WASTE DATABASE IN CONTAMINATED TERRITORIES AFTER THE CHERNOBYL ACCIDENT

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ABSTRACT

The main purpose of the French-German Initiative is to assist in the collection and validation the existing data for constituting a reliable and objective basis of information useful to the planning of countermeasures and informing. Three main axes have been defined, safety of Chernobyl "Sarcophagus" (Project 1), study of radiological consequences of accident (Project2) and study of the medical impact. (Project3).

The "Radioecology" Project (P2) comprises six sub-projects, this paper deals with Sub-Project 2 on Waste dumps and Strategies database.

Solving the problem of Chornobyl Radioactive Waste (RW) environmental safety requires a generalization of available information on RW vault sites and recommendation development on such waste management.

Within the framework of the French-German initiative, in which take part specialists from France, Germany, Ukraine, Russia and Belarus is created project dedicated to problem of management on temporary vaults RW.

Essence of work consists in creating a database of RW standard vaults, housed RW, estimating degrees of probable vault environmental influence, collecting an information on possible RW management methods, choosing the decision for RW environmental influence preventing the base of available information.

The degrees of probable vault environmental influence are estimated on the base of RW and vault categorizations. As a basis for such categorization principles and criteria developed by Ukrainian specialists in RW management within the framework of the French-German Initiative Project are used. Five RW categories were marked out either using developed principles and criteria or considering a correlation between a specific activity of ^{137}Cs and specific alpha-activities. At the development of a general Ukrainian, Russian and Belarussian Chornobyl vaults categorization were considered them specific features.

Identificator which includes information about storage and waste in Ukraine, Belarus and Russia was elaborated. This identificator is the ground for database structure. The database structure is stipulated first of all by fullness and feasibility of putting together (comparing to each other) the information on the RW localized in Belarus, Russia and Ukraine. Preliminary database structure was elaborated on the basis of identificator.

Gained data will allow to evaluate the vault environmental risk objectively, as well as to chose the optimum RW management strategy.

INTRODUCTION

In September 1995, several months prior to the signing of the G7 agreement, the Ukrainian Minister of Environmental Protection and Nuclear Safety appealed to all governments for scientific, technical and financial support to create an International Research and Technology Centre for the problems caused by the Chernobyl accident.

In response to this appeal the French and German Ministers of Environment jointly announced in Vienna on April 12, 1996 their *cooperation initiative* with Ukraine, Belarus and Russia over scientific projects concerning the aftermaths of the Chernobyl disaster. In July 1997, an agreement was signed between IPSN (Institut de Protection et de Sûreté Nucléaire) and its German counterpart GRS (Gesellschaft für Anlagen und Reaktorsicherheit) and the Chernobyl Center.

The following three research topics have been specified :

- the safety of the sarcophagus - Project 1
- the impact of the accident on the environment (radioecology) - Project 2
- the health of the affected population - Project 3.

The main purpose of the French-German Radioecoly project is to assist in *the collection and validation the existing data for constituting a reliable and objective basis of information* useful to the planning of countermeasures and informing. This Radioecology project (P2) comprises six sub-projects, Ecological portrait SP0, Initial contamination SP1, Wastes dumps SP2, Radionuclides transfers SP3, Urban environment and countermeasures SP4 and Countermeasures in Natural and Agricultural areas SP5. The French-German programme concerning the Chernobyl Centre is envisaged for 3 years. In the context of the agreement, data collections are supported by several Ukrainian, Russian and Byelorussian laboratories and Institutes.

This paper deals with sub-project 2 (SP2) on Waste dumps and Strategies database and the first results obtained after one-year collaboration.

Subproject consists in making a database (DB) on repositories and radioactive wastes (RW), evaluation of degrees of repositories probable influence on the surround ambience, collection information on possible ways of treatment with the RAW, choice of best decisions for preventing a RW radiological influence on the surround ambience.

The aim of the first year research is collection information on repositories and RW, analysis of existing categorizations of RW and repositories, development of general categorization of RW and repositories and finally creation of the database structure.

1. THE PROBLEM OF ENSURING THE SAFETY OF KEEPING OF THE LOCALISED RADIOACTIVE WASTE

For some months following the accident, soil and vegetation of the contaminated areas were removed and "buried" in ditches. Their bottoms were covered with clay to limit infiltration into underground water. Presumably more than 800 trenches and clamps practically not isolated from the surround ambience are in Chornobyl Exclusion Zone.

Many trenches are overwhelmed by ground water permanently or during the spring high water, that is a danger for the environment causing by radioactive contamination transfer from dumps into Pripiat River and hereinafter to Dniper watershed. Reliable information on location of most trenches, RW volumes and amounts as well as other features are absent. Broadly there are about 1 million m^3 of RW of above 14 thousand tera-Becquerel of total activity.

