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Radiation Protection

TECHNICAL REPORT

VERIFICATIONS UNDER THE TERMS OF ARTICLE 35 OF THE EURATOM TREATY

URANIUM SITES

Environmental Radioactivity and Discharge Monitoring

BULGARIA

11 to 15 July 2011

Reference: BG-11/04

VERIFICATIONS UNDER THE TERMS OF ARTICLE 35
OF THE EURATOM TREATY

FACILITIES:	Uranium mining and milling sites: Provisions for monitoring and controlling of radioactive discharges and for the surveillance of the environmental radioactivity in the vicinity of the sites.
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REFERENCE:	BG-11/04
VERIFICATION TEAM:	Mr C. GITZINGER (Head of team) Mr E. HENRICH Mr. E. HRNECEK
DATE OF REPORT:	2011-12-16
SIGNATURES:	

[signed]	*[signed]*	*[signed]*
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1 ABBREVIATIONS

ALARA	As Low As Reasonably Achievable
ASUNE	Act on the Safe Use of Nuclear Energy
BDS	Bulgarian State Standard
BULRAMO	Bulgarian Radiation Monitoring network
CMD	Council of Minister's Decree
DG ENER	Directorate General for Energy (of EC)
DG JRC – IES	Directorate General Joint Research Centre – Institute for Environment and Sustainability (of EC)
DGNSCP-MES	Directorate General "National service for civil protection" (of MES)
DG TREN	(former) Directorate General for Energy and Transport (of EC)
EC	European Commission
EEA	Executive Environment Agency
EIA	Environmental Impact Assessment
EMD	Environmental Monitoring Directorate (of MOEW)
EURDEP	EUropean Radiological Data Exchange Platform
FRPIR	Facility for Regeneration Purification of Ion-Exchange Resins
HEAP	Hydro Ecological expertise, Assessment and Prognosis
HEF	Hydroecological Examinations and Forecasts
HPGe	High Purity Germanium (gamma radiation detector device)
IAEA	International Atomic Energy Agency
ICRP	International Commission on Radiological Protection
IRMM	Institute for Reference Materials and Measurements (of EC DG JRC)
ISL	In Situ Leaching
ISPUCMW	Installation for Sorption Purification of Uranium Contaminated Mine Waters
LAAD	Laboratory and Analytical Activities Directorate (of MOEW-EEA)
LRRR	Laboratory for Radioecology and Radioisotope Research (of MAF)
MAF	Ministry of Agriculture and Food
MEET	Ministry of Economy, Energy and Tourism
MES	Ministry of Emergency Situations
MF	Ministry of Finance
MH	Ministry of Health
MOEW	Ministry Of Environment and Water
MP	Monitoring Point
NCRRP	National Center of Radiology and Radiation Protection
NPP	Nuclear Power Plant
NRA	Nuclear Regulatory Agency
NSEM	National System of Environmental Monitoring (of MOEW-EEA)
OJ	Official Journal

PEML	Public Exposure Monitoring Laboratory (of the NCRRP of MH)
RCD	Radiation Control Departments (of RIPHPCs)
REF	Radioecological Examinations and Forecasts
REAP	Radio Ecologic expertise, Assessment and Prognosis
RIEW	Regional Inspectorate of Environment and Water
RIPHPC	Regional Inspectorates for Public Health Protection and Control
RLEW	Regional Laboratories for the Environment and Waters (of MOEW)
RM	Radio ecologic Monitoring
SERAW	State Enterprise Radioactive Waste
SFSF	Spent Fuel Storage Facility at Kozloduy
SG	State Gazette
SHC	State Health Control
SIR	Sources of Ionizing Radiation
TBR	Technical and Biological Remediation
WHO	World Health Organization

2 INTRODUCTION

Article 35 of the Euratom Treaty requires that each Member State establish the facilities necessary to carry out continuous monitoring of the levels of radioactivity in air, water and soil and to ensure compliance with the Basic Safety Standards ([1]).

Article 35 also gives the European Commission (EC) the right of access to such facilities in order that it may verify their operation and efficiency.

For the EC, the Directorate-General for Energy (DG ENER), and in particular its Radiation Protection Unit (ENER D4), is responsible for undertaking these verifications.

The main purpose of verifications performed under Article 35 of the Euratom Treaty is to provide an independent assessment of the adequacy of monitoring facilities for:

- Liquid and airborne discharges of radioactivity into the environment by a site (and control thereof).
- Levels of environmental radioactivity at the site perimeter and in the marine (if applicable), terrestrial and aquatic environment around the site, for all relevant pathways.
- Levels of environmental radioactivity on the territory of the Member State.

From 11 to 15 July 2011, a verification team from DG ENER visited different (uranium) mining sites in central and in south-eastern Bulgaria. The aim of the verification was to check the operation and efficiency of the facilities and associated analytical laboratories for continuous monitoring of the level of radioactivity in air, water and soil in the vicinity of these sites on the territory of Bulgaria. The verification scope also covered on-site facilities monitoring liquid and aerial discharges of radioactivity into the environment. To some extent, the national system for the monitoring of environmental radioactivity in the area visited was covered as well.

During the verification activities addressing the monitoring of radioactive discharges from different mining and milling sites and the corresponding environmental radioactivity monitoring, the EC team was accompanied by representatives of the Ministry of Economy and Energy.

The visit included meetings with representatives of various national authorities having competence in the field of radiation protection. An opening meeting and a closing meeting were held, with all parties involved during the visit, in the premises of the Ministry of Economy, Energy and Tourism at Sofia.

The present report contains the results of the verification team's review of relevant aspects of discharge control and radiological environmental surveillance put in place by the competent Bulgarian authorities on and around the verified uranium mining and milling sites.

[1] Council Directive 96/29/Euratom of 13 May 1996 laying down basic safety standards for the protection of the health of workers and the general public against the dangers arising from ionizing radiation (OJ L-159 of 29/06/1996, page 1).

3 PREPARATION AND EXECUTION OF THE VERIFICATION

3.1 PREAMBLE

The Commission's decision to request the execution of an Article 35 verification was notified to the Bulgarian Permanent Representation to the European Union by letter ENER/D4/CG/cn Ares(2011) 82039, dated 31 January 2011.

Subsequently, practical arrangements for the implementation of the verification were made with the Bulgarian competent authorities, which provided preliminary information on the Bulgarian legislation and its implementation with respect to radiation protection for (former) uranium mining and milling sites.

The Bulgarian Ministry of Economy, Energy and Tourism, together with the Bulgarian Permanent Representation to the European Union, efficiently acted as co-ordinators and thus ensured not only that the verification programme could be fully implemented, but also that all ministries and other actors involved in matters of radiation protection relevant to the mission were present and available during the week of the visit.

3.2 PROGRAMME OF THE VISIT

A preliminary programme of verification activities under the terms of Art.35 of the Euratom Treaty was discussed and agreed upon with the Bulgarian competent authorities.

The programme encompassed:

The verification of liquid and gaseous radioactive discharge control and of the environmental radioactivity monitoring programmes as carried out for the visited uranium mining and milling sites (sampling and monitoring systems, analytical methods, quality assurance, bookkeeping, reporting).

At the locations visited the verification addressed technical aspects of monitoring and sampling activities, analytical methods used, quality assurance, data handling, archiving and reporting.

The verifications were carried out in accordance with the programme, an overview of which is attached as Appendix 1 to this report.

3.2.1 Documentation

In order to facilitate the work of the verification team, a package of information was supplied in advance by the Bulgarian authorities in response to questions from the Commission. Additional documentation was provided during and after the visit. All documentation received is listed in Appendix 2 as well as the web sites used. The verification team notes the comprehensiveness of the documentation provided.

The information thus provided has been extensively used for drawing up the descriptive sections of the report.

3.3 REPRESENTATIVES OF THE COMPETENT AUTHORITIES AND THE SITE-OPERATORS

During the verification visit, the following representatives of the national authorities and the site-operators were met:

Ministry of Economy, Energy and Tourism (MEET):

- Petar Petrov – state expert, Restructuration and liquidation unit
- Julia Makedoncheva

Ministry of Health (MH):

- Res.Ass. Viktor Badulin – NCRRP deputy director
- Res.Ass. Kremena Ivanova – Head of Inspectorate for the Control of Nuclear Facilities within NCRRP

Ministry of Agriculture and Food Supply (MAF):

- Dr. Jordanka Hristozova – Agriculture Academy
- Assoc. Prof. Dr. Ivanka Yordanova – N. Pushkarov Soil Science Institute

Nuclear Regulatory Agency (NRA):

- Nikola Todorov
- Vladislav Dimitrov

Ministry of Environment and Waters – Environmental Executive Agency (MOEW-EEA):

- Mihail Shishenkov – head of Radiological Measurements Laboratory unit, Directorate General Laboratory and Analytical Activities, EEA
- Hristina Halatchliyska – head of Ionizing radiations unit, Environmental Monitoring directorate, EEA

Ecoengineering RM **Ltd.:**

- Ditchko Dikov – specialist monitoring activities
- Angel Angelov

The verification team also had the possibility for discussions with staff of the Rossen site, the Environmental Executive Agency (Regional Laboratories Burgas and Plovdiv) and the Mt. Rozhan station.

4 LEGISLATION AND COMPETENT AUTHORITIES

4.1 LEGAL BASIS

4.1.1 List of legislative acts regulating the environmental monitoring

1. Environmental Protection Act (*SG 91/25.09.2002*)
2. Water Act (*SG 67/27.07.1999*)
3. Act on the protection of agricultural lands (*SG 35/24.04.1996)*
4. Council of Ministers' Decree (CMD) № 74/27.03.1998 on the liquidation of the consequences from the extraction and processing of uranium raw materials (*SG 39/07.04.1998 amm. No. 48/2000 г. and No. 78/2005).*
5. Regulation № 1 on the limit values for the purposes of radiation protection and safety during liquidation of the consequences of the uranium industry in the Republic of Bulgaria (*SG No. 101/23.11.1999)*
6. Regulation on the conditions and the procedure for carrying out environmental impact assessment of investment proposals for construction, activities and technologies. (*SG 25/18.03.2003, amm. SG, No.3/10.01.2006)*
7. Regulation № 6 on the limit values for admissible contents of dangerous and harmful substances in the waste water discharged in the water bodies (*SG 97/28.11 2000)*
8. Regulation № 9 on the quality of water intended for human consumption (*SG* 30/28.03.2001)
9. Regulation № 12 on the quality requirements to surface waters intended for human consumption (*SG 63/28.06.2002*)
10. Regulation № 7 on the indicators and limits for the quality assessment of surface waters (*SG 96/12.12.1986*)
11. Regulation № 1 on the exploration, use and protection of groundwater (*SG 87/30.10.2007*)
12. Regulation № 18 on the quality of water for irrigation of agriculture crops (*SG 43/09.06.2009*)

13. Regulation № 25 on the requirements for the protection of persons from chronic exposure resulting from the production, trade and use of raw materials, products and goods with increased content of radionuclides (*SG 64/05.08.2005*)

4.1.1.1 List of legislative acts establishing the responsibilities of the authorities in this matter

1. Act on the safe use of nuclear energy (*SG 63/28.06.2002*)
2. Health Act (*SG 70/10.08.2005*)
3. Energy Act (*SG 107/09.12.2003*)
4. Measurements Act (*SG 46/07.05.2002*)
5. Regulation on basic norms for radiation protection (*SG 73/20.08.2004*)
6. Regulation for radiation protection during activities with sources of ionizing radiation (*SG 74/24.08.2004*)
7. Regulation No.32 on the conditions and the procedure for carrying out individual dose control of persons working with sources of ionizing radiations (*SG 91/07.11.2005*)
8. Regulation on emergency planning and emergency preparedness in case of nuclear and radiological emergencies (*SG 71/13.08.2004*)
9. Regulation No.29 of 16 September 2005 on the health norms and requirements in case of work in ionizing radiation environment (*SG 78/30.09.2005*)
10. Regulation No. 28 of 9 September 2005 on the conditions and procedures for registration, handling and storage of data, contained in the register of the persons who work or have been working in an ionizing radiations environment (*SG 76/20.09.2005*)
11. CMD № 85/17.04.2007, on the organization and coordination of the European Union issues (*SG 35/27.04.2007*)
12. Regulation № 28 on the conditions and procedures for medical insurance and on individual's health protection norms in case of a radiation accident (*SG 84/2006*)

The control of the radionuclide content in non-animal origin products is defined by Order No. РД 09-744/22.10.2003 of the Minister of Agriculture and Foods.

4.1.2 International legislation and guidelines, on which the environmental monitoring is based

1. Fundamental Safety Principles, IAEA Safety Standards Series No. SF-1
2. Environmental and Source Monitoring for Purposes of Radiation Protection Safety Guide, IAEA Safety Standards Series No. RS-G-1.8
3. Regulatory Control of Radioactive Discharges to the Environment Safety Guide, IAEA Safety Standards Series No. WS-G-2.3
4. International Basic Safety Standards for protection against ionizing radiation and for the safety of radiation sources, IAEA Safety Series No SS 115
5. Council Directive 96/29/Euratom of 13 May 1996 laying down basic safety standards for the protection of the health of workers and the general public against the dangers arising from ionizing radiation (OJ L 159, 29.06.1996)
6. IAEA Safety Reports Series No. 33: Radiation Protection against Radon in Workplaces other than mines, Int. Atomic Energy Agency, 2003.
7. IAEA Safety Standards, Safety Guide No. RS-G-1.8: Environmental and Source Monitoring for Purposes of Rad. Protection, 2005.
8. ICRP Recommendation 60: Annals of the ICRP, 1991.
9. ICRP 2007 Recommendation, approved version, March 2007.
10. World Health Organization: Indoor Air Quality: A Risk-Based Approach to the Health Criteria for Radon Indoors, WHO, 1993. different publications and recommendations of the German Radiation Protection Commission SSK (in particular Publication No. 47) and of the German Federal Office for Radiological Protection
11. ICRP Publication 101: Assessing dose of the representative person for the purpose of radiation protection of the public and the optimisation of radiological protection,

12. ICRP Publication 78: Individual monitoring for the Internal Exposure of Workers, 1998.
13. ICRP Publication 74: Conversion coefficients for use in radiation protection against external radiation, 1997
14. ICRP CD1: Database of dose coefficients: workers and members of the public, 2002.
15. ICRP Publication 68: Dose Coefficients for the Intake of Radionuclides by Workers, 1995.
16. ICRP Publication 72: Age-Dependent Doses to the Members of the Public from Intake of Radionuclides – Compilation of Ingestion and Inhalation Coefficients, 1996.
17. ICRP Publication 66: Human Respiratory Tract Model for Radiological Protection, 1994.
18. The 2007 Recommendations of the International Commission on Radiological Protection (ICRP Publication 103)

4.2 COMPETENT AUTHORITIES

A scheme of the ministries and bodies having competence in radiation protection and environmental radiation monitoring, according to the Council of Ministers' Decree CMD № 74 of 1998 is presented in Appendix 3.

4.2.1 Nuclear Regulatory Agency (NRA)

4.2.1.1 Introduction

Nuclear energy and ionizing radiation are used in the Republic of Bulgaria in compliance with the requirements and principles of nuclear safety and radiation protection for the purpose of securing the protection of human life, health and standards of living of the present and future generations, the environment and material consequences from the harmful impact of ionizing radiation. Nuclear energy and nuclear materials are used only for peaceful purposes in accordance with the Act on the safe use of nuclear energy (ASUNE) and the international treaties which have been ratified pursuant to the promulgated constitutional order, and have entered into force for the Republic of Bulgaria.

According to the law on the safe use of nuclear energy, for the use of nuclear energy and ionizing radiation and for the management of radioactive waste and spent fuel:

- Nuclear safety and radiation protection have priority over all the other aspects of this activity;
- The irradiation of the personnel and population with ionizing radiation is maintained at as low as reasonably achievable level (ALARA).

According to Art. 4 of the law on the safe use of nuclear energy, the application of the state regulation on the safe use of nuclear energy and ionizing radiation, as well as the safe management of radioactive waste and spent fuel, is within the responsibilities of the Chairman of the Nuclear Regulatory Agency. He has the status of an independent specialised body of the executive power and his competence is determined by the above mentioned law. Pursuant to Art. 13 of the law on the safe use of nuclear energy, the Ministers of Health, Environment and Waters, Interior, Defence, Agriculture and Food Supply, Transport and Communications and Education and Science, exercise a specialized control in accordance with the powers conferred on them by this law.

4.2.1.2 Organisational structure of the Nuclear Regulatory Agency (see also Appendix 4)

The Chairman of the Nuclear Regulatory Agency (NRA) is assisted by an administration which is structured in the form of an Agency. The structure, activities, organization of work and the number of personnel of this Agency are determined in the Statutes of the NRA. These Statutes are proposed by the Chairman of the NRA, approved by the Council of Ministers and published on the NRA website.

Directorates which carryout licensing and inspection activities are:

- General Department of Safety Regulation of Nuclear Facilities;
- Department of Safety Analyses, Assessment and Research and Development;
- Department of Radiation Protection and Emergency Preparedness.

