in a time as close as possible to the production of the waste.

Conclusions – Project Importance

- A minimum set of WACs (physico-chemical-radiological) is defined and can be taken as a reference by those countries that have not yet developed their own list of WACs;
- Some waste characterization techniques/procedures are defined and can be taken as a reference to evaluate the characteristics of the waste;
- Can be a starting point for implementing of bilateral-multilateral detailed info exchange and agreement among organizations managing similar waste streams;
- Possible joint management of radioactive waste. And why not, up to a possible future in a multinational disposal facility.

Synergies and Collaborations between countries could be very useful!

SOGIN

We protect the present
We guarantee the future