A bulk of radioactive waste (RW) had been forming during the deactivation activity on Chernobyl Power Unit IV vicinity as well as within a wide area around it. For them isolation interim storages of RW (ISRW) and dumps of RW had been created in 1986. The ISRW and the DRW position around the CNPP is given by the Fig. 1. Fair amount of temporary vaults has formed on the territory of Russia (Bryansk region) and Belarus (Gomel region). Location of radioactive waste repositories in Bryansk region during in-field investigations in May 1999 is represented in Fig.2.

A solving the problem of Chornobyl RW environmental safety requires a generalization of available information on RW vault sites and recommendation development on such waste management. Within the framework of the French-German initiative is created project dedicated to problem of management on temporary vaults RW.

2. DEVELOPMENT OF UNIFIED CATEGORISATION OF RADIOACTIVE WASTE AND DISPOSAL SITES

2.1. Development of unified categorization of radioactive wastes.

Radioactive wastes RW classifications accepted in Belarus, Russia and Ukraine has been made and native acting normative rules has been analyzed. Almost any of these documents have been accepted in the Soviet Union (previous to 1991) and stay on acting in Belarus, Russia and Ukraine. The "Sanitary regulations to radioactive waste management (SRRWM-85)" is a base national normative document at present. This and other documents determine only criteria and radioactivity levels for waste reckoning with radioactive waste. National RW classifications have not developed in Belarus, Russia and Ukraine.

Consequently, as a backbone the following principles is underlying the RW and storage categorization in Belarus, Russia and Ukraine.

- Categorization of the RW must be as best as possible adequate to normative documents, acting in Belarus, Russia and Ukraine.
- At the categorization must be used general approach to the RW classification recommended by IAEA.
- RW categorization must reflect common singularity of the RW of Chernobyl origin taken into account specific features localised RW in each of three countries.

- The categorization must be unelaborated enough and ensure a practical possibility of identification the RW by available data.
- The storage categorizations must reflect specific features of storages the RW of Chernobyl origin.
- At the categorization must be used most essential storage features in aspect of RW multibarrier isolation concept.
- Categorization must be unsophisticated enough and ensure mating all storages of Belarus, Russia and Ukraine within a system of chosen features.

There are the RW classifications at departmental and requesting documents. Practically in USSR has been accepted departmental classification, according to which RW are divided into three categories. These are wastes of low, average and high activity level, according to the dose rate of γ-emitting, specific β-activity and specific α-activity. At present such classification is used for all radioactive wastes in Russia and Ukraine. It has been underlay for Chornobyl RW categorization in the Ukraine classification on RW of Chornobyl origin is accepted in Belarus also. RW are divided into three categories in dependence on ^{137}Cs content, which is a main radionuclide of waste within Belarus. According to new document, published in Belarus, devoted to the minimum level of specific activity of ^{137}Cs we have to take into account the minimum level like 0.96×10^3 Bq/kg.

The comparative analysis of Belarussian, Russian and Ukrainian RW classifications allows making a conclusion: Categorization criteria (^{137}Cs specific activity and waste specific α-activity) may be used for the benchmarking to unified RW.

As a rule the specific activity of RW localized in Belarus and Russia does not reach levels, which qualify the waste as radioactive according to acting national normative documents. Specific activity of majority of RW localized in the Ukraine does not reach these levels also. In spite of this partners from Belarus, Russia and Ukraine are of the same mind of unified categorization all localized RW of Chornobyl origin, since waste of lowest activity levels have the greater amounts and are not isolated at localization sites.

According to stated above, RW are categorized by two criteria: ^{137}Cs specific activity level $A(^{137}Cs)_S$ and α-activity $A(\alpha)_S$. At last working meeting on project attended by representatives of all five countries it was decided for borders of categories to take round $A(^{137}Cs)_S$ and $A((\alpha)_S$ values closest to γ- and α-activity borders of classification had been used in USSR. For borders of RW of lowest activity have been took the round border ^{137}Cs specific activity amenably Belarussian classification on Chornobyl RW.

Thereby, the border levels of RW categorization are:

$A(^{137}Cs)_S = 1.10^3, 1.10^4, 1.10^5, 1.10^7$, (Bq/kg);
$A((\alpha)_S = 4.10^2, 7.10^3, 4.10^5$, (Bq/kg).

Accordingly RW are divided into following categories (Table l, Fig. 3).