The Department of Radiation Protection and Emergency Preparedness (staff – 22 persons) assists the Chairman of the Agency in performing his regulatory and control functions related to the sources of ionizing radiation and to the radioactive waste management at facilities using sources of ionizing radiation, including radioactive waste transports to the State Enterprise Radioactive Waste (SERAW) facilities. Besides this, the Directorate assists the Chairman in performing his crisis management functions in case of emergencies at nuclear facilities or at facilities using sources of ionizing radiation.

The following bodies are established within the NRA and function under the direct control of the Chairman:

- Nuclear Safety Advisory Council;
- Radiation Protection Advisory Council.

These Advisory Councils assist the Chairman's activities in giving opinions on nuclear safety and radiation protection scientific issues. Leading scientists and experts in the field of nuclear energy and ionizing radiation are members of these councils. The membership and the Rules of the Advisory Councils' work are determined by the NRA Chairman.

4.2.1.3 Licensing and permission activities of the Nuclear Regulatory Agency

The activities related to the use of sources of ionizing radiation have to be based on licenses or permits for their safe implementation, issued by the Chairman of the NRA. Such permits may cover among others the construction of facilities with sources of ionising radiation; decommissioning; temporary storage of radioactive substances; transport of radioactive substances and import and export of sources of ionising radiation. Issuing of licences covers among other the use of radioactive substances and other sources of ionising radiation for economic, medical or scientific purposes; the manufacture of sources of ionising radiation and the handling of such sources.

4.2.1.4 Inspection activities of the Nuclear Regulatory Agency

The Act on the Safe Use of Nuclear Energy (ASUNE) entrusts the NRA Chairman to implement the control of nuclear safety and radiation protection in the use of nuclear energy and ionizing radiation and in the management of radioactive waste and spent fuel.

This control may consist of:

1. Preventive control – which is implemented during the process of issuing licenses, permits or qualification certificates;
2. Current control on the implementation of the conditions set in the issued licenses, permits or qualification certificates;
3. Follow-up control on the implementation of the recommendations and the prescriptions, given by the controlling authorities.

The NRA Chairman, in implementation of his controlling functions, through duly empowered administrative officers from the NRA (controlling inspectors) may:

- carry out periodic and extraordinary verifications (inspections);
- notify other bodies for specialized control of the measures to be taken related to their competence;
- notify the prosecutor authorities in case of available data relative to a crime;
- amend or repeal a permit, license or qualification certificate issued;
- impose enforcing measures and administrative acts, foreseen in the law on the safe use of nuclear energy.

The NRA Chairman is entitled to require from legal or physical bodies information on their activities, the necessary documents related to the implementation of the control, and – if needed – to require co-operation from the respective control authorities.

The common aim of the regulatory inspections and the implementation of enforcing measures is to ensure the implementation of all activities of the license holder in a safe manner and in compliance with the requirements, norms and rules on nuclear safety and radiation protection. For the implementation of this goal, the activities of regulatory control are included in the annual plan of the NRA.

4.2.2 Ministry of Environment and Waters (MOEW)

4.2.2.1 Introduction

The Ministry of Environment and Water (MOEW) is the principal actor responsible for the monitoring of the environment in Bulgaria.

The state policy for environmental protection is under the responsibility of the Minister of Environment and Waters. This Minister, in coordination with the Minister of Health, the Minister of Regional Development and Public Works, the Minister of Transport, the Minister of Agriculture and Food and the other interested Ministers and heads of state agencies, develops a National Strategy on Environment and submits it for approval by the Council of Ministers. According to the law on environmental protection, state policy is integrated into the transport, energy, building works, agriculture, tourism, industry, education etc policies.

4.2.2.2 Organisational structure

The organisational structure of the Ministry of Environment and Waters is shown in Appendix 5.

In the structure of the Ministry of Environment and Waters are included:

- Environmental Executive Agency (EEA)
- Regional Inspection of Environment and Water (RIEW)
- Basin directorates;
- National parks directorates;

The Executive Environment Agency (EEA) and the Regional Laboratories for the Environment and Waters (RLEW) are entrusted with the operational responsibility for the monitoring of environmental radioactivity on behalf of MOEW. In total there are fifteen Regional Laboratories for the Environment and Waters, seven of which carry out radiological monitoring (Burgas, Varna, Vratsa, Montana, Pleven, Plovdiv, and Stara Zagora).

The Environmental Executive Agency (EEA) has two relevant directorates: the "Environmental Monitoring Directorate" (EMD) and the "Laboratory and Analytical Activities Directorate" (LAAD).

EMD operates the automated online national gamma dose rate monitoring and early warning network comprising 26 measurement stations known as BULRAMO (Bulgarian Radiation Monitoring network). The BULRAMO network was not part of this verification. The continuous measurements from the BULRAMO network are available, online and in real time to concerned national authorities and to the Kozloduy NPP. They are also downloaded once a day to the European Commission's (public) EURDEP internet site.

The following bodies are established by the Minister of Environment and Waters:

- Higher expert ecology council;
- Advisory councils on the policy for the management of the environmental components.

4.2.2.3 Responsibilities and functions of the Ministry of Environment and Waters

The Minister of Environment and Waters:

- Monitors the state of the environment on the territory of the country;

- Issues orders, permits, instructions and endorses methods;
- Manages the National system of environmental monitoring (NSEM) through the Environmental Executive Agency;
- Issues jointly with the interested executive bodies standards for maximum permissible emissions, for maximum permissible concentrations of harmful substances in environmental media and pathways and for rational use of renewable and non-renewable natural resources, endorses methods for Environmental Impact Assessment (EIA);
- Prepares the annual report on the state of the environment to the Council of Ministers as well as reports on the implementation of the legislative acts of the EU acquis to the European Commission.

4.2.2.3.1 Environmental Executive Agency (EEA) within the Ministry of Environment and Waters

The Environmental Executive Agency (EEA) is an administration which reports to the Minister of Environment and Waters, performing management, coordination and information functions as regards the control and protection of the environment in Bulgaria.

It is also a National reference centre for the European Environment Agency.

The Agency is managed by an Executive director and includes three directorates:

- "Environmental Monitoring Directorate" (EMD);
- "Laboratory and analytical activities Directorate" (LAAD);
- "Administrative and legal servicing, financial and economic affairs and ownership management Directorate".

The Agency is entrusted with the guidance of the National System of Environmental Monitoring (NSEM). The "Environmental Monitoring Directorate" (EMD) administers NSEM.

The National System of Environmental Monitoring includes the national monitoring networks for:

- the air in the atmosphere;
- rainfall and surface waters;
- underground and sea waters;
- the geological medium, lands and soils;
- the forests, protected territories and biological diversity;
- depots and old waste contaminations;
- radiological monitoring;
- non-ionizing radiation and noise "pollution" in the environment.

For the purpose of the information procurement of NSEM, a national automated system for environmental monitoring was created, which is organized at national, regional and basin level and which is maintained by the Environmental Executive Agency.

The Laboratory and Analytical Activities Directorate (LAAD) coordinates a laboratory-based national environmental monitoring system consisting of eight laboratories (the central laboratory at Sofia and seven regional laboratories). The LAAD environmental radioactivity monitoring programme is developed within the Environmental Executive Agency and approved by the MOEW. The results of laboratory measurements (reported on a quarterly basis) are centralised in a database run by the EEA's Ionising and Non-ionising Radiation Section. Chiefly, the monitored media are:

- radionuclides in the atmosphere;
- natural and anthropogenic radionuclides in soils, sediments, wastes;
- total alpha- and beta- activity of surface, ground and waste waters;
- Cs-137 and H-3 activity of surface, ground and waste waters;
- radon at (uranium) mining sites.

The MOEW is, in conjunction with the Ministry of Health, responsible for the implementation of Commission Recommendation 2000/473/Euratom on the application of Article 36 of the Euratom Treaty ([2]).

The tasks of the National System of Environmental Monitoring are:

- defining the state of the environment by carrying out a monitoring of the available national networks;
- providing information for operational control;
- processing, analysing, visualisation and storage of the information from the national networks and from EEA's own monitoring;
- forecasting the state, assessing the risk for the environment and development of proposals for improvement;
- creation and maintenance of specialized maps and registers of the environment components and the factors influencing them;
- information procurement of the executive bodies and the public;
- exchange of information on the state of the environment with the European monitoring system.

4.2.2.3.2 Regional Inspectorates of Environment and Waters (RIEW) within the Ministry of Environment and Waters

The Regional Inspectorates of Environment and Waters, the Basin directorates and the National parks directorates ensure the pursuance of the state policy on environmental protection at regional level.

The RIEW directors, the directors of National parks and the directors of the Basin directorates draw up precautionary and ascertainment protocols, issue instructions, orders for implementation of compulsory administrative measures and penal decrees.

The number, territorial scope of activity, functions and structure of RIEW, the powers of their directors and the activity of the National parks directorates and the Basin directorates are determined with rules issued by the Minister of Environment and Waters.

Expert ecology councils are established by RIEW and the Environmental Executive Agency. The functions, tasks, composition, and rules of procedure are determined by the Minister of Environment and Waters.

In case of an emergency or any other type of pollution, when the emission limits for the polluting substance into the environment established by a legislative or administrative act are broken, the persons which committed the infringement and the persons responsible for respecting the limits are obliged to immediately inform the respective district governors, municipality mayors, RIEWs, the Basin directorates and the bodies of the Ministry of Emergency Situations, and in case of a change in the radiation situation, the Nuclear regulatory agency.

The competent authorities are obliged to immediately inform the Ministry of Health and the population concerned about the pollution and to propose measures for the protection of human health and property.

[2] Commission Recommendation 2000/473/Euratom of 8 June 2000 on the application of Article 36 of the Euratom Treaty concerning the monitoring of the levels of radioactivity in the environment for the purpose of assessing the exposure of the population as a whole (OJ L-191 of 27.07.2000).

4.2.3 Ministry of Health (MH)

4.2.3.1 Introduction

The Minister of Health manages the national system of health services and carries out control over the activities concerning citizens' health protection and the State Health Control, thus ensuring a sustainable development of health services in the medical and health institutions as well as in medical specialists' reports.

The state policy for public health protection is carried out by the MH. For the organisational structure of the Ministry of Health see Appendix 6.

The Ministry of Health is, in conjunction with the Ministry of Environment and Water, responsible for the implementation of Commission Recommendation 2000/473/EURATOM on the application of Article 36 of the Euratom Treaty. Both the Ministry of Health and the Ministry of Agriculture and Food share responsibilities in the implementation of Council Regulation (EC) No 733/2008 and associated EU legislation governing the import of agricultural products from third countries into the Community.

4.2.3.2 Responsibilities and functions of the Ministry of Health

The Minister of Health discharges its operational responsibilities in radiation protection through the:

- National Center of Radiobiology and Radiation Protection (NCRRP), in particular through its Public Exposure Monitoring Laboratory (PEML) and its Inspectorate for the Control of Nuclear Facilities;
- Regional Inspectorates for the Protection and Control of Public Health (RIPCPH), in particular the Radiation Control Departments (RCD) in five out of 28 RIPCPHs (at *Burgas*, *Plovdiv*, *Ruse*, *Varna* and *Vratsa*).The five regional inspectorates with a radiation control department are in charge of:
    - their respective regional environmental monitoring programmes;
    - regional control of all practices involving sources of ionising radiation.

The State Health Control (SHC) for the protection of persons from the impact of ionizing radiation is carried out systematically by the NCRRP and the RIPHPCs, both nominated by the Minister of Health. This control is performed without prior notification, and with set purpose – in case of warnings received from citizens, state and municipality bodies and organizations, and also in case of the availability of other data about what occurred.

Managing authorities (State Health Control bodies) within the Ministry of Health system which are competent in the field of radiation protection and exercising medical and radiation control are:

- The Chief state health inspector;
- Public Health Directorate;
- National Center of Radiobiology and Radiation Protection (NCRRP);
- Regional Inspections for Public Health Protection and Control (RIPHPC) determined by the Minister of Health.

During the implementation of the State Health Control (SHC) the state health inspectors have the following rights:

- free access to the facilities, products, goods, activities and persons, subject to control;
- to require information and documents and to obtain copies of them on paper or electronic medium;
- to take samples and specimens for laboratory analyses in quantities necessary to carry out testing;
- to order examinations and tests for the assessment of the health status of persons;
- to prescribe suspension from work of persons, who are sick or contagious and represent a danger for the health of the surrounding persons;

- to prescribe implementation of obligatory hygienic and anti-epidemic measures, determining the terms for their implementation;
- to put certifying marks in the respective cases;
- to draw up statements in case of establishment of administrative infringements;
- to draw up proposals for the enforcement of administrative measures, foreseen in the law.

The state bodies, carrying out the monitoring of the radiation parameters of the living environment periodically submit data to the Minister of Health, necessary for the assessment of the health risk.

Both the NCRRP and the RIPCPH are also part of the national radiological emergency response structure.

4.2.3.2.1 National Center of Radiobiology and Radiation Protection (NCRRP) within the Ministry of Health

The National Center of Radiobiology and Radiation Protection (NCRRP), located at Sofia, carries out the state health and radiation control in nuclear facilities of national importance and on sites of the former uranium mining industry in the whole country, as well as of facilities with sources of ionizing radiation on the territory of Sofia and the districts of Sofia, Pernik, Kyustendil and Blagoevgrad.

Furthermore the Public Exposure Monitoring Laboratory (PEML), as reference lab, is in charge of performing quality assurance assistance and controls in the five regional inspectorates that operate a radiation control department (and hence perform radiological assays and measurements).

The National Center of Radiobiology and Radiation Protection (NCRRP) functions as:

- Specialized body of the Ministry of Health regarding its policy for prevention and/or decrease of unfavourable impacts of the sources of ionizing radiation on the health of the population;
- Control body for the compliance with the requirements for the protection of persons from ionizing radiation; in nuclear power plants, research nuclear installations, radioactive waste management facilities and other facilities with sources of ionizing radiation; the radiation factors of the living environment – water, food and goods relevant to the population health;
- Expert body regarding: assessment of the exposure and of the radiation risk for the population and of the occupationally exposed persons; procurement of protection for the patient in case of medical exposure; assessment of the health status of the persons, who are or have been working in an ionizing radiation environment or who have been exposed during a radiation emergency.

The National Center of Radiobiology and Radiation Protection (NCRRP) is structured in specialized units, in compliance with the main activities in the field of radiobiology, radiation protection, radiation control, medical radiological protection and training and information activities.

National responsibilities within the Centre are allocated to the following teams:

1. Laboratory of the *Inspectorate for the Control of Nuclear Facilities*;
2. Laboratory *Control of irradiated food*;
3. Laboratory *Quality control of radiological equipment*;
4. Laboratory *Metrology of ionizing radiations*;
5. Inspection body 'type A', based on the state accreditation by the Executive agency “Bulgarian accreditation service”;
6. Information and training unit.

The Section for Radiation Control of the NCRRP through the laboratory of the *Inspectorate for the Control of Nuclear Facilities* and the *Public Exposure Monitoring* laboratory organizes the radiological monitoring of the living environment for the purposes of assessing the population exposure as a whole or of groups of it, through:

- Monitoring of the population exposure from natural and increased radiation background and assessment of the radiation risk;

- Analysis of the radioactive substances' content in environmental samples, mainly the artificial and enhanced content of natural radionuclides;
- Control of the content of radioactive substances in consumer goods, relevant for population health (drinking water, food, building materials);
- Monitoring of the radiation gamma-background in Sofia (continuous high-precision measurement of the ambient equivalent dose rate on the territory of the NCRRP).

The laboratories are part of the Inspection body 'type A', accredited by the Executive agency "Bulgarian accreditation service"in compliance with BDS EN ISO/IEC 17020:2005.

The laboratory of the *Inspectorate for the Control of Nuclear Facilities* carries out the radiological control of the working environment in facilities, which have obtained an operation license for a nuclear facility by the Nuclear Regulatory Agency, and of the living environment in the vicinity of facilities of the former uranium mining and uranium processing industry in Bulgaria.

The State Health Control (SHC) of the living environment in the vicinity of the facilities of the former uranium mining and uranium processing industry keeps track of the qualitative remediation of the environment in these facilities and of the exposure of the population.

4.2.3.2.2 Regional Inspectorates for Public Health Protection and Control

The Regional Inspectorates for Public Health Protection and Control (RIPHPCs) within the Ministry of Health carry out and organize the implementation of the state health policy on the territory of the respective districts. With the aim to protect the health of the citizens on the territory of the Republic of Bulgaria, State Health Control is carried out for the observance and implementation of the established health requirements in legislative acts concerning facilities for public use, products, goods and activities relevant to human health and the living environment.

The structure and activity of the RIPHPCs are defined by rules issued by the Minister of Health.

The RIPHPCs nominated by the Minister of Health for carrying out state health and radiation control on the territory of the country are:

- RIPHPC Plovdiv covering the districts of Plovdiv, Pazardzhik, Smolyan, Haskovo, Stara Zagora and Kardzhali;
- RIPHPC Ruse covering the districts of Ruse, Targovishte, Veliko Tarnovo, Gabrovo, Silistra and Razgrad;
- RIPHPC Varna covering the districts of Varna, Shumen and Dobritch;
- RIPHPC Burgas covering the districts of Burgas, Yambol and Sliven;
- RIPHPC Vratsa covering the districts of Vratsa, Vidin, Montana, Lovetch and Pleven.

