ENVIRONMENTAL MONITORING AND RADIATION PROTECTION PROGRAMS OF NOVI HAN RADIOACTIVE WASTE REPOSITORY

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GENERAL

The system for monitoring and control as an important part of the safety management of the Novi Han Radioactive Waste Repository contains two independent programs:

1. Environmental monitoring of the site (controlled area), the restricted access area and the surveillance area (supervised area) of the repository;

2. Radiation protection program including personal dosimetric control and indoor dosimetric control of workplaces in the buildings of the repository.

The primary aims of the monitoring program are:

1. To estimate the impact of the facility on the environment.
2. To provide data and information to estimate the population exposure.
3. To estimate of consequences of incidents.
4. To provide information to demonstrate the safe working of the repository.

The monitoring program is carried out since 1964 (since the Novi Han Radioactive Waste Repository is put in operation) accordingly the legal rules at the same time and their amendments. incl. after 1994, when the operations at the site have been temporally suspended by the regulatory authority, the Committee for Use of Atomic Energy for Peaceful Purpose (CUAEPP).

The last amendment of the monitoring program is made accordingly the nowadays requirements during the implementation of IAEA Technical Cooperation Program "Increasing safety of Novi Han Radioactive Waste Repository", Task 4. "Development of system for environmental monitoring and control" (Model Project BUL/4/005).

The development of the monitoring system is closely related with the safety analysis, the geological and hydrogeological survey and the environmental risk assessment of the Novi Han Radioactive Waste Repository. The environmental hazard consist in release of stored radioactive waste (possible failure of the radioactive waste storage system and propagation of released radioactivity via surface and underground water). Though contamination of the terrain can also occur in result of technological operations, this would affect only the territory of the repository.

The monitoring has got three basic subjects:

1. the territory of the repository (Fig.1.) – the monitoring aims to detect possible radioactive contamination of the site;

2. the restricted access area (RAA, Fig.2.) with radius 1 km around the center of the Novi Han Radioactive Waste Repository - the monitoring aims to detect possible radioactive contamination outside the territory of the RAWR;

3. the supervised area (SA, Fig.2.) with radius 5 km around the center of the Novi Han Radioactive Waste Repository - the monitoring aims to estimate the possible impact of the RAWR on the living conditions of the population in the SA.

THE ENVIRONMENTAL MONITORING PROGRAM

1. Specification of the types of samples, the sampling points, the sampling schedule, methods of sampling (Table 1.)

1.1. Types of samples: surface and underground water, soil, sediment, vegetation, food, aerosols, fallout. The samples are taken from 24 marked sampling points in all three areas (the site, RAA, SA)

1.1.1. Water samples (three times per year):

- Underground water from three control boreholes, located on the Novi Han Radioactive Waste Repository site near the vaults for solid radioactive waste in the direction of the predominant flow of shallow underground waters (No. 1, 20 m of depth, and No.2, 15 m of depth) and one located on RAA.
- Surface water in the region – running water, lakes, permanent and seasonal springs, rain water, drinking, household and irrigation water.

1.1.2. Soil samples (once per year): from 5-10 cm of depth (dug from surface layer) and area 40x40 cm.

1.1.3. Vegetation samples (grass and tree leaves) from the same location as the soil samples and according to the same schedule.

1.1.4. Food samples (once per year, seasonal) from the SA.

1.1.5. Aerosol samples and fallout from the Novi Han Radioactive Waste Repository site

1.1.6. The dose rate is measured by means of thermoluminescent dosimeters

(TLD) in all sampling points three times per year

1.1.7. A pedestrian dosimetric map on the site of the Novi Han Radioactive Waste Repository is made twice per year (29 marked measuring points); the distance between every two measuring points is not more than 10m. The schedule of all the activities with radioactive wastes are traced. The pedestrian dosimetric map is made for the RAA as well. The total number of points is 44 (Fig.1).

1.2. Methods of sampling are selected to provide maximal adequacy to the estimation of the impact of the facility on the environment.