Table 1
Categorization on RW of Chornobyl origin

Category of RW	Specific activity of ^{137}Cs $A(^{137}Cs)_S$, Bq/kg	Specific α-activity $A(\alpha)_S$, Bq/kg
I. Conventionally radioactive waste	$1\cdot10^3<A(^{137}Cs)_S\leq1\cdot10^4$	$A(\alpha)_S\leq4\cdot10^2$
I-A	$1\cdot10^3<A(^{137}Cs)_S\leq1\cdot10^4$	$A(\alpha)_S>4\cdot10^2$
I-B		
II. RW of very low activity level	$1\cdot10^4<A(^{137}Cs)_S\leq1\cdot10^5$	$A(\alpha)_S\leq4\cdot10^2$
II-A	$1\cdot10^4<A(^{137}Cs)_S\leq1\cdot10^5$	$A(\alpha)_S>4\cdot10^2$
II-B		
III. RW of low activity level	$1\cdot10^5<A(^{137}Cs)_S\leq1\cdot10^7$	$A(\alpha)_S\leq4\cdot10^2$
III-A	$1\cdot10^5<A(^{137}Cs)_S\leq1\cdot10^7$	$4\cdot10^2<A(\alpha)_S\leq7\cdot10^3$
III-B	$1\cdot10^5<A(^{137}Cs)_S\leq1\cdot10^7$	$A(\alpha)_S>7\cdot10^3$
III-C		
IV. RW of medium activity level	$A(^{137}Cs)_S>1\cdot10^7$	$A(\alpha)_S\leq7\cdot10^3$
IV-A	$A(^{137}Cs)_S>1\cdot10^7$	$7\cdot10^3<A(\alpha)_S\leq4\cdot10^5$
IV-B	$A(^{137}Cs)_S>1\cdot10^7$	$A(\alpha)_S>4\cdot10^5$
IV-C		

2.2. Categorization on disposal sites and benchmarking the unified categorization on disposal sites.

The "storage" term within the framework of this subproject is applied to all sites of concentration the RW, which in official RW inventory documents in the Ukraine are referred to as "RW Disposal Storage" (Interim storage in this subproject), or "Temporary RW Disposal Storage" (herein referred to as dumps).

The following principles are underlying the storage categorization.

- The Categorization must reflect most essential storage features in aspect of RAW multi-barrier isolation concept.
- The Categorization must reflect specific storage features of the RAW of Chornobyl origin.
- Categorization must be unsophisticated enough and ensure mating of all storages within a system of chosen features.

The results of the comparative analysis of features of the disposal sites allow stating following:

1. Designed disposal sites of RW exist in the Ukraine and Belarus (point for the burying of deactivating site - PBDW-I, PBDW-II). There are disposal sites constructively alike ISRW «Buriakovka». However these disposal sites do not answer national and international rules of RW maintenance.
2. Russian points of temporary RW localization (DRW) and Belarussian PBDW-III are alike Ukrainian DRW in manner of RW localization. But Russian DRW and Belarussian PBDW-III present scattered instances of RW localization places, while Ukrainian DRWs are the territories of concentrating the ensemble of RW localization places.

For the benchmarking the unified categorization on disposal sites are used criteria chosen for categorization on Ukrainian disposal sites, considering singularities of Belarussian and Russian disposal sites:

- Presence (or absence) of most main elements of design figuring barriers - a basement, a wall;
- Presence (or absence) of isolation with intimation on its material;
- Mode of RW placement into disposal sites and presence of RW containerized package.

Categorization on disposal sites of localized RW is represented in Table 2.

Table 2.
Categorisation on disposal sites of localized RW

Category	Type of disposal site	Basement and wall. Material	Isolation. Material	RW placement mode and package	Representative of the category
A	Surface	Basement and wall. Concrete, reinforced concrete	Isolation is only covering. Concrete, clay	Capacities of reinforced concrete. Neither packaged nor non-packaged.	«Podlesny» ISRW
B	Near-surface; of trench type.	Basement and walls. Concrete, reinforced concrete	Isolation is covering and littering. Clay	Neither packaged nor non-packaged.	«3-rd queue of ChNPP» ISRW, PBDW-I (Belarus)
C	Near -surface; of trench type.	Are absent	Isolation is covering and littering. Clay	Non-packaged	«Buriakovka» ISRW, PBDW-II (Belarus)
D	Near -surface; of trench type.	Are absent	Isolation is only covering. Soil.	Non-packaged	Elementary objects of DRW (Ukraine), PBDW-III (Belarus), DRW (Belarus, Russia)
E	Near -surface; of clamp type.	Are absent	Isolation is only covering. Soil.	Non-packaged	Elementary objects of DRW (Ukraine), PBDW-III (Belarus), DRW (Russia)
F	Compact group of storage sites of D- and E-category	Are absent	Isolation is only covering. Soil.	Non-packaged	Part of DRW territories (Ukraine)

The degrees of probable vault environmental influence are estimated on the base of RW and vault categorizations. Five RW categories were marked out either using developed principles and criteria or considering a correlation between a ^{137}Cs specific activity and specific alpha-activities. At the development of a general Ukrainian, Russian and Belarussian Chornobyl vaults categorization were considered them specific features.