The bodies of the State Health Control (SHC) participate at the expert councils on the territorial arrangement, agree, when needed on the arrangement schemes and plans, participate in the assessment of compliance of investment projects, in commissions on commissioning of buildings, according to the Law on the territorial arrangement and in commissioning of facilities with sources of ionizing radiation, according to the Act on the Safe Use of Nuclear Energy (ASUNE).

The Regional Inspectorates for Public Health Protection and Control establish and maintain a public register of the "facilities for public use", including the facilities with sources of ionizing radiation (SIR) in the country. In case of non-observance of the health requirements in facilities for public use or in case of carrying out activities relevant for the health of the population (including facilities and activities with sources of ionizing radiation), the bodies of the State Health Control may order the cessation of the operation of a given facility or of parts of it, and may also suspend the respective activity until the removal of the infringements.

RIPHPC carries out its activities in continuous relationship and interaction, at regional level, with the other control bodies on the territory of the district.

4.2.4 Ministry of Agriculture and Food (MAF)

4.2.4.1 Introduction

The state policy in areas of agriculture, rural regions, forestry, hunting, fishery and aquaculture is implemented by the Minister of Agriculture and Food (MAF). The organisational structure of the MAF can be found in Appendix 7.

4.2.4.2 Responsibilities and functions of the Ministry of Agriculture and Food

The Minister of Agriculture and Food manages and controls veterinary and medical supervision of the breeding of animals, of the reprocessing, import and export of foodstuffs and raw materials of animal origin, of fodder, as well as the introduction of veterinary and medical products. He develops and updates the Ministry's strategy in the field of food safety and prepares programmes for its realization, coordinates and controls the activities of the supervisory bodies to the Ministry on the implementation of the strategy and the programme. He coordinates the Ministry's activity with the Ministry of Health and other institutions involved in food safety.

The Minister, through the *N. Pushkarov* Soil Sciences Institute controls the implementation of the requirements of the Rural Lands Act, soil control and the remediation of the affected and contaminated terrains.

The state control of agricultural production, including it's radionuclide content, is carried out by the bodies acting under the Laws on foods, health, and veterinary medical activity.

The radiological analysis of the samples is performed by two laboratories, carrying out distinct environmental radioactivity monitoring programmes:

- The Laboratory on Radioecology and Radioisotope Research (LRRR) at *N. Pushkarov* Soil Science Institute, which carries out the monitoring of foods of non-animal origin, and
- The Central Laboratory for Veterinary and Sanitary Investigation and Ecology (CLVSIE) of the National Veterinary and Medical Service, which carries out the monitoring of foods of animal origin.

The laboratories are accredited as testing laboratories by the "Bulgarian Accreditation Service" Executive Agency, according to Bulgarian norm BDS EN ISO/IEC 17025.

All measurement results are registered in testing protocols, on the basis of which the state control authorities issue a certificate for the suitability of the production (or trade) in the concerned foods. In case these measuring results point to noncompliance with the regulation №10/2002 requirements for the radionuclide content in foods, or with the temporary limits established by the Minister of Health, the Ministry of Health has to be notified. In case of an infringement, the foodstuffs are withdrawn from the trade network by the state control authorities and are either destroyed or re -exported to their country of origin, at the expense of the last owner.

The Ministry of Agriculture and Food through its Laboratory of Radioecology and Radioisotope Research (LRRR), carries out the monitoring of soils and sediments, according to the Bulgarian State Standard (BDS 17.4.5.01). The sampling is carried out through an established monitoring network for North and South Bulgaria.

4.2.5 Ministry of Emergency Situations (MES)

4.2.5.1 Introduction

The aim that the Ministry of Emergency Situations is pursuing is the establishment of an efficient and effective technically guaranteed and materially integrated system for prevention, training, response and recovery in case of disasters and accidents, which shall correspond to the actual needs of the Bulgarian citizens in such cases.

This aim is to be achieved through development, maintenance and efficient use of resources for prevention, monitoring, timely and adequate response and overcoming of the consequences from crises and other significant negative impacts on the national economy and particularly the critical infrastructure.

4.2.5.2 Responsibilities and functions of the Ministry of Emergency Situations

The main objectives and principles of the state policy for the protection of the population and national economy are:

- Establishment of a single system for protection of the population and the national economy in case of crises;
- Operation of the National emergency telephone system (phone number 112);
- Establishment of a single system for monitoring, early warning, notification and crisis management;
- Prioritized development of programmes and measures for prevention with the purpose of making studies, analyses, forecasts and assessments of the risk factors and dangers for the population, environment and national economy, as well as development of scientifically based solution proposals for raising the degree of their protection and security;
- Allocation of duties for the implementation of the protection measures;
- Prevention of increased risks for the population and the national economy.

The district governors and the mayors bear responsibility for crisis management.

4.2.5.3 Directorate General "National Service for Civil Protection" within the Ministry of Emergency Situations

The Directorate General "National Service for Civil Protection" (DGNSCP) is a specialized administration within the MES with 28 territorial units.

The territorial units of DGNSCP-directorates are established at the administrative centres of the districts, composing the territory of the Republic of Bulgaria.

Within DGNSCP a crisis management centre is established, which is connected with the ministries, institutions, district administrations and the *Emergency and Rescue Activities* Units of the Civil Protection. Through it, in case of emergency situations the coordination and interaction with district administrations and crisis management bodies and forces of the ministries and institutions is provided. At the *Information and Analysis Centre* all the information is gathered, handled, analyzed and distributed in case of a crisis situation and the state and local authorities are kept informed. In a similar way operational communication and information centres are established within the Civil Protection directorates.

A single register of the potentially dangerous facilities is maintained. The data base is updated monthly concerning the presence of dangerous chemical substances and radioactive sources in the facilities and an assessment of the risk for the population and the environment is made.

4.2.6 Ministry of Economy, Energy and Tourism (MEET)

4.2.6.1 Introduction

The Nuclear facilities in Bulgaria are state-owned. The Ministry of Economy, Energy and Tourism (MEET) is the sponsoring authority and principal owner of the Kozloduy Nuclear Power Station (KNPS) as well as of radioactive waste management facilities, including the Spent Fuel Storage Facility (SFSF) at Kozloduy. On the KNPS site, the State Enterprise for Radioactive Waste operates solid waste management facilities. The corresponding processing and conditioning operations were taken over from KNPS management in 2005; they are performed by this State owned company under a separate license.

In implementation of the Council of Ministers Decree № 74/1998, the Ministry of Economy and Energy supervises and coordinates also the implementation of the working projects on liquidation of the consequences from uranium extraction and processing.

4.2.6.2 Organisational structure and functions

For the organisational structure and the functions of the MEET see Appendix 8.

According to the Constitution and in implementation of the laws' provisions, the Minister of Economy, Energy and Tourism independently or in co-operation with other authorities and/or public organizations:

- Manages the development of the economy and energy policy and the current activities of the ministry;
- Develops and supervises the implementation of the energy strategy of the country;
- Defines strategic objectives and priorities of the economy and the energy policy within the framework of his power, organizes and coordinates the development of strategies and programs for their achievement;
- Proposes to the Council of Ministers a list of strategic facilities of national importance in the energy sector;
- Makes proposals for the amendment of legislative acts in force or for the adoption of new legislative acts, within the framework of his power;
- Exercises the property rights of the state over the state owned single-property trade enterprises and their management assignment; exercises the state rights as shareholder or as partner in trade enterprises;
- Implements the state policy in the search, exploration, production and efficient use of the energy resources, ferrous and non-ferrous resources– industrial materials; organizes the activities on the granting of permissions for search and/or exploration and on granting concessions for extraction of underground mineral resources and concessions for the construction of hydro-energy facilities; carries out follow-up supervision according to the Law on concessions.

In implementation of the Council of Ministers Decree № 74/1998, the Ministry of Economy, Energy and Tourism supervises and coordinates the implementation of the working projects on liquidation of the consequences from uranium extraction and processing and coordinates also the interaction with international cooperation programs.

In this context, the Minister of Economy, Energy and Tourism approves:

- Technical and economical assignments on work projects, feasibility studies and self-monitoring plans;
- Working projects on technical liquidation, technical and biological remediation, water treatment and monitoring of their changes;
- Annual programs and their amendments by facilities, by trimesters and by type of activities, as well as the financial resources necessary for their implementation;

The Minister of Economy, Energy and Tourism organizes the work of an Advisory Council, involving experts from the Ministry of Environment and Waters, Ministry of Finances, Ministry of Agriculture and Food, Ministry of Health, Ministry of Regional Development and Public Works, State Forestry Agency and Nuclear Regulatory Agency. The Advisory Council discusses and proposes for approval technical and economical assignments, feasibility studies, work projects, self-monitoring plans and work programmes.

4.2.6.3 Natural Resources and Concessions Directorate within MEET

The Natural Resources and Concessions Directorate:

- Participates in the development and implementation of the state policy and strategy on the search, exploration and production of energy, metallic and non-metallic (industrial) mineral resources;
- Participates in the development and implementation of the state policy and strategy in the energy sector concerning energy resources;
- Organizes and participates in the development and approval of projects of legislative and other type of acts related to the prospecting, exploration and production of underground resources (mineral resources) and construction of hydro-energy facilities;
- Prepares projects for updates of the legislative acts in force on technical liquidation and remediation of inefficient production facilities in coal mining, uranium mining and mineral resources extraction;
- Organizes the activities on granting permits for prospecting and/or exploration and concessions for production of energy, metallic and non-metallic (industrial) mineral resources;
- Organizes the activities on granting concession for construction of hydro-energy facilities;
- Organizes and coordinates the implementation, the update and the supervision of programs and projects for prospecting, exploration and extraction of energy, metallic and non-metallic (industrial) mineral resources;
- Organizes and carries out supervision on the implementation of the executed concession agreements and of prospecting and/or exploration of underground resources agreements;
- Organizes and coordinates the development, adoption and supervision of the implementation of programs and projects for technical liquidation and/or remediation of inefficient production facilities in coal mining, uranium mining and mineral resources production;
- Establishes and maintains a departmental register and data base on the permits and concessions granted;
- Participates in the preparation of information and analyses on the production of energy, metallic and non-metallic (industrial) mineral resources at regional and national scale;
- Participates in the preparation, supply and supervision of the state aid use in the coal industry, uranium mining and mineral resources production;
- Plans and checks analytically the incomes and expenditures of the concession activities, permits for prospecting and exploration of underground resources, technical liquidation, remediation and monitoring of facilities for coal mining, uranium mining and mineral resources production.

4.2.6.4 Ecoengineering-RM Ltd.

Ecoengineering-RM Ltd. is a single property company with limited responsibility, 100% state owned by the Ministry of Economy, Energy and Tourism. It was established according to the Council of Minister's Decree (CMD) No 74 of 27.03.1998 in compliance with the national policy for cessation of the extraction and processing of uranium and liquidation of the consequences at the affected areas. With regard to its organisation see Appendix 9.

The Council of Ministers of the Republic of Bulgaria assigned to *Ecoengineering-RM Ltd.*, *Sofia*, the organization and supervision of the activities on technical liquidation, of technical and biological remediation and implementation of the related activities on water trapment, treatment, embedding and monitoring, as well as all other type of monitoring for the liquidation of the consequences from the exploration, extraction and processing of uranium raw material in the affected areas.

The company carries out its activities on the basis of projects, accounting documentation and programmes, including self-monitoring plans for water, for each facility or activity. The activities of water treatment, embedding and monitoring at the facilities are carried out according to permits issued under the Water Act.

The financing by facilities starts after advice from the Advisory Council, concerning the projects, the accounting documentation and the underlying programmes has been provided to the Minister of Economy, Energy and Tourism and further to the approval of this ministry. The financing of all activities foreseen in the Council of Ministers' Decree CMD № 74 of 1998 is provided by the

State budget. The expenditures and financial reporting on the budget resources foreseen for these activities, is carried out according to the Regulation issued by the Ministry of Finance.

5 URANIUM MINING AND MILLING IN BULGARIA

5.1 INTRODUCTION

Occurrences of uranium ores in Bulgaria were known since 1920. First exploration activities took place in 1935 at the *Buhovo* ore deposit, 25 km from *Sofia*. Serious exploration activities based on technological research and economical calculations were conducted in 1938 and 1939 with the cooperation of German specialists and a first batch of 300 tonnes of uranium ore was mined in 1939 at the *Goten* pit, close to the town of Buhovo.

In the period 1946 - 1947 Soviet geologists performed intensive geological investigations of the *Buhovo* ore deposit. At the beginning of 1946 a joint Soviet-Bulgarian enterprise was established but its activity ceased in 1956.

Under the control of the Council of Ministers of Bulgaria the "Rare Metals" Bureau was established. Different exploration methods were applied: geological, geophysical, technological and combined, including aero-gamma-ray-spectrometry, hydro-radiochemical methods and aerial photography.

As a result of these explorations, 39 ore deposits were identified and developed on the territory of Bulgaria.

The main ore deposits for underground extraction are: *Buhovo* near Sofia, *Eleshnitsa*, *Senokos* and *Simitli* in South-West Bulgaria, *Vinishte* and *Smolyanovtsi* in North-West Bulgaria, *Sliven* in Central Bulgaria, *Smolyan*, *Dospat* and *Selishte* in the *Rhodope* Mountains.

These uranium deposits are of small or medium size (up to 10 000 t), with a uranium concentration of 0.1% and have a complex morphology and are of irregular structure.

Deposits exploited via classical mining methods have a complex geological structure and are situated mainly in mountain regions (*Stara Planina*, *Rhodope* massif, East *Sredna Gora*). The mean surface of the ore beds is between 250 m^2 and 20 000 m^2, occurring at a depth of about 500 m and a low metal concentration. Technical mining conditions and geological parameters lead to high primary costs. Efficiency of the uranium production under these conditions is low.

Under favourable conditions of the ore beds, the ISL method (In Situ Leaching) was applied.

In 1969 this methodology was adopted for the first time in Bulgaria mainly for the exploitation of sediment deposits (90%), using drilling systems for leaching and partially in rock deposits through underground systems.

The uranium production followed an ascending rate from 150-200 t per year in the 1950s to 430 t in 1975.

The adoption of the ISL method for uranium production from upper *Thracian* uranium deposits permitted reaching an extraction quantity of 660 t in 1989. At that time 70% of the total quantity of uranium was extracted using this methodology.

Until 1990 16 500 tons of uranium concentrate (U_3O_8) had been mined in the country.

The uranium extraction from the leaching solutions (ISL-method) by ion-exchange resins and their processing had been performed on an industrial scale at the *Zvezda* processing plant near Elezhnitsa. Two

hydro-metallurgical plants had been built in the town of Buhovo and in the village of Elezhnitsa for uranium ore processing and production of uranium concentrate (U_3O_8; with a concentration of 80-82%).

The extraction and processing of uranium ores in the Republic of Bulgaria ceased, based on three secondary acts of the Council of Ministers Decree (CMD) of the Republic of Bulgaria:

- CMD № 163 of 20 August 1992 on the cessation of uranium extraction activities,
- CMD № 56 of 29 March 1994 on staged cessation of activities and liquidation of the consequences from the extraction and processing of uranium raw materials, and
- CMD № 74 of 27 March 1998 on the liquidation of the consequences from the extraction and processing of uranium raw materials.

The activities foreseen in CMD № 74 of 27 March 1998 on the liquidation of the consequences from the extraction and processing of uranium raw materials in the Republic of Bulgaria are:

- technical liquidation,
- technical and biological remediation,
- purification of uranium contaminated mine waters, and
- environmental monitoring in the regions affected by the uranium extraction.

Upon cessation of mining activities, hydro-ecological and radiological assessments and prognoses were prepared, as pre-project studies, work projects for the technical liquidation, the technical and biological remediation and for water purification and monitoring.

The verification team was informed that the liquidation of the classical uranium and of the geo-technological production sites has been completed. All exits of the classical uranium production mines have been sealed. This means that by now the technical liquidation of all sites mentioned in the Council of Ministers Decrees is completed and the related remediation projects have been accomplished. 1173 ha of agricultural lands have been remediated biologically and returned to their owners after approval by the land property commissions.

5.2 URANIUM MINING AND MILLING SITE ISSUES AND SITE DESCRIPTIONS

The uranium mining (uranium ore production and processing) activities resulted in the environmental contamination of the surroundings of the mining sites, both radioactive and non-radioactive.

5.2.1 Radioactive contamination

During the course of uranium ore processing the major part of the radioactive elements present in the ore (Th-230, Ra-226 and its decay products) is collected in the waste products resulting from the production processes. From these, the most dangerous radionuclide appears to be Ra-226 with 1617 years half-life, decaying down to Rn-222, a gas emitted into the atmosphere from the tailings ponds. The half-life of the latter is 3.8 days. Rn-222 decays to several short-lived products (Po-218, Pb-214, Bi-214, Po-214), to Pb-210 and Po-210, and finally to stable Pb-206. Radon is the key contamination agent of the air and in case of unfavourable climatic conditions, lack of vertical circulation and re-distribution in the surface-circulating air, its concentration significantly increases to values exceeding by far the permissible levels.