2. Sample preparation, types of analyses and sample storage.

2.1. Sample preparation – depends on the analytical method applied (in generally: volume reduction, homogenization and preservation measures)

2.2. Types of analyses

- gamma-spectrometry (for Co-60 and Cs-137)
- determination of gross alpha and gross beta activity
- determination of H-3 and C-14 in water samples

The determining of H-3 is performed by applying liquid scintillation spectrometry directly, or by electrolytic reduction of the sample volume (LLD $\approx$ 2.5 $Bq.l^{-1}$ for acidic electrolysis and $\approx$ 0.25 $Bq.l^{-1}$ for alkaline, both for 100 minutes counting time)

- direct measurement of the dose rate with TLD ($CaSO_4$:Dy), developed in the Institute for Nuclear Research and Nuclear Energy, Bulgarian Academy of Sciences (Standard IEC 1066; $LLD \approx 2\ \mu Sv$)
- direct measurement of the dose rate by portable surveillance monitors
- in situ gamma-spectroscopy
- determination of Sr-90 and Pu-239

In case of detection of gross alpha and/or gross beta activity which differs from the background values and cannot by explained by the gamma spectrometric analysis, specific analytical techniques for the determination of radionuclides of the main radiological risk and contained in the storage inventory (like Sr-90, Pu isotopes) are applied.

2.3 Storage of small amount of the measured samples as archive material :up to 10 years, as FIFO (First In, First Out) in line

3. Storage, analysis, classification and reporting of the results: a data base project is developed for storage, analysis and statistic estimation of the results

- description of the sampling points by code (identifier), location, sector and name
- description of the samples collected by type, quantity, sampling date and point, name of the operator making the sampling
- the sample preparation procedures (general and for different analyses) and the analytical methodologies are presented in the different records
- the results of the performed analyses, the dates of the analyses, uncertainties and limit of detection of different radionuclides for every measurement are put in the final report

The data base makes possible to sort by chosen in advance feature all the kept in information for the time of caring out monitoring from all control points and to make statistical estimations of the stored data.

4. Quality control system of the monitoring program

4.1. measurements of duplicated samples (about 5% of all samples) in independent laboratories;

4.2. control in the laboratory itself, which is of higher priority and importance

- strict keeping of all procedures carried out in the laboratories;
- regular periodical calibrations;
- use of certified standards;
- participation in national and international interlaboratory comparisons

The environmental monitoring system of the Novi Han Radioactive Waste Repository is amended till now. A procedure of the European Commission, Directorate-General Environment, 'Nuclear Safety, Regulation and Radioactive Waste Management' Unit is opened for a project "Assessment and Upgrading of the Novi Han Monitoring System" (ref.: ENV.C.2/SER/2000/0006).

The project shall cover the following tasks:

- Validation of the radiological situation and measuring practice;
- Development of a comprehensive environmental surveillance program;
- Creation of a special measurements handbook
- Creation of a special radiological database
- Development of a Quality Assurance (QA) system
- Study of emission monitoring

The monitoring system is to take into account all the requirements imposed by possible future operation of the repository. The end result should be an upgraded system in line with modern accepted practice and in compliance with current and future legislation, both at the national as well as at the European Union level.

RADIATION PROTECTION PROGRAM

1. PREFACE

The program for radiation protection is a system of organizational and a technical means which provides the safety of the personnel occupied in the exploitation of the Radioactive Waste Repository, the inhabitants living in the surveillance area and the environment.

The radiation protection of the Novi Han Radioactive Waste Repository is carried out by the Department "Nuclear Safety and Radiation Protection" according to the following schedule:

* arrangement and accomplishment of the environmental monitoring;

* analysis of the results of the radiation control;

* prescription of recommendations and implementation of measures for ensuring of the radiation protection and the safety of technological processes and the environment. Giving a final form to reports or recommendations;

* complying with the requirements of the legal basis (acts, rules and regulations) in the field of the atomic energy in Republic of Bulgaria.

The next documents concerning radiation protection are valid nowadays in the Novi Han Radioactive Waste Repository:

⇒ rules for the internal order;

⇒ emergency plan;

⇒ rules and instructions for radiation control

⇒ radiation control methodologies

⇒ radiation safety instructions

The radiation control consists of the next parts:

◊ Radiation control of the technological processes and laboratory research

◊ Radiation control of the environment

◊ Personal dosimetric control

2. RADIATION CONTROL ON THE TECHNOLOGICAL PROCESSES

The radiation control on the technological processes and the laboratory research is carried out accordingly the radiation and dosimetric control program consisting of radiation control of the workplaces (measurement of dose rate indoor), outdoor in the control points of the site, different elements of the technical equipment, the density of flux of the alpha- and beta- particles, contamination of work surfaces, floors, walls and equipment. This kind of control is carried out in the radiochemical laboratories I and II classes during and after each experimental work with radioactive sources. The total number of controlling points for the technological processes is 68.