3. THE STRUCTURE OF DATABASE ON CHORNOBYL WASTE DISPOSAL SITES

The first stage of work was devoted to the creation of database structure as the basis for which is used elaborated identificator including information on Ukrainian, Belarussian and Russian standard vaults and on housed RW (Fig.4).

Main identificator points are:

- Information on object site.
- Information on facility creating and operating.
- Hydrogeological features.
- Contamination of surface inside of storage.
- Information on technical features of object.
- Information on regime actions and on surveillance.
- Information on waste.

The database structure is developing in accordance with accepted identificator of information.

The structure has been chosen at the stage of database conceptual computerized design, which describes the information of RW disposal and characteristics most completely. Mentioned above structure represents a number of interconnected tables carrying both dynamic and statistic information. For example, table SECTOR represents list of dumps with unique code. Table SUBSECT shows list of the location sectors. Each site from SECTORS table serves several sectors. Table GENDATA represents the detailed information of each storage - term of storage erecting, features of artificial barriers, hydro-isolation of a storage bottom, thickness of a storage deck, total waste volume, total waste mass etc. Table HYDRDATA shows information about ground water level - minimal and ultimate, dominant type of soil in the aeration zone. Table COORD represents coordinates of storage center with X-, Y-accuracy to seconds. Table ACTDATA illustrates the contribution of each radionuclides to the total activity. Table DOSEDATA includes average and ultimate dose rate for the height of 1 m from the surface in Sv/sec unit. Table MEASURES can be a textual field including a description of actions on a storage preservation, accomplishment, safety.

Preliminary structure scheme of database is represented in Fig.4.

CONCLUSIONS

1. The problem of ensuring the safety of localized radioactive waste in Ukraine, Russia and Belarus was described and shown that on the various reasons, organizing and economic, these temporary dumps haven't got a sufficient protection of surrounding pollution and some of them are a serious danger. There is no exact data on most of the trenches sites, the RW volumes and amounts .
2. The united categorization of radioactive wastes and storages was created. United RW categorization as well as united storage categorization are designed on the basis of principles and criteria developed by Ukrainian specialists in RW management. As a result, all storages and RW localised within are identified by their belonging to the certain category. At the end of the second year of reseach the typical storages, presenting different categories of storages and RW will be selected. These storages will typify for father estimation the probable danger of storages of different categories.

3. Identificator which includes information about storage and waste in Ukraine, Belarus and Russia was elaborated. This identificator is the ground for database structure. The database structure is stipulated first of all by fullness and feasibility of putting together (comparing to

4. each other) the information on the RW localized in Belarus, Russia and Ukraine. Preliminary analysis of data presented by the partners allows to conclude that information available in Belarus, Russia and Ukraine partly are not comparable and not sufficient for filling all the items of the identificator. So, the next step of our work will be the modifying the identificator of RW and storages in dependence on feasibility of getting comparable data on Belarus, Russia and Ukrainian RW.