Radon and the aerosols emitted into the atmosphere as well as the dust rising from the open, non-vegetated portions of the dumps stimulate the mechanical accumulation of radioactive dust in the adjacent agricultural and forest areas and the accumulation of long living and radiotoxic alpha- and beta-active nuclides such as Pb-210, Po-210 and Th-230 in values exceeding the permissible levels.

5.2.2 Non-radioactive contamination

Apart from radioactive nuclides, other waste products resulting from uranium ore production and processing may be detected. These are sulphates (SO_4), carbonates (CO_3) and bicarbonates, nitrites, organic solvents and other reagents stemming from the uranium extraction and processing as well as toxic metals (Fe, Mn, Cu, Zn, Co, Ni, Cr, As, Hg, etc.) from poly-metallic and sulphide-poly-metallic mineralisation accompanying the uranium ores. The well samples from areas of In Situ Leaching, from

a number of observation wells in the tailings ponds, from the natural water sources as well as from the gullies of the river grid flowing near the dumps show different concentrations of heavy metals and ion complexes exceeding the permissible levels. The chemical analyses of the waters flowing out from the mine workings (adits) that contain concentrations of these macro-components directly identify the quality and type of underground waters for each site, and when compared with the general classification of the waters by regions reveal the variations resulting from the mining and uranium mining activities.

5.3 TECHNICAL LIQUIDATION, TECHNICAL AND BIOLOGICAL REMEDIATION (DESCRIPTION AND VERIFICATION ACTIVITIES)

The verification team was informed that the technical liquidation of the uranium mining facilities in the Republic Bulgaria has been completed as described below:

- The activities concerning the technical liquidation of the mining facilities for classical extraction, as well as the one of 18 sorption sites implementing the in situ leaching-method (ISL-method) in the Upper *Thracian* Valley have been accomplished in the period 1992 – 1997.
- The technical liquidation of the uranium processing plant near the town of Buhovo has been completed in 2002/2003 (see the technical report of the 2009 verification).
- With the technical liquidation of the *Zvezda* plant near Elezhnitsa in 2004 the activities on technical liquidation at the uranium mining facilities within the State Enterprise "Rare metals" have been completely finalized. Radioactively contaminated materials – building waste, scrap etc. have been deposited at the tailings ponds of the *Zvezda* site near Elezhnitsa and of the *Metalurg* site near Buhovo. (see the technical report of the 2009 verification).
- All activities for Technical and Biological Remediation (TBR) of the *Zvezda* Plant, village of Elezhnitsa, are completely finalized. For the implementation of the remediation activities at the *Metalurg* Plant, Buhovo, technical projects are developed. The implementation of the remediation activities is forthcoming. (see the technical report of the 2009 verification).
- In the Upper *Thracian* Valley region during the period 1996 – 2001 the biological remediation of 1173 ha of agricultural lands had been completed successfully. They are included in the land regulation plans and have been restored to their former landholders, as agricultural lands. The measured results of the content of radionuclides and toxic elements in analysed samples from these areas are below the maximum permitted levels, which indicate a negligible risk for the population, the flora and the fauna.

The verification team was informed that after 2005 the implementation of the activities under CMD No 74 of 1998 was limited only to activities for technical and biological remediation, monitoring, purification of the mining waters leaking to the surface, regeneration of ion exchange resins, maintenance and guarding of the tailings ponds.

During the verification visit of 2009 to the *Elezhnitsa* site, which still performs the regeneration of ion exchange resins stemming from the water purification process, the team was informed that there is not yet any solution for the currently stored uranium products ('yellow cake' of 40-45% concentration) resulting from the regeneration process. The intention is to sell this yellow cake to a uranium producing country, but the interest of such countries seems to be low due to the rather low uranium content of this material. At present, the yellow cake belongs to the State (Ministry of Finance).

All the activities regarding the technical liquidation and technical and biological remediation of the uranium mining facilities are based on a prepared Hydro-Ecological expertise, Assessment and Prognosis (HEAP) and a Radio-Ecological expertise, Assessment and Prognosis (REAP) performed in the period 1992 - 1994.

5.4 WATER PURIFICATION AND REGENERATION OF ION EXCHANGE RESINS (NOT INCLUDED IN THE PRESENT VERIFICATION; FOR DETAILS, PLEASE CONSIDER THE REPORT OF THE 2009 VERIFICATION)

The verification team was informed that after the cessation of the activities of uranium extraction and uranium processing the pumping stations for circulating water in the mines were dismantled: this created conditions for the outflow of water contaminated with radionuclides from the stulms. For this reason mining waters containing radionuclides flowing out to the surface created preconditions for contamination of surface waters in the region of the closed down facilities.

The team was informed that in the regions where these processes were particularly intensive, sorption type treatment facilities have been set up, so called "Installations for sorption purification of uranium contaminated mine waters" (ICPUCMW).

The verification team stresses its recommendation from 2009 to study the issue of leachates accumulating inside the mines below the outflow surface, in particular with regard to any contamination of ground water in the very long run, and to consider measures to overcome the highlighted issues.

5.5 URANIUM MINING AND MILLING SITES VISITED AND VERIFIED IN CENTRAL- AND SOUTH EASTERN BULGARIA.

5.5.1 Momino former uranium mining site

The team visited and verified the Momino former uranium mining area. The former uranium mine was situated at a depth of about 200 to 300 metres (Karstic rocks), exploitation was performed by ISL (in situ leaching).

Further to the closure of the mining activities, hydro-ecological and radiological expertises were performed. From 2003 to 2007, each 3 months, ground water samples were taken from shafts and drills. For this, ground water was pumped for one hour, then, each 15 minutes tests on physical parameters (pH, conductivity, solved oxygen, temperature) were performed.

In 2008, a general classification of the former uranium mining and milling took place in Bulgaria (Ministry of Health). Objects were classified in high / medium / low risk categories. Areas of high risk would be sampled twice a year; medium risk areas once per year and low risk areas once every second year. After this, in 2009, a three years monitoring programme was started.

The *Momino* site was classified as being of low risk. Both, the Ministry of Health and the Ministry of Environment (with higher frequency; Plovdiv Inspectorate) take samples.

The verification team was informed that currently (2011), based on an assessment of these data, the monitoring programme will be re-designed. A four years programme is foreseen including tests for U, alpha, beta and Ra.

Now a huge agricultural production centre (hectares of glasshouse production of fruit and vegetables) is installed within the area of this former mine. This agricultural production uses big amounts of underground water, all pumped from a depth of about 50 to 120 metres (wells no 11 and 12), to water its production. Underneath that horizon, a clay layer prevents this groundwater from contact with waters from the former ISL-mining area at ~250 metres; thus there is no connection between these water levels (connections exist only if drills are compromised; no hints exist to such an effect). The water used for irrigation has no measurable uranium contamination.

The team visited the wells N°11 and 12 and was explained that at well N° 11, groundwater is pumped from a depth of 120 m and used for watering the agricultural exploitation This water is claimed to be of low risk. It undergoes a radiologic monitoring once a year or at least every second year. The water

from well no 12 is led to a large concrete basin where it is mixed with additives as needed for the agricultural use.

The team was also informed that wells N°07 and 08 situated at Letchko go down to a depth of ~250 metres (Pliocene level). (The batteries that formerly pumped the leaching solution (H_2SO_4) now are all blocked. During operation the leachate was piped to a nearby sorption plant.) The verification team draws the attention to the fact that uranium solutions from the former mining activities may still be present at production level and might have migrated with ground water to other locations. This eventually could cause problems in the future.

Even though uranium production level waters appear not to be contaminated and do not show problematic pH values (pH 6.5 to 8.5), they are not allowed to be used in agriculture.

The team recommends that due to the intensive agricultural use of the groundwater in the Momino area, a more frequent monitoring for uranium and radium (eg.: four times per year) should be performed to prevent the risk of an unnoticed (even if very small) increase of uranium and radium in the irrigation water that could lead to significant economic consequences. It furthermore recommends studying the above mentioned issue of eventual migration of contaminated waters in relation to ground water flow at production level. (This applies to all former ISL production sites in Bulgaria.)

5.5.2 Sliven former uranium mining site

The team visited the uranium mining site situated at a hill slope at the east end of Sliven. The site had used 'classical' methods.

Formerly the uranium mine had a special railroad system for transporting the ore to Buhovo for further processing. No processing (grinding or chemical treatment) was performed at the Sliven site.

Some piles of extracted waste rocks from past mining activities are still visible at the slope of the mountain, near the (now closed) previous mine entrance. The site was remediated. The slope was stabilised, covered with clay. The team was informed that in all remediation cases the thickness is individually calculated depending on the measured radiation levels. After this, a cover of sand/gravel was placed (for drainage) followed by a layer of 30-40 cm soil.

All mine shafts have been closed with concrete. Water from the mine flows into the lowest shaft (nr. 13). All drainage water goes to this lowest part of the mining area (at the time of the visit the flow rate was low due to dry season). The threshold for uranium contamination in the outflow water is set at 2 µg/l, the actually measured values are around 0.5 µg/l. The team could not access the closed entrance of this shaft and the water outflow due to impenetrable vegetation. The outflow of drainage water from the former mine (three pipes) thus could not be witnessed by the team, but the water sampling place (at a distance of about 25 metres) could be visited.

The land has been returned to private owners and is re-cultivated. It is dedicated as forestry land, in particular for (natural) growth of chestnut (flat rooting tree).

Verification does not give rise to specific remarks.

5.5.3 Rossen, former copper mining site (NORM activity)

The team visited the remediated tailings ponds (R3 "Rossen tailings pond" and R4) of the former *Rossen* copper mine (area ~230 ha). The site is situated near Chernomorets, some 20 km southeast of the town of Burgas. Mining of copper took place from 1988 to 1998. About 4.5 millions of tonnes of waste were produced by the mine and deposed in tailings pond R3. A large quantity of these wastes went (by overflow of the tailings ponds, or by a pipe system) down the hill and directly into the Black Sea at the Vromos Bay area. These wastes from copper mining activities were contaminated by natural radioactive substances, mainly by uranium and radium.

Since 2009, the area is monitored and under remediation. It has been re-cultivated. Annual monitoring reports are sent to the Ministry of Economy, Energy and Tourism.

Amongst others, for the monitoring of any movements of the dams of the R3 tailings pond 26 piezometers are installed in the dam. Pressure curves of the 26 piezometers are measured. The *Rossen* tailings pond has been covered by a geotextile layer and by 'geonet plus', previous to being covered by 0.6 m of clay followed by 0.5 m of gravel and 30 cm of soil. Flat rooting trees (acacia) are allowed to grow.

The sand from a first cleaning up of Vromos Bay (beach and first metres of the sea ground) has been deposed in the tailings pond R4 (dry dump of uranium contaminated sand; natural evaporation of water).

For R3 and R4, drainage water samples are taken for radiological monitoring. The team was told that generally water is available only in April/May and sometimes in November. The drainage water is analysed by the radiological laboratory of the *Pushkarov* Institute.

Verification does not give rise to specific remarks.

5.5.4 Vromos Bay (radiological contamination by NORM activity)

Vromos Bay, along beach stretch covered with gray sand, is situated at about 2 km downhill from the former *Rossen* mining area. The bay and large parts of the "Hinterland" are still radioactively contaminated from the past overflow of mining wastes from the former mining area (tailings ponds), or directly through a pipe system to the sea in the centre of Vromos Bay. Rests of this pipe system were witnessed by the team at the beach, close to some houses. The team was informed that uranium contaminated material was washed ashore leading to increased radiation values at the beaches.

The beach was cleaned-up previously (see 5.5.3), but according to information by Bulgarian authorities the area and the adjacent sea are still contaminated; in some parts of the beach the radiation levels are still elevated (up to 10 times of the dose rate limit set).

Towards the north the beach is closed by a fenced military area. The team witnessed that a number of houses have been built close to the bay on contaminated land (according to information given at the closing meeting this was done without permit and now the owners of these properties would like to legalise the situation). Local population has been informed by the authorities through radio of the contamination of the beach/sea areal.

The team was informed that a further cleaning campaign is expected (there seem to be ideas about using the site for construction of a new Burgas harbour and to recover useful material from the sands).

The Bulgarian authorities have prohibited access to and bathing at Vromos beach and signalised this by written panels at different places of the area.

The team witnessed some of these panels and witnessed also that some had been destroyed or cut (stolen). At the time of the verification quite some persons, some with small children, used the beach area as a recreational area for sun-bathing and bathing in the sea. The place was also used for fishing. The visible prohibition panels were obviously ignored. There seems to be some mistrust about the information on radioactive contamination given by the national authorities and/or a fear that this is caused by strong (economical) interests rather than by radiological reasons.

The team recommends that the radiation dose received from the residents of houses within the contaminated area should be checked – especially for Rn-222 – and construction of houses on contaminated areas should be prevented effectively if radiation levels are above limit. Special attention should be given to the radiation dose received by children of low age.

As long as radiation levels at the beach are above limit, the team strongly recommends closing the beach as recommended by the Ministry of Health and making sure that public access is prevented effectively by local authorities.

5.5.5 Orlov Dol: former uranium mining site

The team visited the former uranium "in situ leaching" (ISL) site of *Orlov Dol*. The leached uranium layers were situated at a depth of about 250 to 300 metres. The team was informed that about 1 Mio tons of leaching agent were pumped into 18 deposits at this site. The percentage of leachate pumped up for uranium production is estimated at 90%. The remaining 10% are thought to be rather well fixed.

Today drinking water is pumped from a depth of 100 to 150 metres.

The team witnessed sampling point M12 and was explained that this sampling point is used for drinking water analysis pumped from a depth of about 70 m. The team was informed that the sampling point is located in the pumping station but that the samples are not taken from there since the station is locked; thus an approximately 5 m deep concrete shaft situated close to the pumping station is used as sampling point. Since 2009 sampling at that point is performed once every two years.

Due to high and abundant vegetation, sampling point M11 could not be located exactly during our visit and hence could not be verified. The team was informed that at M11, drinking water samples from a depth of about 50 metres are taken. It was explained that uranium in drinking water should be monitored by both the Ministry of Health and the Ministry of Environment; neither the number of samples taken by each ministry, nor the frequency of sampling could be indicated to the team on demand at the time of the verification.

At sampling point M10 (shaft with 128 metre depth), the team noticed that the water level in the pipe (diameter 93 mm) was at 18 to 10 metres below the soil surface.

The team was informed about the sampling procedure: the static water level is determined with an electric lead, then water is pumped out, every 15 minutes a sample is taken and physical parameters are determined. When these parameters are constant (generally after one hour and the pumping of about 600 l, corresponding to about 4 times of water exchange in the well), a sample is taken for the determination of chemical and radiological parameters.

Close to the ruins of the former sorption installation of *Orlov Dol*, well number M9 was visited. The team witnessed that the metal tubing emerging from the soil had disappeared (obviously stolen) and that only some concrete fragments were left. The team was told that this well goes down to the productive horizon, however outside the border of the ISL uranium production zone, in direction of the groundwater flow.

The team recommends that in case the water is used for human consumption, monitoring of uranium and radium should be maintained in regular intervals. Water samples should be taken from the pumping station and not from the nearby shaft. All existing wells should be repaired and maintained.

5.5.6 Vladimirovo: former uranium mining site

The team was show different locations in the *Vladimirovo* uranium mine area.

ISL mining took place at a depth of about 170 metres. The mining area was closed between 1992 and 1994. Piping closure was at about 2 metres below the ground surface. About four years after the closure, the concrete tampon of the closure broke and mine water from the deep layers flowed out from the well forming a sort of small swampy pond which is not fenced in. Water sampling point M5 (~170 metres of depth), now in the pond area, marked with a pipe, was witnessed by the team. Up to 2008 sampling took place five times per year. Now, sampling takes place only once every second year.

The next sample should be taken in the 3rd quarter of 2011. The team was told that the water will be probably taken from the pond since the sampling pipe will not be accessible anymore.

During the visit the ground water sampling point ТТБ4 (situated at ca 4 m besides the road) could not be found easily because it was covered by a hedge of blackberries. An Ecoengineering staff member made a new GPS registration for future easier finding of the location. The well is 6-9 m deep; sampling is manual (not with a pump).

The team also witnessed the former *Vladimirovo* sorption plant installations, which were in ruins, only the foundations remaining.

The team suggests preventing public access to the swampy pond area e.g. by placing warning signs and a fence with a view to avoid physical risks.

5.5.7 Smolyan: former uranium mining site

Smolyan was an uranium mining area with two shafts for production (altogether 500 tons U) and a total of 56 horizontal adits (tunnels) in the mountain for exploration, 13 of them with water outflow. The mine was using 'classical' methods (no leaching). The ore was transported to Elezhnitsa for processing.