Control measurements are carried out during and after each disposal of radioactive wastes in the vaults and on the site of the Novi Han Radioactive Waste Repository. Indoor radiation control is performed at last once a week in the places where the personnel works constantly and if the dosimetrist on duty judges it is needed.

The Novi Han Radioactive Waste Repository must be equipped with air-control device for control aerosols and gases. Till nowadays that kind of control was not carried out because of lack of suitable equipment.

During each transport of radioactive wastes to the Novi Han Radioactive Waste Repository with the specialized vehicle the dose rate is measured and must not exceed 28 μSv/h in the driver's cabin and 2 μSv/h on the outer surfaces of the vehicle. The specialized vehicle enters and leaves the site of the Novi Han Radioactive Waste Repository through a radiation control arch. The arch is provided by stationary beta-gamma spectrometer supplied by passive lead shielding and suitable interface.

3. PERSONAL DOSIMETRIC CONTROL

The personal dosimetric control is an important part of the whole radiation protection program which is performed assessing the work conditions of the personnel exposed at ionizing radiation.

The schedule, the scope and methodology of the personal dosimetric control is approved by the administration of the Institute for Nuclear Research and Nuclear Energy and comply with the requirements of the legal rules for radiation control in Republic of Bulgaria.

The personal dosimetric control depends on the type of the work and assesses the external exposure each quarter.

The worker is supplied with the digital dosimeter besides the thermoluminescent detector (TLD) when the risk of exposure is higher (in particularly in case of incident) in order to controlling the time of exposure in the dangerous zone and the information for the received doses can be saved as well.

All the sources of ionizing radiation during the working hours in the work place are taken into account when the professional exposure is assessed (the only exception is the natural background typical in this region).

The analyses of the data accumulated during the personal dosimetric control till now shows undoubtedly professional dose addition that not exceed more than 30 % of the mean natural dose.

The data and results of personal TLD are kept in the archive of the radiation and dosimetric control, part of the whole document system in the Novi Han Radioactive Waste Repository.

4. ASSESSMENT OF THE PRESENT CONDITION OF THE RADIATION SAFETY IN THE NOVI HAN RADIOACTIVE WASTE REPOSITORY

Accordingly the radiation and dosimetric control program the Department of Nuclear Safety and Radiation Protection must fix levels of the radiation parameters in specialized internal rules and instructions depending on the type of the work with ionizing radiation .