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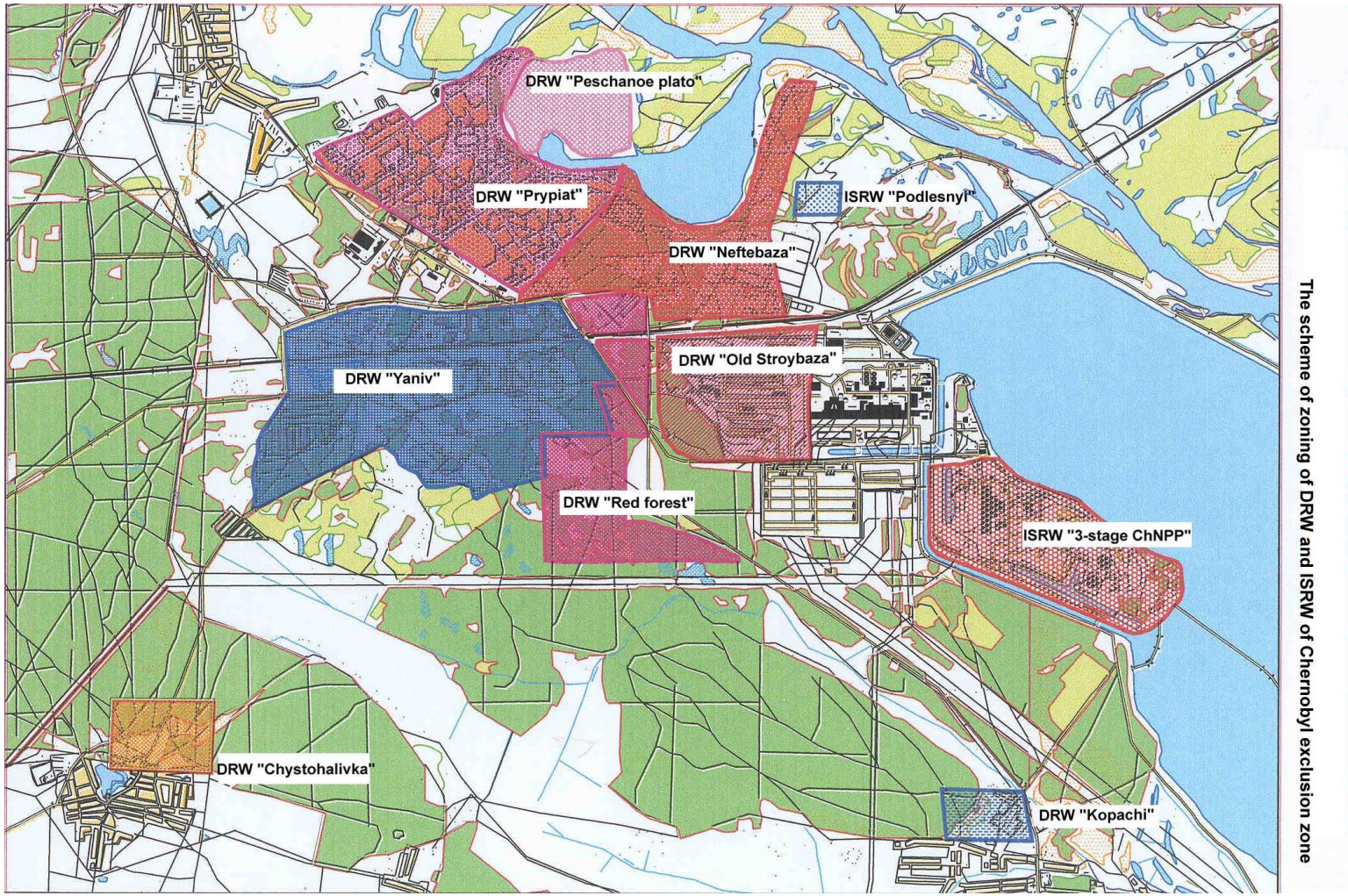