The team visited exploration tunnel 51, closed with a concrete brick wall. A ca. 30 cm by 60 cm wide hole in the wall demonstrated "illegal access" to the mine. The team was told that closing the hole could lead to increased interest and thus to again opening the wall in the search for potential valuable material (such as iron rails). In front of the closed tunnel entrance, the team witnessed monitoring point No. 9, at which monitoring was performed until 2008 (4 times per year water and radon; twice per year soil and vegetation). The area is classified as being of medium risk. Since 2009 no soil and no radon monitoring is performed anymore, water monitoring takes place once per year (sampled at the drainage at the left hand side of the closed tunnel).

A surface water sampling point is located downstream the nearby Černa river; until now no uranium contamination was detected.

The team visited the site of the former production shaft No 7 (now filled with cement) and the ore loading building (which is currently locked with a chain and used for parking trucks, however in a bad shape). The team witnessed various water sampling places in the area that were used until 2008. It was told that in the Smolyan area originally there were 30 water sampling locations; currently only 12 for underground water and two for surface water (river Arda and river Černa) are used.

At exploration tunnel No 5 the team noted that the tunnel entrance is closed with a concrete brick wall; however, a ca. 40 cm by 40 cm wide hole has been broken into the wall to allow water outflow and access is also still possible by a broken portion of the tunnel roof. The nearby sampling point No 4 is not used anymore, the area being re-cultivated.

The team suggests effectively closing holes in the walls of the tunnel entrances to prevent physical danger and placing useful warning signs.

5.5.8 Izgrev (Dospat Barutin): former uranium mining site

At the *Dospat Barutin (Izgrev)* site formerly in the upper part of the valley an open pit uranium mine was operated. This place has been remediated and now houses a (conventional) household waste dump owned by Dospat City.

Some 1 km down in the valley an underground mine with one shaft and 34 tunnels was used. The verification team observed that the shaft is partly covered with a small heap, re-cultivated, but a hole is still there. It was told that some 20 m below a plate blocks the access to the shaft (this was tested by throwing a stone).

Altogether the mines used the 'classical' method and a small experimental leaching area: ISL and 'heap leaching' by placing the ore as a heap on insulating foil.

The first monitoring programme contained 15 water monitoring points for the whole deposit; until 2008 sampling was 4/a. After classification as 'medium risk' only 13 points were kept (sampling 1/a), in addition there are 5 sampling points off site (e.g. Barutin village). Also 10 creeks and the mine water outlet are monitored.

The team was told that there are three mine water sampling points (the coordinates are known, but the places are not marked), one of them coinciding with a sampling point of the regional Southwest Bulgarian monitoring net (code 14-B3).

The team witnessed one of the sampling places at outbursts (springs) of water from the uranium mine area feeding the Barutinska River. Water flow is some 3-4 l/sec; the U content is said to be within the limits of regulation (waste water, 2 mg/l); however, due to its sulphate content the water is not usable for drinking purposes. At the outburst the team observed cows' traces: apparently cows drink there. The team was informed that cow's milk is not sampled and analysed claiming that cows don't drink there. In addition it is assumed that the outburst does not contain mine water but natural spring water coming out via a fault line. Due to organisational reasons the other mine water sampling locations could not be visited. Thus, a statement on their usage by cows or other animals cannot be given.

The verification team recommends initiating a study with a view to determine any uranium and radium contamination in the milk of the cows that are using the outburst water and eventually setting up an according monitoring programme.

5.5.9 Uranium mill tailings ponds (not part of the present verification)

The uranium ore production and processing development during the last century made it necessary to construct several tailings ponds. Originally these were built by *SE "Redki metali"*. Nowadays *Ecoengineering-RM Ltd.*, Sofia, is in charge of their management, operation and maintenance.

The verification of 2009 included the *Buhovo* and *Elezhnitsa* tailings ponds (for information, please consider that report).

5.6 ENVIRONMENTAL RADIOACTIVITY MONITORING OF FORMER URANIUM PRODUCTION SITES

5.6.1 Introduction

The radiation monitoring activities at the former uranium sites are regulated as per Article 1 of the Council of Ministers Decree (CMD) No 74 of 1998 for the elimination of the consequences resulting from uranium production and processing, and include the following activities covering:

- waters catchment, purification and monitoring, as well as
- other types of monitoring performed in the course of eliminating the consequences resulting from exploration, production and processing of uranium ore.

The radiation monitoring is carried out on technologically damaged terrains, dumps, open mine workings (adits, shafts, etc.) by sampling soil, sediments, waters and air.

Measured radiation parameters are:

- Gamma dose rate at one metre above surface;
- Measurement of surface contamination with alpha- and beta-active radionuclides;
- Measurement of volume specific activity (total alpha and beta);
- Measurement of volume specific activity of radon in the surface atmosphere.

5.6.2 Legal basis

The general requirements to the license and permit holders and the general principles, norms and rules on radiation protection provision, which have to be observed during activities in facilities with Sources of Ionizing Radiation (SIR) are determined by the Law on the Safe Use of Nuclear Energy (LSUNE) and its secondary legislation.

Radiation protection is assessed through an analysis of:

- External and internal exposure of the personnel and the population, received during activities with SIRs;
- Radioactive contamination of the environment;
- Radiation protection measures and the observance of the limits and rules for radiation protection;
- Probability for radiation accidents and their scale, emergency situations and the protective measures undertaken;
- Preparedness for response in radiation accidents and for the liquidation of their consequences.

Assessment criteria are as follows:

- Radiation impact in using SIRs;
- Maintaining of lower limits than defined in the legislative acts of the external and internal exposure doses for the personnel and the population and at a reasonably achievable low level.

Radiation monitoring provides continuous monitoring and information on the radiation situation in the controlled, supervised, radiation protection and observation zones and on the exposure for the personnel and the population resulting from activities in facilities with SIRs. The monitored radiation quantities, the type, their range and the precision of the radiometric and dosimetric equipment used, the posts monitored and the frequency of the radiation measurements are defined in a radiation monitoring programme. This programme is prepared by the respective license holders.

Radiation monitoring is carried out by a departmental service or by an accredited laboratory.

The radiation monitoring is carried out with technical equipment for:

- Measurement of the equivalent gamma-ray dose-rate at the working places, in the production premises, in the radiation protection and in the monitored zones of the Facility for regeneration and purification of ion-exchange resins (FRPIR);
- Measurement of the level of the surface radioactive contamination of working surfaces, equipment, transport vehicles, individual protective means, the body and the clothes of the personnel;
- Measurement of the volume activity of gases and aerosols in the air of the production premises;
- Measurement of the activity of liquid radioactive effluents;
- Measurement of the radioactive contamination of different components of the environment (air, water, soil, sediments, plants) within the radiation protection and the observation zones;
- Measurement of the equivalent dose-rate, specific activity, radionuclide composition and surface contamination during transport and storage of radioactive substances.

Through monitoring of soil, water, fall-out, vegetation, aquatic flora and fauna and agricultural production; the content of radionuclides and toxic metals is determined.

The radiation monitoring programme is approved by the competent state authorities.

The licenses issued on the use of SIRs in the Facility for regeneration and purification of ion-exchange resins (FRPIR) include specific requirements on the radiation protection provision and on the periodicity and the type of reporting to the Nuclear Regulatory Authority (NRA) on the results from the monitoring.

Quarterly reports with the results of the radiation monitoring on the FRPIR site and of the environment are submitted to the Nuclear Regulatory Authority (NRA). The NRA inspectors analyze and assess the compliance of these data with the legislative requirements, as well as the trends in time.

5.6.3 Monitored parameters

The monitoring covers all environmental components including waters (surface and underground), soil and air:

- Mining waters flowing freely from the tailings ponds, the mine workings and the free-flowing wells in the closed-down uranium production sites;
- Artificial radioactive contaminations relating to uranium ore production and processing with regard to destruction of the sub-surface and the relief, as well as the areas where the dumps are located;
- The technological sites of the sorption complexes (In Situ Leaching - ISL methodology), the tailings ponds and the technogenic dumps (waste rock) as sources of ionizing radiation and exhalation of radon and its short-lived decay products;
- The air as the most dynamic component that depends directly on the atmospheric circulation is subject to analysis regarding the outgoing and incoming air flow at the mouth of the galleries and shafts, as well as the radon exhalation within the mine dumps and tailings ponds.

5.6.4 Monitoring networks and points

Local and regional networks have been elaborated for radiation monitoring during and after termination of the mining activity aimed at identification, surveillance and control of the environment within the uranium production sites.

These monitoring networks and points location schemes comply with the conclusions and evaluations included in the Radioecological Examinations and Forecasts (REF) and the Hydroecological Examinations and Forecasts (HEF).

The location and purpose of the monitoring networks and points are based on the following considerations:

- The sampling, measurement and observation points are located along the most dangerous and critical flows or filtrations of radionuclides and toxic metals contaminated waters from the zones where the surface flows occur close to non-contaminated areas. The observations cover the most effective zones and migration directions along normal faults, permeable and lithological contacts and boundaries, karst zones and surface water channels.
- The soil, dump, spoil heaps and vegetation control points are located in the areas that have been most affected by uranium mining in order to acquire the most complete and reliable information and monitoring on the effectiveness of the re-cultivation operations.
- The radiation monitoring of the air is carried out at points of potential risk of radon and short-lived radon decay products emanation.
- The surveillance networks consist of fixed and labelled sampling and measurement points: mine workings, observation wells, natural flows of underground and surface waters, drainage systems of the additional artificial basins, technological lakes, water intake facilities; comprising in particular points with higher concentrations of dangerous radionuclides and heavy metals in the ore fields and production sites and the catchment zones around the sites.
- The elaboration of the monitoring programmes mandatorily takes into account and prescribes the measurement of the water quantities flowing out of the separate points of the site to the main catchment with a view to introducing a contaminated water management scheme or adopting certain purification procedures.
- The monitoring networks and marked points cover 24 out of the total 46 uranium production sites included in the Council of Ministers Decree No 74 of 1998.

At the ISL sites in addition to the main control points for water (besides surface water) seventy-seven observation wells to monitor the underground water within the mining sites have been drilled.

5.6.5 Radiation monitoring activities

5.6.5.1 "Own" monitoring by Ecoengineering-RM Ltd.

The team was informed that *Ecoengineering-RM Ltd.* performs the surveillance for quality control of waters that fall within the category of the so called "own" monitoring stipulated in the Law on Waters and its implementing instruments.

For this purpose the waters are separated into four groups, according to their origin:

- 1st group: surface water reservoirs (rivers, gullies, channels, technological lakes, etc.), 89 monitoring points (MP);
- 2nd group: mining waters (from underground workings, open cast mines and mine dump, drainage waters from tailings ponds' collectors, etc.), 73 MPs;
- 3rd group: waters from Quaternary and other non-producing horizons occurring at a depth of up to 50 m, 62 MPs;
- 4th group: waters in producing horizons and deep wells at depths below 50 m (usually 200-250 m) where the ISL method was applied for enriched solutions as well as waters occurring below the elevation of the last producing horizon in underground mining sites, 54 MPs.

Four radiation parameters (natural uranium, Ra-226, total alpha- and beta-activity) and ten non-radiation parameters (pH, F, SO_4, Fe, Mn, Pb, Cd, Ni, As, Se) are subject to analysis.

The analysis of soil and sediments includes the measurement of five radiation parameters (natural uranium, Ra-226, Th-232, K-40, Pb-210) and 16 non-radiation parameters (pH of water extraction, Fe, Zn, Mn, Pb, Cd, Cr^{3+6+}, As, Cu, Co, total absorbed forms of nitrogen, organic carbon, phosphorus, total absorbed forms of potassium, total content of water-soluble salts).

Radon is measured on a site by site basis where accessible mine galleries are available.

Each year the results from the laboratory analyses of waters by sites are reviewed for identification of trends in changes of the major contaminators.

The approved water monitoring programme for 2009 prescribes that for the high-risk sites the samples should be taken twice a year, for the medium-risk sites – the sampling of the waters should be carried out once per year, and for the low-risk sites – once every two years.

The programme is presented in Appendix 10. The methodology applied for water and soil sampling and some field measurements is given in Appendix 11.

It was explained that the site monitoring programme is implemented by teams of specialists of *Ecoengineering-RM Ltd.* according to a preliminary schedule drawn up for field inspections and sampling of the monitoring points. The field equipment includes three mobile gasoline generators (of 2.8 to 3.6 kW output), three submersible pumps – two of them *Grundfos MP3* with 90 m submersion depth and a flow rate of 2 l/min and one *SQ 3-40* with 60 m submersion depth and a flow rate of 1 l/min.

All laboratory studies and analyses of water, soil and sediment samples taken within the monitoring programme are carried out in a specialised certified laboratory; in 2009 this laboratory was *DIAL Ltd.* and was verified during that verification visit.

The analyses are performed on the basis of the Bulgarian State Standard BDS EN ISO/IES 17025 and relevant legal certificates.

5.7 LABORATORIES OF THE COMPETENT AUTHORITIES

Some of the laboratories of the competent authorities, which are involved in the authorities' control programme of the remediation and monitoring of the former uranium mining and milling activities were included in the present verification (see Chapter 7); information concerning a verification of

some other of these laboratories can be found in the Commission's verification report concerning the *Kozloduy* NPP (2007).

In 2007 the specialized departments of MOEW-EEA and MH-NCRRP conducted joint sampling and radiological analyses of environmental samples from the *Buhovo* uranium production region.

5.7.1 MOEW - Environmental Executive Agency (EEA)

The verification team was informed that the analytical activity in implementing the radiological monitoring programme and ensuring the collection of the required information on the radiation status of the environment in the regions under surveillance is performed by the Laboratory for Radiation Measurements and Analytical Activity of Directorate General of the Environmental Executive Agency (EEA) of MOEW and by its regional units in the towns of Burgas, Varna, Vratsa, Montana, Pleven, Plovdiv and Stara Zagora.

This EEA analytical laboratory is accredited by the Bulgarian Accreditation Service Executive Agency in compliance with BDS EN ISO/IEC 17025. The involved laboratories for radiation measurements take part in national and international inter-comparisons and proficiency tests, organized by IAEA and EC (DG JRC – IES and IRMM).

5.7.2 Ministry of Health (MH) – National Center of Radiobiology and Radiation Protection (NCRRP)

The National Center of Radiobiology and Radiation Protection (NCRRP), Radiation control Section, within the Ministry of Health has two laboratories, namely the Public Exposure Monitoring Laboratory (PEML) and the Inspectorate for the Control of Nuclear Facilities including Regional Inspectorates for the Protection and Control of Public Health (RIPCPH), in particular the Radiation Control Departments (RCD) in five out of 28 RIPCPHs (at Burgas, Plovdiv, Ruse, Varna and Vratsa) that are in charge of analysing radiation parameters of the living environment aimed at assessing the radiation exposure of the population.

The verification team was informed that NCRRP carries out the specialised radiation control on the parameters of the living environment in the regions covering the former mining sites including the former uranium ore processing sites according to a schedule approved by the Minister of Health Order No RD-15-2688 of 9 September 1998. For the purposes of the specialised control, the programme classifies the sites into three groups:

- regions of high,
- medium and
- low radiation risk.

The programme also specifies the points, frequency, sites and controlled parameters as follows:

- High radiation risk sites are subject to control twice a year;
- Medium radiation risk sites are subject to control once a year;
- Low radiation risk sites are subject to control every two years.

Living environment object	*Controlled parameter*
Background radiation	rate of ambient gamma dose
Air	Rn-222
Soil	Natural radionuclides
vegetation	total alpha-activity
Mining and surface waters	total alpha-activity, total beta-activity, Ra-226, natural uranium
Sediments	Natural radionuclides

These laboratories did not form part of the present verification; information with regard to these laboratories can be found in the Commission's verification report concerning the *Kozloduy* NPP (2007).

6 NATIONAL ENVIRONMENTAL RADIOACTIVITY MONITORING PROGRAMME

6.1 MINISTRY OF ENVIRONMENT AND WATER AND MINISTRY OF HEALTH

The Ministry of Environment and Water (MOEW) and the Ministry of Health (MH) have statutory duties to monitor environmental radioactivity throughout Bulgaria (National System for Environmental Monitoring - NSEM), including in the vicinity of the *Kozloduy* NPP. The present verification covered part of the national monitoring in southern Bulgaria. Additional information with regard to national monitoring can be found in the Commission's verification report concerning the *Kozloduy* NPP, 2007.

6.2 THE MINISTRY OF ENVIRONMENT AND WATER (MOEW)

6.2.1 Introduction

The Ministry of Environment and Waters is the competent authority that implements the radiological monitoring of the environment in Bulgaria including the regions of former uranium production.

The MOEW's national programme consists of six regional programmes. The execution of these regional programmes is entrusted to the regional branches of the Executive Environment Agency (EEA) in Burgas, Vratsa, Varna, Stara Zagora, Montana, Plovdiv and Pleven. With the exception of Burgas and Plovdiv these were not part of the present verification.

6.2.2 Executive Environment Agency (EEA)

The Ministry of Environment and Water (MOEW), through the Executive Environment Agency (EEA) and its regional bodies (Regional Inspection of Environment and Water - RIEW) carries out a specialised radiation monitoring in the country.