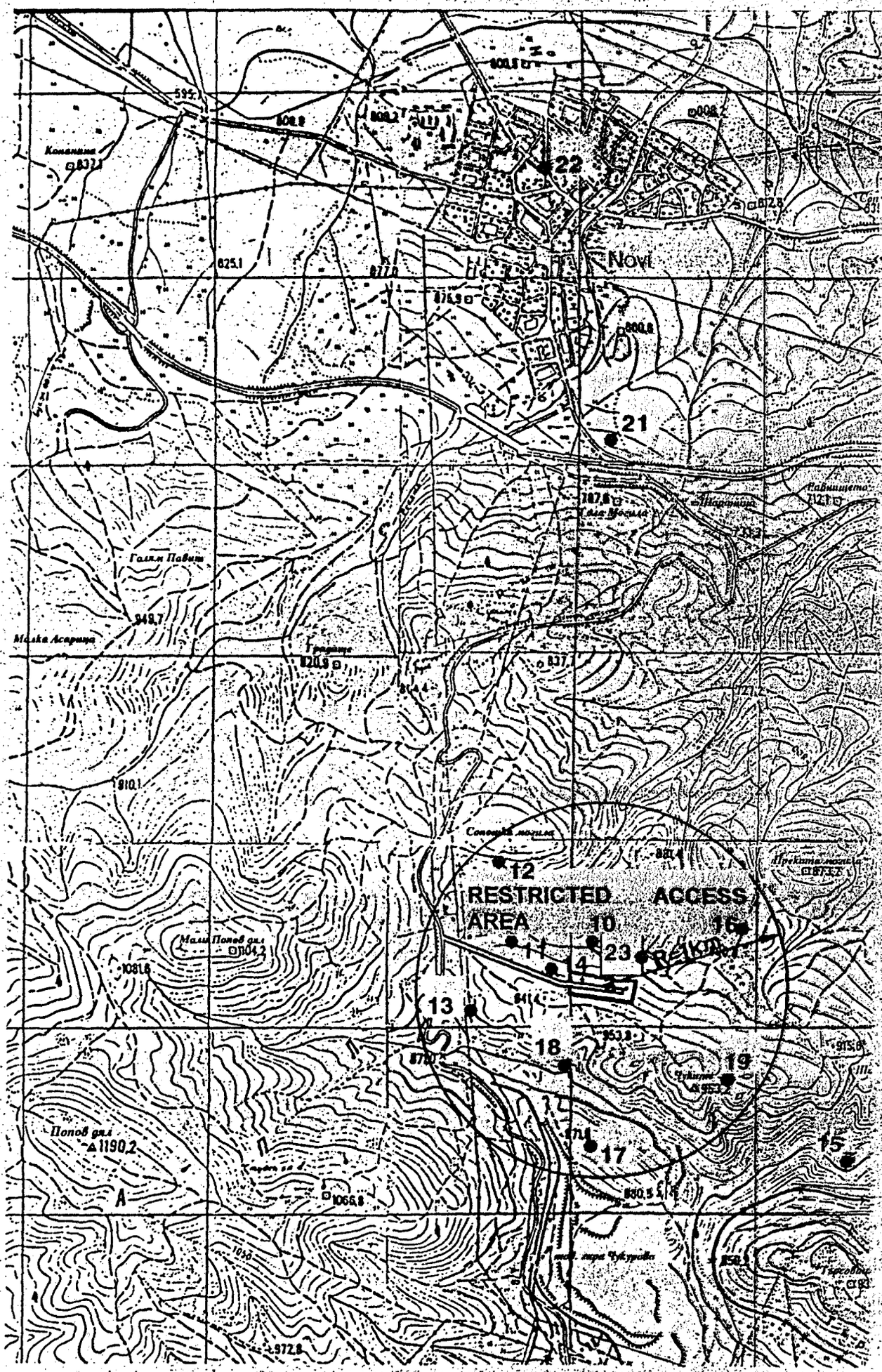
The radiation safety condition is presented in detail reports monthly, quarterly and yearly by the departments involved in the radiation protection activities of the Novi Han Radioactive Waste Repository and the Institute for Nuclear Research and Nuclear Energy. The report of the radiation safety condition must include:

- the technological processes and the research work which use sources of ionizing radiation;
- the site, the restricted access area and the surveillance area condition as a result of the Novi Han Radioactive Waste Repository activity;
- the personal dose of the workers received during management of radioactive wastes and sources.

Table 1. Monitoring programme of Novi Han Repository

Type of sample		Sampling point, No.	Annual schedule	Measurement type	Laboratory engaged in sample preparation and analysis in INRNE
Water	From control boreholes (CB), permanent and seasonal springs, lakes, rivers, drinking and household, irrigation	3., 7., 10., 12., 13., 14., 15., 16., 18., 23, 24.	3	gross alpha gross beta gamma spectrometry counting of ^{3}H and ^{14}C	Department of Radioanalytical Methods and Laboratory for Radiation Dosimetry Department of Radioecology Department of Radioecology
Soil and sediments	From all sampling points From springs, rivers and lakes	1 - 24	1	gross beta gamma spectrometry	Department of Radioanalytical Methods and Laboratory for Radiation Dosimetry Department of Radioecology
Vegetation	From all sampling points	1 - 24	1	gross beta gamma spectrometry	Department of Radioanalytical Methods and Laboratory for Radiation Dosimetry Department of Radioecology
Environmental dosimetry	From all sampling points	1 - 24	3	termoluminescent dosimetry	Laboratory for Radiation Dosimetry
Food - meat, milk, bee honey, vegetables, fruits, corps, forage	Produced in the supervised area - villages of Novi Khan and Gabra	22.,24.	1	gross beta gamma spectrometry	Department of Radioanalytical Methods and Laboratory for Radiation Dosimetry Department of Radioecology
Aerosols	From conventionaly clean and conventionaly contaminated area	1, 5	1	gross beta gross alpha gamma-spectrometry	Department of Radioanalytical Methods and Laboratory for Radiation Dosimetry Department of Radioecology
Fallout	On the site	1	each precipitation	gross beta gross alpha gamma-spectrometry	Department of Radioanalytical Methods and Laboratory for Radiation Dosimetry Department of Radioecology

Plan of Radioactive Waste Repository and Restricted Access Area, Novi Khan, Bulgaria



Novi Han Repository Dose Control System