Fig. 1. The scheme of DRW and ISRW of Chernobyl exclusion zone

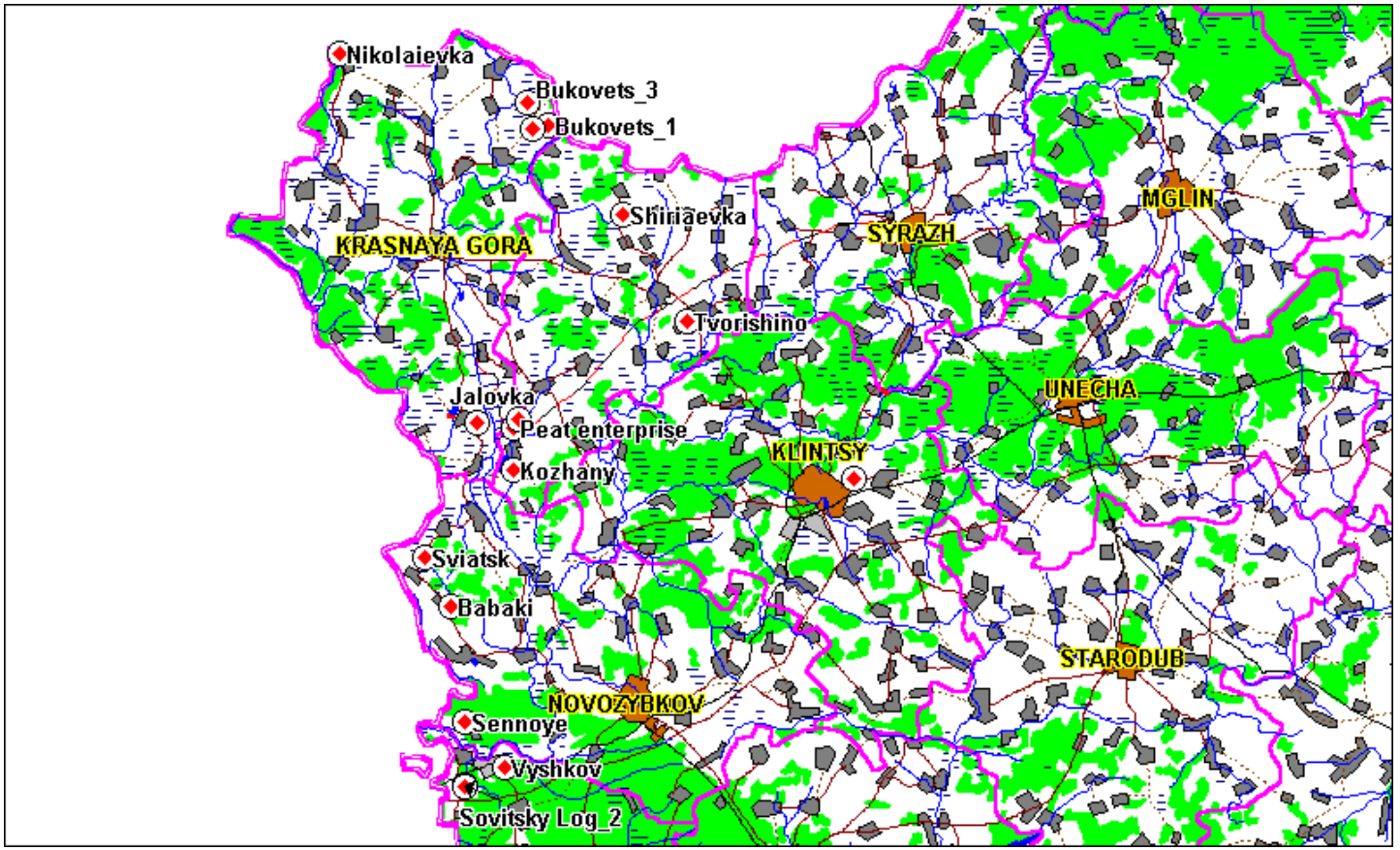

Fig. 2. Location of radioactive waste repositories in Bryansk region revealed during in-the-field investigations in May 1999