The national system for environmental radiological monitoring aims at early detection of the deviations from the radiation parameters' permissible levels in the main components of the environment – air, water and soil. The EEA follows levels of radioactivity in the environment both on-line and off-line:

- On-line through the automated system for on line surveillance (BULRAMO).
- Off-line through laboratory measurements of samples.

The monitored parameters are:

- Gamma-background in the country;
- Radionuclides in the air;
- Natural and anthropogenic radionuclides in soils, sediments, wastes;
- Total alpha and beta activity of surface, ground and waste waters;
- Cs-137 and H-3 specific activity of surface, ground and waste waters;
- radon from uranium mining, other ore mining, or the energy industries.

The continuous and periodic monitoring of the radiation parameters of the environment's main components aimed at ensuring up-to-date information for the state and local management authorities and the public is based on a radiation monitoring programme. The programme is approved by the Minister of Environment and Waters and is a part of the National System for Environmental

Monitoring (NSEM). It includes a network of surveillance posts, a defined periodicity of measurements and a set of radiation parameters that are monitored.

The field radiation measurements, sampling and laboratory and analytical activities are carried out by the radiation measurement laboratories within the Laboratory and Analytical Activities Directorate of the EEA in Sofia and in the regional laboratories in Burgas, Varna, Vratsa, Montana, Pleven, Plovdiv and Stara Zagora.

These laboratories ensure the necessary information on the environmental radiation status for the regions monitored by them.

Data are collected, handled and stored in a database, which is part of the Central database of the EEA. Specialised software is used to visualise the information available.

MOEW is the competent authority that implements monitoring of the radiation status of the environment in the regions of former uranium production under a programme that is a part of an overall radiation monitoring programme.

Radiological monitoring covers:

- continuous measurements of the gamma dose rate – through the Local automated radiological monitoring system (LARMS) in the *Buhov*o uranium mining region at two local monitoring stations (LMS), namely in the village of Yana and in the town of Buhovo;
- discrete measurements of the gamma dose rate at all points of the network;
- periodical monitoring of the atmospheric radioactivity including automated sampling of atmospheric aerosols, once per month, at the LMSs in Buhovo and Yana followed by gamma-spectrometric analysis for the assessment of the volume specific activity of the natural and artificial radionuclides U-238, Ra-226, Ra-228/Th-232, Th-230, K-40, Pb-210 and Cs-137;
- periodical monitoring of uncultivated soils and waste products from dumps and tailings ponds; samples from the 0-20 cm surface soil bed are taken and analysed once a year in order to determine the specific activity of the natural and artificial radionuclides U-238, Ra-226, Th-232, Th-230, K-40, Pb-210 and Cs-137;
- periodical monitoring of surface water from rivers and other water basins and of underground water in the vicinity of uranium mining sites; samples are taken once per year. Total alpha and total beta activity, natural uranium and Ra-226 are measured;
- periodical monitoring of waste/mining water; samples are taken once per year. Total alpha and total beta activity, natural uranium and Ra-226 are measured applying radiochemical analysis;
- periodical monitoring of sediments; samples are taken once per year. In practice, sediment samples are taken at all surface water monitoring posts located in rivers, surface reservoirs and catchment gullies for further gamma spectrometry analysis. The specific activity of natural and artificial radionuclides is measured: U-238, Ra-226, Th-232, Th-230, K-40, Pb-210 and Cs-137.

The sampling, reception, preparation and analysis of the environmental samples are performed in accordance with methods complying with the Quality System requirements ('BDS EN ISO 17025').

The results of the environmental radiological monitoring in the former uranium mining sites are published in the periodic publications of the EEA. Quarterly and Annual Bulletins are available on the web-site of the Agency.

6.2.2.1 Elhovo Hydrometeorological Station

The verification team visited the Hydrometeorological Station at Elhovo, which belongs to the Bulgarian Academy of Sciences and mainly contains meteorological devices. EEA is using the premises for dose rate monitoring.

The gamma probe (*Hörmann/TechniDATA DLM 1440* dose rate monitor) with low and high dose rate tubes, was located in the meteorological garden of the station on a lawn without trees. A one storey building was situated at a distance of about 10 meters from the probe. The effective height of the probe was ca. 1.50 m above ground. General location (very soft hills) is very good.

The data logger in a locked case was situated in the building. The key was locally available. A 500 VA UPS ensures electrical power for several hours. The equipment log sheet was at its place with test info and exchange of parts info (signed).

The team was informed that the data transmission interval is set at 10 minutes (radio transmission). It can be switched to a transmission every minute when needed (centrally controlled).

Generally, for the dose rate monitoring system a bulletin with monthly values is publicly available on the internet.

Verification does not give rise to specific remarks.

6.2.2.2 Astronomic Observatory Mt. Rozhan

The Astronomic Observatory, is situated at 1740 meter above sea level at Mount Rozhan. The whole area is fenced and access controlled. The station is used as a background station for air quality (ozone etc.). EEA is using the premises for dose rate monitoring.

The team verified the dose rate probe located at this site. The location of the probe is ideal on a mountain meadow with no buildings or trees in an area of 10 metres around.

The probe is protected by a hood (against ice) and had a bird's nest inside. It is mounted at some 2.5 m above ground (because of the possible snow layer in winter which might be more than 2 m).

In a nearby air conditioned container a *Hörmann/TechniDATA* data logger is installed in a locked cabinet; the key was not at its place.

A large local display showed various data including for radiation (at the time of the visit 0.014 mR/h).

Data transmission to the data centre in Sofia is performed by radio (via the Botev Peak station of the network).

The verification team suggests changing the unit for displaying radiation data from mR/h to a useful SI unit (e.g. µGy/h or µSv/h). It also suggests having a key to the data cabinet locally available and removing the bird's nest.

6.3 MINISTRY OF HEALTH – NATIONAL CENTRE OF RADIOLOGY AND RADIATION PROTECTION

The National Center of Radiology and Radiation Protection (NCRRP) is a specialised administration with the Ministry of Health, charged with executing the Ministry's policy on protecting the public against ionising radiation.

There are a total of 28 Regional Inspectorates for the Protection and Control of the Public Health (RIPCPH) carrying out activities concerning public health. The RIPCPHs have radiation control units, located in Burgas, Varna, Vratsa, Plovdiv and Rousse charged with monitoring in relation to public health.

Through NCRRP the Ministry of Health implements the specialised State Health Control on the radiation parameters of the living environment in areas surrounding the former uranium production and processing sites.

The State Health Control is performed as follows:

- consultation on and approval of the Radiation Protection section of the projects for technical and biological re-cultivation of uranium production and processing sites;
- participation in committees for approval of reclaimed and re-cultivated lands.

In addition, in the vicinity of the former uranium ore mining and processing sites, tests of the living environment factors are performed. The living environment factors control includes:

- Measurement of the radiation parameters of the living environment:
  - measurement of gamma dose rate;
  - measurement of Rn-222 volume specific concentration in the air;
  - sampling and analysis of natural radionuclides' content in water, soil, sediment, vegetation and food samples;
- Compatibility assessment of the controlled parameters with the effective rules and regulation, and determination of the additional above-background exposure of the population;
- Compilation of instructions aimed at the elimination of discrepancies;
- Drawing up statements and issue of penalty notices in case of administrative breaches.

A focused control is applied in case of complaints from citizens, state and municipal authorities and organisations.

7 VISITED AND VERIFIED LABORATORIES

7.1 BURGAS

The team visited the regional laboratory of the Executive Environment Agency in Burgas. The centre employs 18 persons of which only one is running the radiological laboratory, which deals with about 100 samples per year. Sample registration is performed for the entire centre manually in one log book. Each sample has an internal identification number. The laboratory has ISO17025 accreditation (for sampling and radiological analysis for various waters, solid waste, sediments, air: valid until 31.5.2012; no detailed analysis method mentioned in certificate) and participates on a regular basis in IAEA inter-comparisons as well as in worldwide open proficiency tests. The verification team received copies of the results for some of the IAEA inter-comparisons (in IAEA nomenclature: most results acceptable, some warnings, a few not acceptable).

The team verified the gamma spectrometry laboratory which has one HPGe detector. Marinelli geometries are used for counting (e.g. 500 ml beakers for soil) and *Canberra Genie 2000* is used for analysis calculations.

The team was shown the 10 years log book with the measurement results. Calibration is done for density 1, correction for density is done by a method developed in the central laboratory in Sofia: A correction factor is calculated for the different gamma energies and the new calibration curve is stored in the analysis system. With regard to coincidence summing personnel is aware of the issue, however – as in most similar laboratories – no formalised correcting procedure is applied.

The team witnessed also a chemical hood for the drying soil samples, a *Genitron AlphaGuard* device for radon measurement as well as some mobile equipment: a *Berthold UMo LB 123* contamination monitor; a *FAG FH40F2* dose rate monitor; both with official calibration certificate by the Bulgarian National Centre of Metrology.

Sartorius and *Gibertini* balances are used in the sample preparation process.

Generally, the laboratory is in a good condition. However, having only one staff member available with detailed expertise in the field may lead to problems in the case of prolonged sick leave or holidays.

The verification team suggests finding solutions with a view to guarantee the permanent local availability of expertise in the field.

7.2 PLOVDIV

The verification team visited the regional laboratory on environment and water in Plovdiv. The laboratory has ISO 17025 accreditation (for gamma dose rate and gamma spectrometry for air, soil, and water samples) since 2004 and in total employs 25 persons, one of which for the radiological laboratory. The whole laboratory handles about 10000 samples per year, the radiologic laboratory about 300 samples (~120 samples for radiology during the first half of 2011).

The team was informed that there are 57 points for soil sampling managed by this laboratory and that dose rate is measured in parallel to this sampling as background information. All surface water samples are taken manually.

Maritsa River surface water is taken at Plovdiv once per year during spring or summer; the corresponding measurements are done in Sofia.

Gamma spectrometry

The laboratory performs gamma spectrometry on samples from tailings and on soil, sediment and rock samples. Soil samples firstly are air dried, grinded and sieved, then oven dried at 105°C for 24 hrs. Analysis results are expressed in Bq/kg dry weight. Sample size generally is some 0.5 kg.

The gamma spectrometry laboratory is air conditioned at 22°C and has a *Silena* HPGe detector (31-33%, 1.9 keV, made in 1994) with a 12-sample-changer. For the lab uses *Canberra Inspector* and *Canberra Genie* for analysis on PC. The team checked the peak shape for Cs-137 in the running test sample and found it well formed.

Ra-226 is evaluated from its 186 keV line; a correction for interference from U-235 at this energy is done on the assumption that U is of natural origin, which seems perfectly acceptable.

With regard to calibration the central laboratory in Sofia has the coordination and sends out standards (once every 3 years): a mixed radionuclide source (MRNS) from the Czech Metrological Office, on an epoxy carrier. For energy calibration the lab uses Eu-152. Calibration checks are performed once per month, energy checks once per week, with Cs-137, Am-241 and Co-60 point sources (500 sec). Background is verified several times per year during holidays (25 days). The team witnessed calibration labels on the gamma spectrometer (4.4.2007 and 15.1.2010, next recalibration in 2013). As at the Burgas laboratory, the density correction uses the methodology provided by the Sofia laboratory.

Summing corrections are (as in Burgas) apparently not contained within the spectroscopy system itself, however, the team was told that 'manual' corrections could be made if needed (without giving details about the procedure to be applied).

Measurement protocols from *Canberra Genie* evaluations were readily available. Measurements are checked manually on the evaluation printout.

For detector cooling with LN_2 the lab has a reserve dewar of 35 l (*Air Liquide TR35*).

A UPS device (*APC 1500VA* from *Canberra Central Europe*, Schwadorf, AT) guarantees sufficient electric power in case of power failures.

Tracing of a sample

For tracing purposes the verification team chose a soil sample (16.4.2010) from the region of the village of Prvenets (sample no 1007.10, protocol no 438, code 8;). It was shown all related documents: the sample sheet with name and signature of the sampler; the sampling protocol 0247 (yellow) that goes to the lab; the assignment protocol (green) that shows what has to be done; the sample result protocol (white) which is stamped and held the analysis values with signature.

The values in the sample result protocol, in the lab log book and the printout of the *Canberra Genie 2000* analysis system (no 438/1007.10; hand written corrected value) for K-40 showed perfect agreement.

All information documents were locally available (also for accreditation checks).

Calibration source archive

Sources are stored in a locked cabinet of metal built into a concrete wall (key is hidden).

Sample archive

The laboratory keeps samples for one year. After this they are either deposed as waste or returned to the location of sampling ('active' ones). Five samples per year are sent to Sofia for comparison measurement there.

Quality Management

The laboratory has ISO 17025 accreditation for most tasks. Annually, it participates in inter-comparison exercises. The verification team noted several certificates for successful participation in IAEA AQCS Programme inter-comparison exercises.

Daily records are introduced into the log book.

Measurements are performed according to a quality assurance protocol, reports are made in two copies: one is kept in Plovdiv, the other one is sent to Sofia via internet. Every three months data are transferred to the central data base in Sofia.

Balances

Balances are checked (certified) every three years by a firm; at each use tests are made and the results signed.

Generally, the laboratory is in a good condition. However, having only one staff member available with detailed expertise in the field may lead to problems in the case of prolonged sick leave or holidays.

> *The verification team suggests finding solutions with a view to guarantee the permanent local availability of expertise in the field.*

Plovdiv dose rate station

The team verified also the Plovdiv dose rate station located at the regional laboratory backyard. The gamma dose rate probe is of the same type as the ones at Elhovo and Mt. Rozhen (*Hörmann/TechniDATA*). Data transmission is online by radio connection. Data are displayed in the office of director (at the time of the visit 0.014 mR/h), the key for the electronics rack was not available.

The general location of the probe is good (wide Maritsa valley). However, trees (ca 5 m high, were small when the station was set up) are in a distance of some 10 m. The two-storey lab building is ca 15 m away.

The verification team suggests changing the unit for displaying radiation data from mR/h to a useful SI unit (e.g. µGy/h or µSv/h). It also suggests having a key to the data cabinet locally available. The trees in the vicinity of the dose rate probe may have to be cut in the near future with a view to reduce any disturbing influence on the measurement.

8 CONCLUSIONS

All verifications that had been planned by the verification team were completed successfully. In this regard, the information supplied in advance of the visit, as well as the additional documentation received during and after the verification, was useful.

(1) The verification activities that were performed demonstrated that the facilities necessary to carry out continuous monitoring of levels of radioactivity in the air, water and soil around the remediated former uranium mining and processing sites at Momino, Sliven, Orlov Dol, Vladimirovo, Smolyan and Dospat Barutin as well as the verified parts of the national monitoring system for environmental radioactivity are adequate. The Commission could verify the operation and efficiency of these facilities.

(2) A few topical suggestions and recommendations are formulated. These aim at improving some aspects of the remediation and the environmental surveillance of former uranium sites and do not discredit the fact that environmental monitoring around former uranium sites is in conformity with the provisions laid down under Article 35 of the Euratom Treaty if the measures are maintained in the long term and the recommendations implemented.

(3) With regard to the situation at Vromos Bay (area of a former copper mine at Rossen with releases of natural radionuclides to that bay leading to elevated radiation levels) the verification team recommends that the radiation dose received by the residents of houses near the contaminated area be checked – especially with regard to Rn-222 – and construction of houses on contaminated areas be prevented effectively if radiation levels are above limit.

As long as radiation levels at the beach are above limit, the team strongly recommends closing the beach as recommended by the Ministry of Health and making sure that public access is prevented effectively by local authorities.

(4) The verification team recommends studying the issue of leachates accumulating inside the mines (production level), in particular with regard to any contamination of ground water in the very long run, with a view to prevent any future problems with drinking water. Especially in the case of extensive use of such waters for irrigation in agricultural production intensified monitoring is recommended. Also, the issue of the use of outburst springs in uranium mining areas for watering cows should be studied and an appropriate monitoring (e.g. of milk) be set up.

Furthermore, the team recommends for all remediated sites maintaining an appropriate radiological monitoring (e.g. with regard to radon emanation at the site and potential groundwater contamination). Such monitoring would have to be in place for long term surveillance; adequate administrative and financial support would be necessary.

(5) The Commission services ask the Bulgarian competent authority to inform them of any progress or significant changes with regard to the situation at the time of the verification, in particular with regard to (3).

(6) The present Technical Report is enclosed with the Main Conclusions document and is addressed to the Bulgarian competent authorities through the Bulgarian Permanent Representative to the European Union.

(7) Finally, the verification team acknowledges the excellent co-operation it received from all persons involved in the activities it performed.