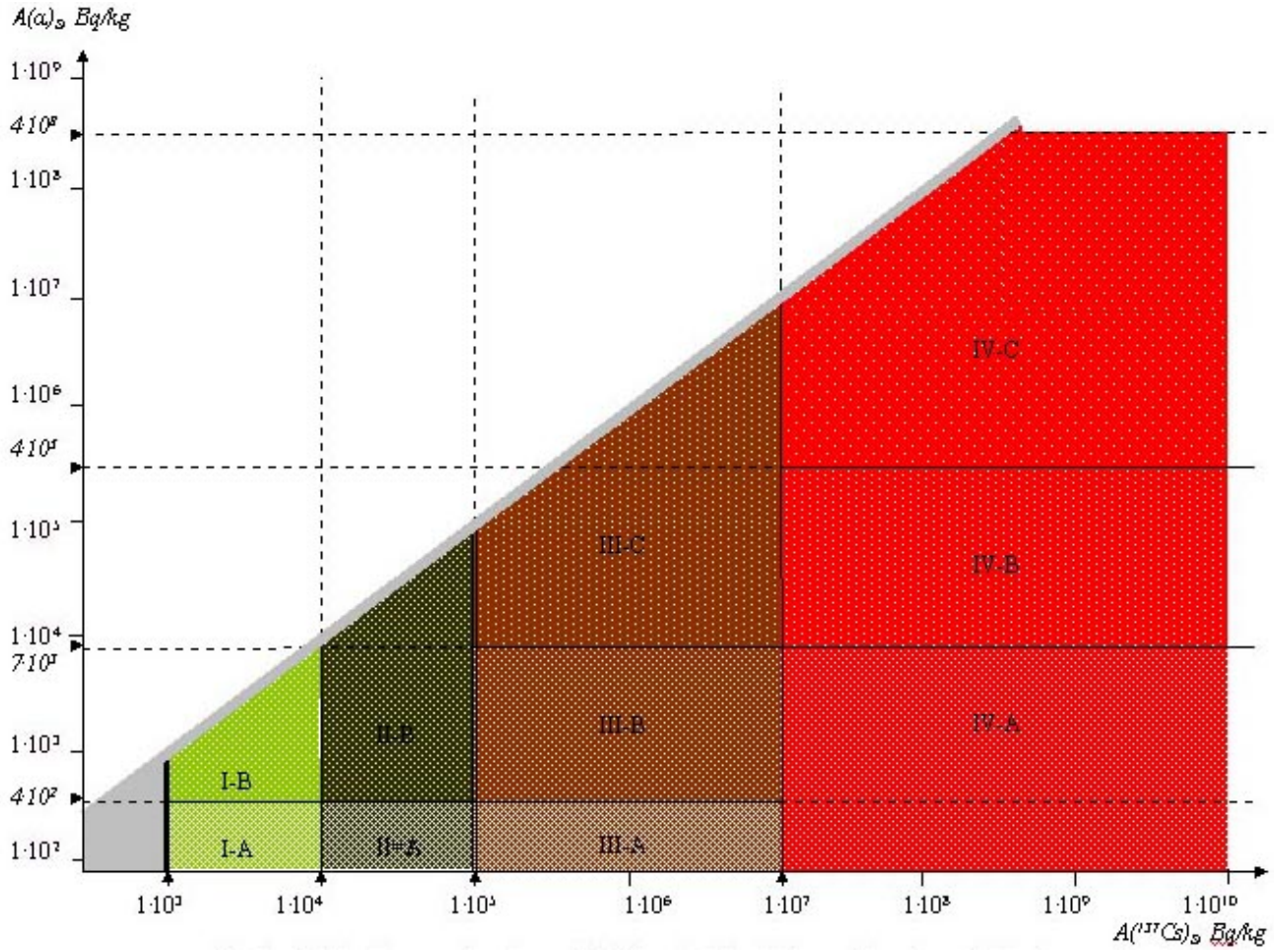

Fig. 3. Unified Categorisation on RW localised in Belarus, Russia and Ukraine.