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APPENDIX 1

THE VERIFICATION PROGRAMME – OVERVIEW

Art. 35 verification BG – 11 to 15 July 2011
Former uranium mining and contaminated areas
National monitoring network

Sun 10.7.	Travel to Sofia
Mon 11.7.	Sofia, MEET: Opening Meeting
	Momino: site visit
	Sliven: site visit
Tue 12.7.	Burgas: Visit national monitoring system lab.
	Rossen mine, Vromos Bay: site visit
	Elhovo: Visit national monitoring system station
	Orlov Dol: site visit
	Vladimirovo: site visit
Wed 13.7.	Plovdiv: Visit national monitoring system station, lab.
	Mt. Rozhen: Visit national monitoring system station
Thu 14.7.	Smolyan: site visit
	Dospat: site visit
Fri 15.7.	Sofia, MEET: closing meeting
	Return flight

EC Team: Constant Gitzinger, Eberhardt Henrich, Erich Hrnecek
Head of verification team: Constant Gitzinger

APPENDIX 2

DOCUMENTATION RECEIVED AND CONSULTED WEB SITES

In reply to a specific questionnaire on Art.35 matters that was submitted by the Commission services to the competent Bulgarian authorities in preparation of the visit, an explanatory text document with numerous detailed appendixes was received. This document entitled "Preliminary information on the implementation of the obligations under Article 35 of the EURATOM treaty" was prepared by the Bulgarian authorities for the purposes of the verification mission of the EC. The document answers relevant questions concerning uranium mining and milling in Bulgaria (legal situation; competent authorities; uranium mining and milling - historical and actual situation; radiological site monitoring and remediation activities, etc..

Note: This list does not include various other documents that were asked for (and received) during the verification activities such as calibration certificates, standard operation procedures, quality assurance procedures, source records and measurement results, technical drawings, legislative texts, reports …

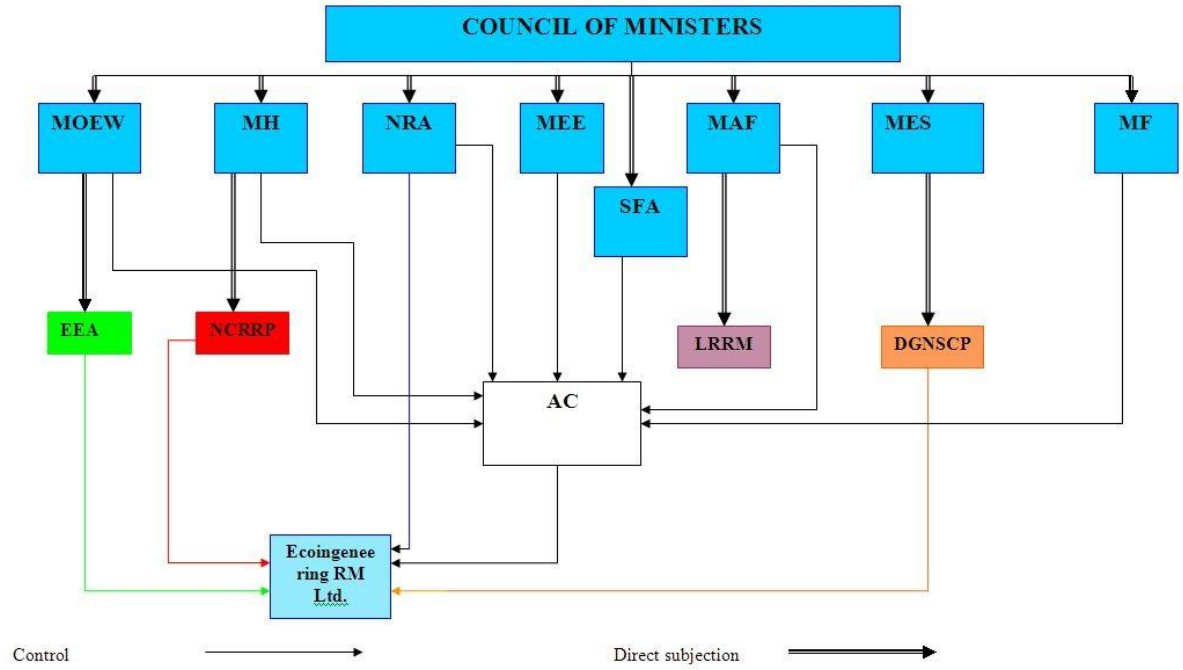
Consulted web sites

Ministry of Economy, Energy and Tourism	www.mee.government.bg
Ministry of Health	www.mh.government.bg
Ministry of Environment and Waters	www.moew.government.bg
Ministry of Agriculture and Food Supply	www.mzh.government.bg
Ministry on State Policy for Disasters and Accidents	www.mdpba.government.bg
Ministry of Emergency Situations	www.mes.government.bg
Nuclear Regulatory Agency	www.bnra.bg
National Center of Radiobiology and Radiation Protection	www.ncrrp.org
Executive Environment Agency	http://nfp-bg.eionet.eu.int/ncesd/eng/index.html

APPENDIX 3

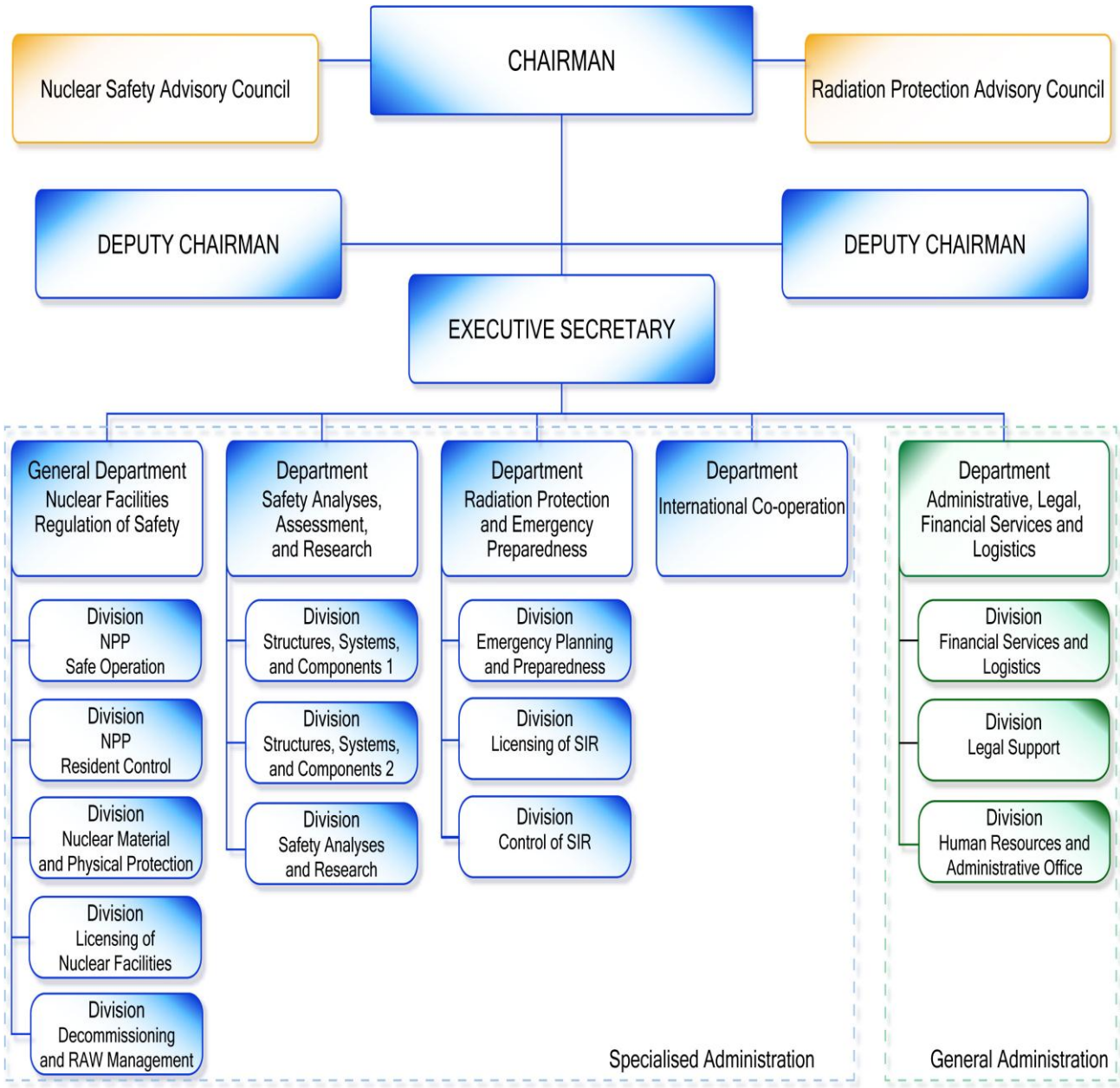
MINISTRIES AND BODIES HAVING COMPETENCE IN RADIATION PROTECTION AND ENVIRONMENTAL RADIATION MONITORING