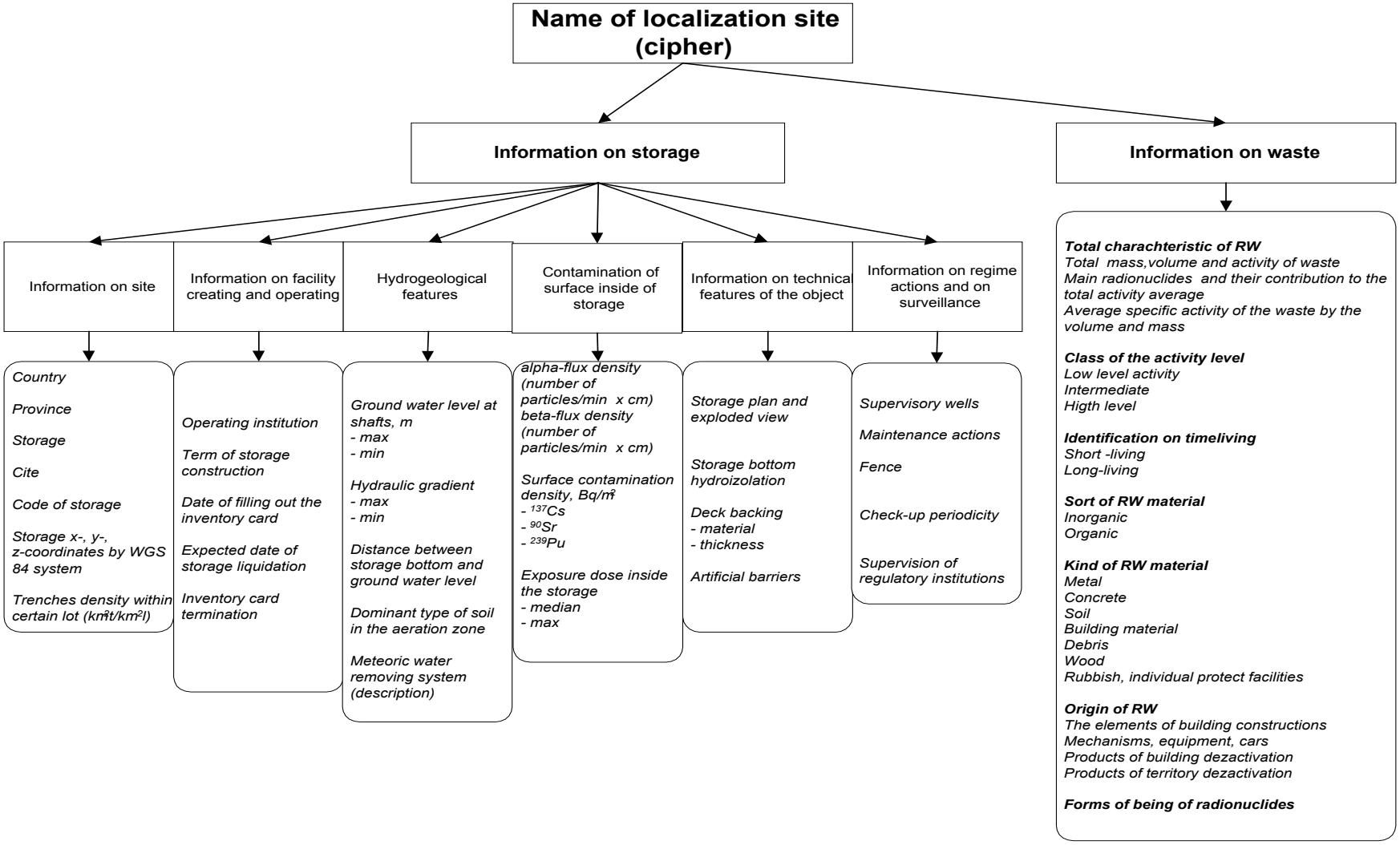

Fig. 4.Identificator of main information of RW and storages for Ukraine, Belarus and Russia.

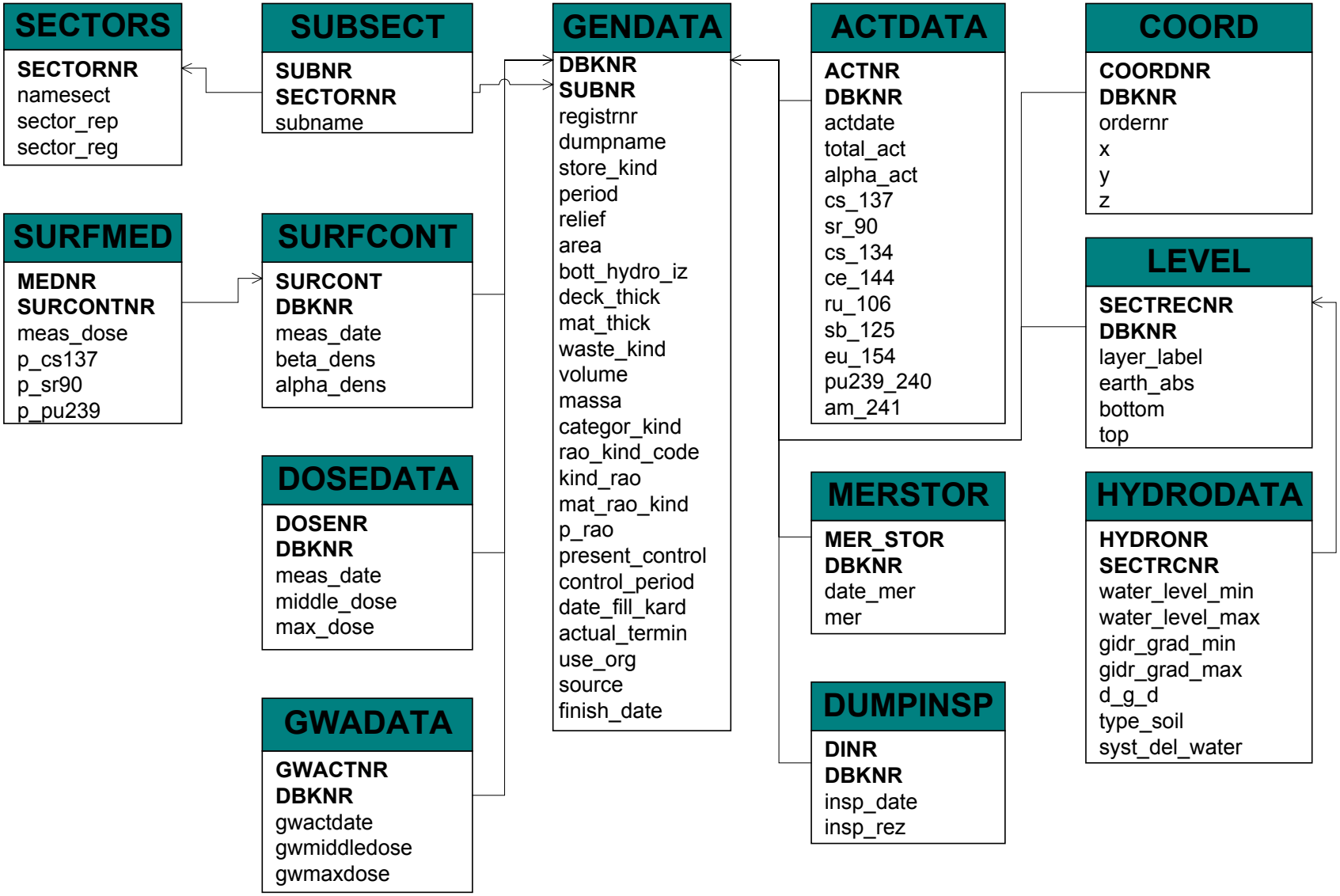

Fig. 5. Preliminary structure of database.