SCHEMATIC CHART OF COMPETENT AUTHORITIES HAVING DUTIES UNDER CMD No 74 of 1998



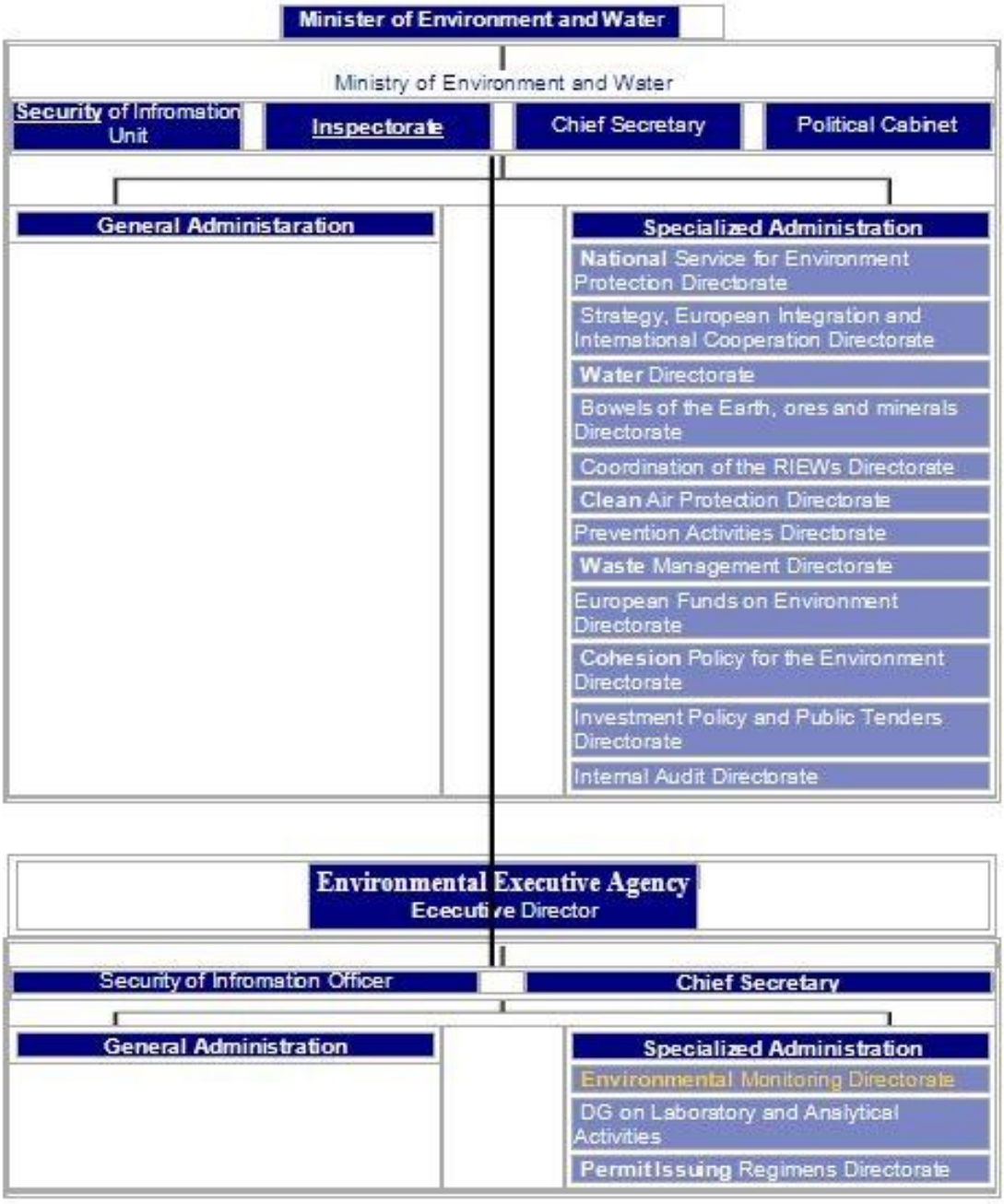
APPENDIX 4

NUCLEAR REGULATORY AGENCY - ORGANISATIONAL CHART



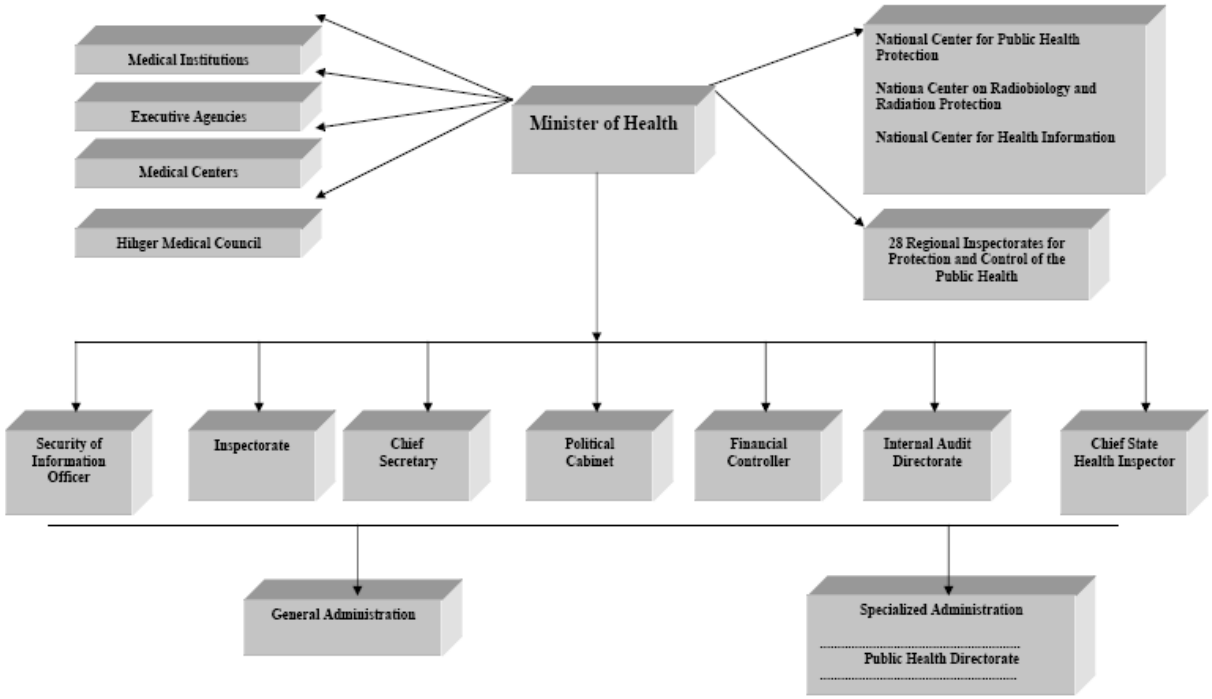
APPENDIX 5

MINISTRY OF ENVIRONMENT AND WATERS - ORGANISATIONAL CHART



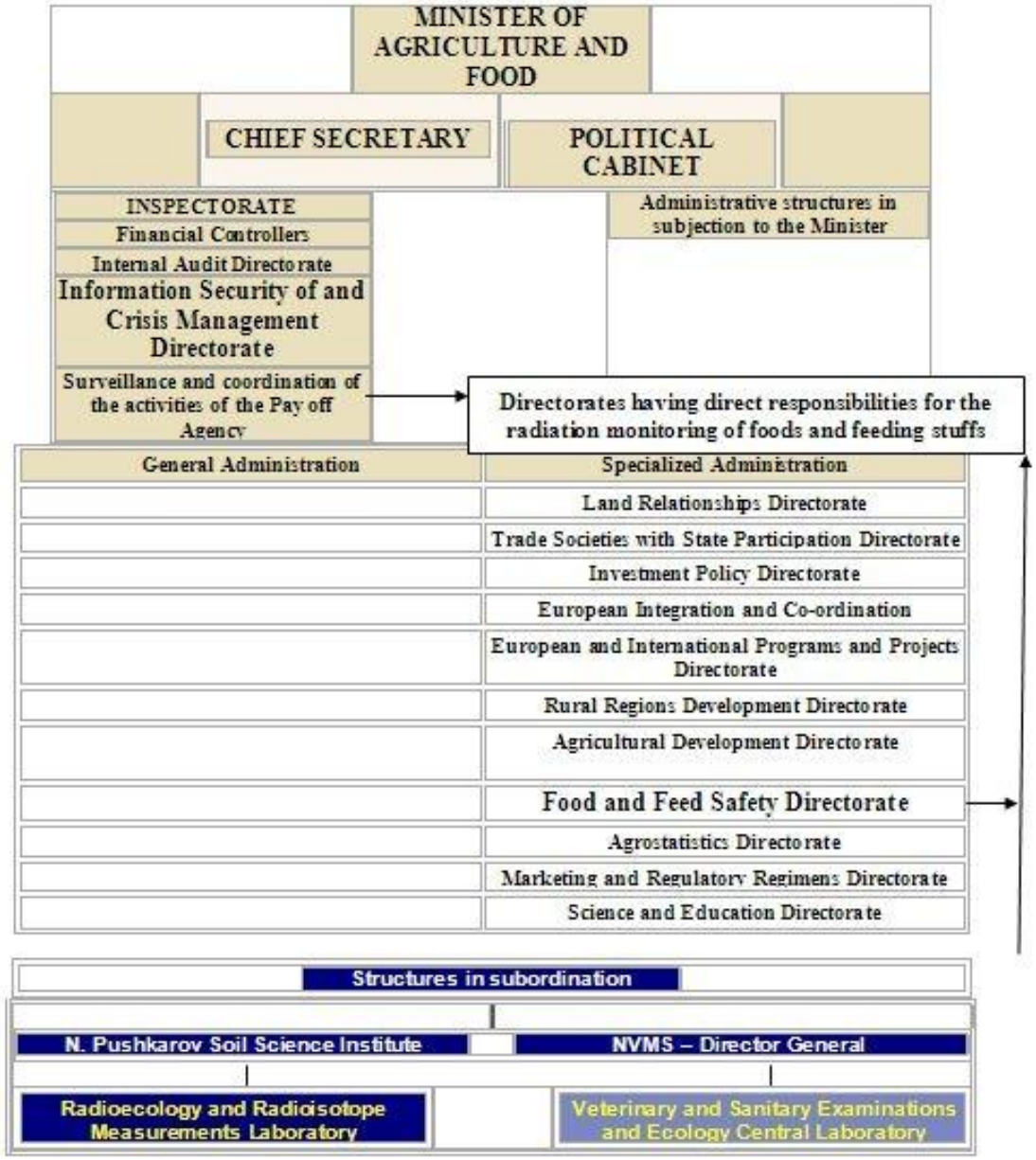
APPENDIX 6

MINISTRY OF HEALTH - ORGANISATIONAL CHART



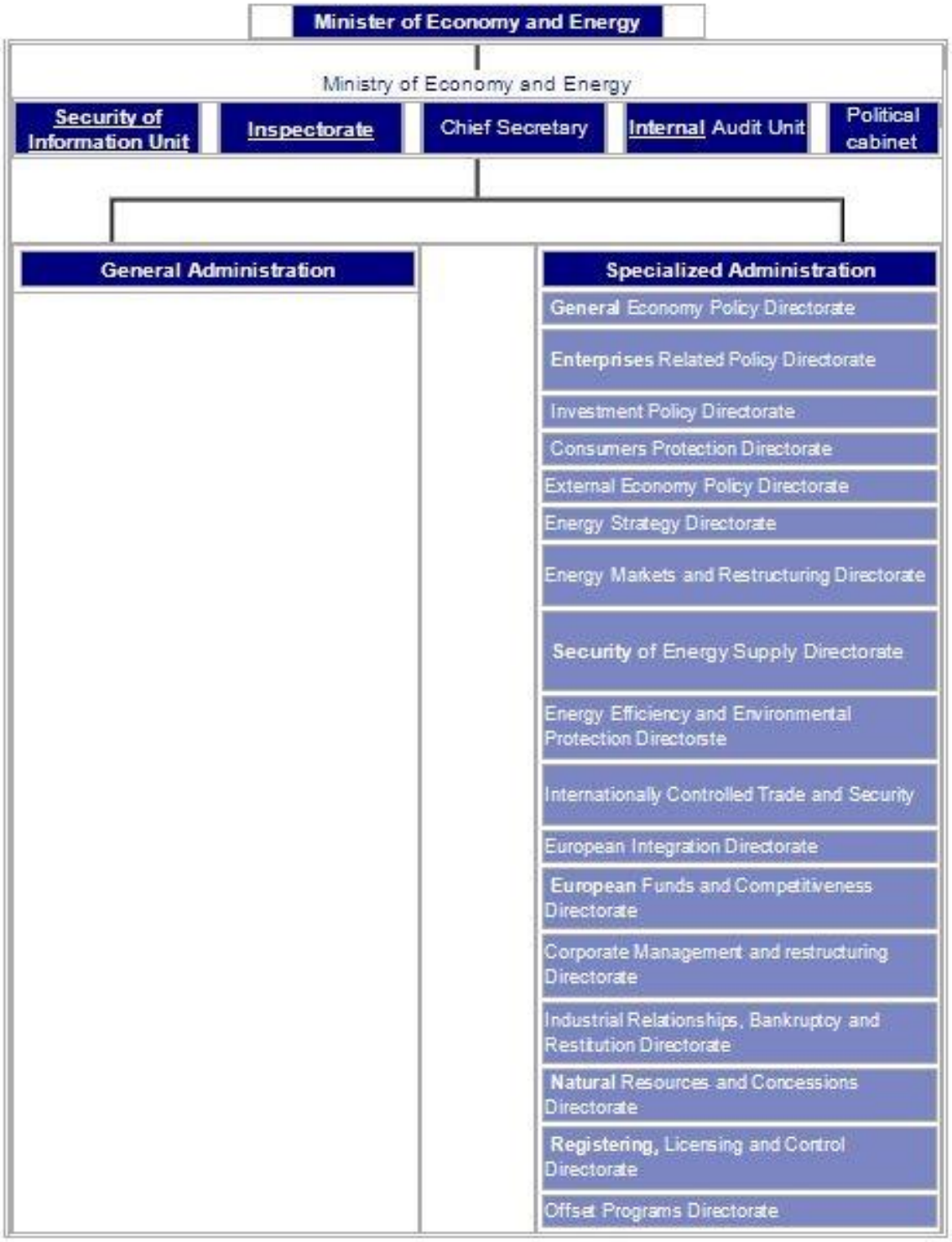
APPENDIX 7

MINISTRY OF AGRICULTURE AND FOOD – ORGANISATIONAL CHART



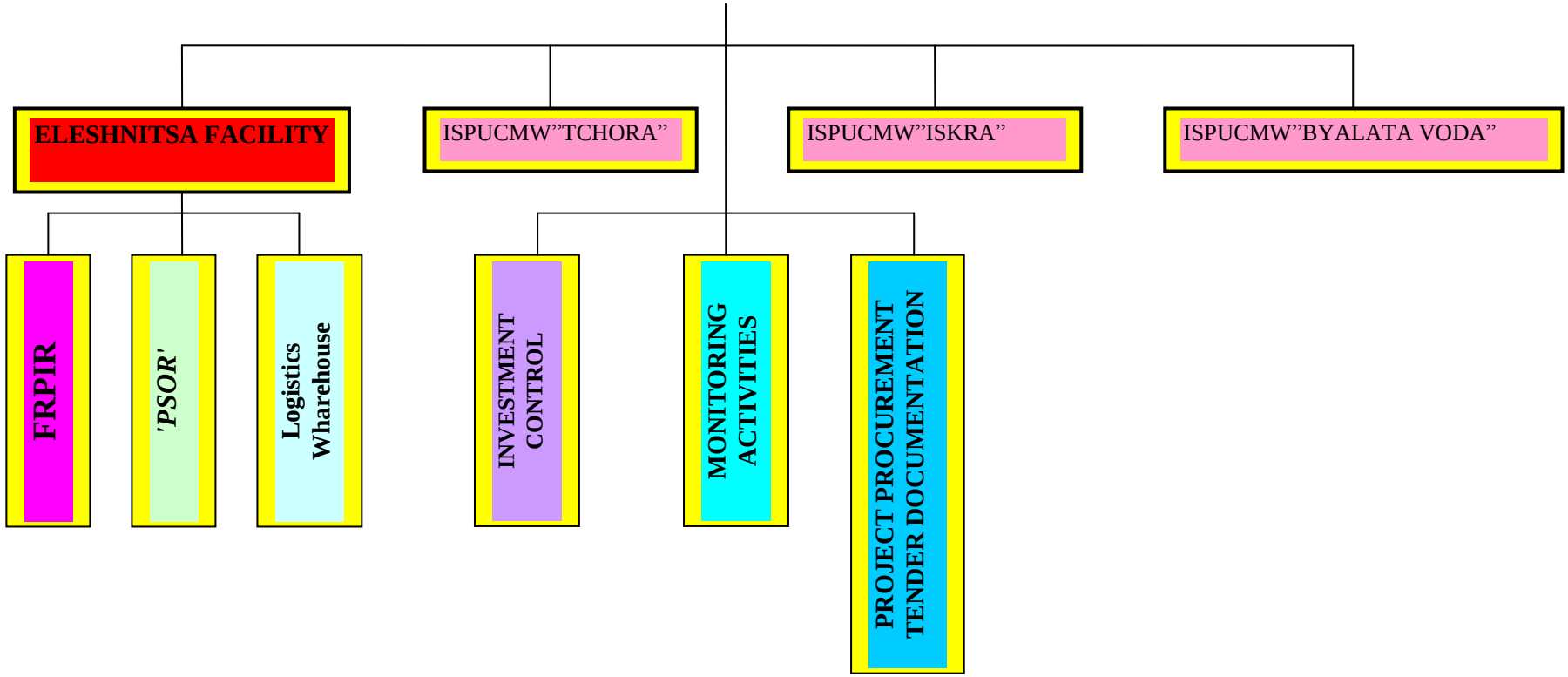
APPENDIX 8

MINISTRY OF ECONOMY, ENERGY AND TOURISM – ORGANISATIONAL CHART



APPENDIX 9

ECOENGINEERING – ORGANISATIONAL CHART



APPENDIX 10

MONITORING PROGRAMME 2009 FOR THE SITES INDICATED IN CMD 74 OF 1998

(NCRRP CLASSIFICATION ACCORDING TO THE LEVEL OF RADIATION RISK)

№	(Closed) uranium mining site	Number of mines	Number of monitoring points	Underground water	Surface water
1	**2**	**3**	**4**	**5**	**6**
Sites with High radiation risk according to the classification by the NCRRP					
1	**Druzhba 1 and 2**	2	17	9	8
2	***Metalurg* plant and tailings pond**	1	7	4	3
3	**Sliven**	1	4	4	-
4	**Fifth shaft**	1	6	5	1
5	**Naretchen**	1	2	1	1
	Sub-Total:	**6**	**36**	**23**	**13**
Sites with Medium radiation risk according to the classification by the NCRRP					
6	**Shafts 7 and 8**	2	14	9	5
7	**Izgrev**	1	13	8	5
8	**Smolyanovtsy shaft**	1	4	3	1
9	**Selishte**	3	6	5	1
10	**Byalata voda**	1	2	1	1
11	**Senokos**	1	9	7	2
12	**Proboynitsa**	2	4	3	1
13	**Beli Iskar***	2	4	2	2
14	**Babeshka river**	1	4	3	1
15	**Melnik**	1	5	3	2
16	**Pripetchene**	1	3	3	-
17	**Sugarevo**	1	3	1	2
18	**Dobralak**	1	3	1	2
19	**Partizanska (Kirilova) poliana**	2	7	2	5
20	**Yavorovets**	1	6	3	3
21	**Ribaritsa**	1	4	1	3
	Sub-Total:		**91**	**55**	**36**
ISPUCMWs - according to permits, issued by the Basin Directorates to the MOEW for water embedding					
22	**ISPUCMW "Chora"**	1	6	5	1
23	**ISPUCMW "Iskra"**	1	5	3	2
	Sub-Total:	**2**	**11**	**8**	**3**
Sites with Low radiation risk according to the classification by the NCRRP					
24	**Bortche**	1	5	2	3

№	(Closed) uranium mining site	Number of mines	Number of monitoring points	Underground water	Surface water
25	**Tcheshmata**	1	3	3	-
26	**Navasen**	1	4	3	1
27	**Troyan**	1	3	2	1
28	**Orlov dol**	1	3	2	1
29	**Madrets**	1	3	2	1
30	**Vladimirovo**	1	2	2	-
31	**Zdravets**	1	2	2	-
32	**Brezhani**	1	1	1	-
33	**Igralishte**	1	2	1	1
34	**Gabra**	1	3	1	2
35	**Golak - sreden**	1	4	2	2
36	**Pratevoto**	1	6	3	3
37	**Planinets**	1	3	2	1
38	**Beslet**	1	4	2	2
39	**Krupnik**	1	3	3	-
40	**Svidnya**	1	4	2	2
41	**Belmeken**	1	6	2	4
42	**Dobarsko**	1	2	2	-
43	**Katina**	1	2	-	2
44	**Zlatolist**	1	2	1	1
45	**Kosovo**	1	1	1	-
46	**Skrebatni polyani**	1	3	1	2
47	**Gradevo**	1	1	-	1
48	**Bazelivo dere**	1	3	1	2
49	**Lipets**	1	3	1	2
50	**Bablon**	1	3	-	3
51	**Vitina**	1	3	1	2
52	**Shtodenski vrah**	1	3	2	1
53	**Bukovo**	1	2	-	2
Sub-Total:			**89**	**47**	**42**
Total for 2009			**227**	**133**	**94**

APPENDIX 11

METHODOLOGY FOR SAMPLING OF WATER, SOIL AND SEDIMENTS AND FOR FIELD MEASUREMENTS

Water - surface and underground

The sampling of surface and underground water is carried out at each of the established water monitoring points, which are specifically marked with permanent markings.
During the water sampling the electrical conductivity, pH, Eh, temperature and dissolved O_2 are measured using portable, temperature compensated equipment (*WTW 340i* from Germany), with a set of sensors, which are easily calibrated under field conditions.
At water monitoring points obligatory measurements are carried out of the level, discharge, and water temperature. Discharge measurement is carried out using a volumetric method – through a measuring container with a defined volume and a stopwatch – for catchment drain water, underground mine drifts and naturally outpouring boreholes. The mean value of three consecutive measurements is accepted as credible. For sources without catchment, small streams and rivers, the method uses portable overflow drains (type *Cipolletti*, *Thomson*) or hydraulic propellers.

Sampling of surface water

The sampling of water from surface streams and rivers is carried out using an appropriate recipient (PVC-can with a volume of up to 5.0 litres) plunged below the water level at the location with the fastest flow, , paying attention that the sample is not contaminated with outside impurities (for instance sludge from the river bed).

Sampling of underground water

The sampling of underground water is carried out with a submersible pump (*Grundfos* model *MP-1* or *SQ 3-40*, for depths from 50 to 90 m), or with a centrifuge motor pump. The water sample is taken after constant values of the electrical conductivity, pH and temperature are reached or, alternatively, if the water quantity is at least three times greater than the borehole volume. The sampling from naturally outpouring boreholes is direct

Soils, sediments, and technologically contaminated terrains

All soil sampling points are defined for each of the local monitoring networks and are permanently marked.
In the cases where no monitoring networks are established, individual sampling points or profiles at the spoil heaps are defined.
Soil samples are taken under dry weather conditions. The samples are taken from depths of 25-30 cm for arable land and 10-15 cm for uncultivated or forest areas, at four points, N, S, E and W, approximately 5 m from the permanent marking. Using a soil sampler, about 1.5 dm^3 of soil is taken. The four samples are mixed, then divided in four parts; about 1.5-2.0 kg is filled in a paper bag. The sample number, point number and the sampling date are marked on the paper bag. A paper label with the same data is put into the bag. The sampling place is photographed, GPS–coordinates are taken.
Sampling from technologically contaminated terrains is carried out in the same way. During sampling, measurements of the gamma dose rate are carried out, either in contact with the soil or at 1 m above ground. Measurements are carried out using a calibrated scintillation radiometer, type *SRP 68-01* or with a gamma-ray detector with external probe, type *FH-40GL-10*.
Sediment sampling is carried out at the same points, where surface water monitoring is done, normally at the end of summer, after a long period of drought. Sediment sampling is carried out directly from the river beds. The material, with a volume of 8 to 10 dm^3, is divided in four parts which are piled up on the river bank for 2-3 hours at an appropriate place for drainage. After that a homogenised sample comprising about 1.5 – 2 kg from each part is taken. The sample is packed in a labelled plastic bag,

with the sample number, as well as the sampling point number and the sampling date being indicated. The sampling place is photographed, GPS–coordinates are taken.
Surface α and β contamination measurements are performed at the posts, facilities, sorption installations, working premises and spoil heaps. They are carried out with field α, β, γ detectors with an external probe of the type *FH-40GL-10*.

Radon at the mine outlets

Radon measurements, at shafts and stulms of the closed sites, are carried out twice a year with a radiation meter *AlphaGUARD PQ 2000*. Measuring time is 30 minutes (three consecutive measurements of 10 minutes each).
Simultaneously with the radon concentration measurements, the device continuously supplies data on temperature, atmospheric pressure and air humidity.

In parallel with the observations, sampling and field measurements, a technical inspection of the status of the facilities is carried out, including boreholes, pits and their outlets, stulms and their outlets, status and terrain markings. All observed changes of terrain status are documented, an assessment is carried out and a proposal for any necessary repair, recovery or replacement measures is issued.