



EUROPEAN COMMISSION  
DIRECTORATE-GENERAL FOR ENERGY

DIRECTORATE D - Nuclear Safety and Fuel Cycle  
D.3 Radiation Protection

# TECHNICAL REPORT

## VERIFICATIONS UNDER THE TERMS OF ARTICLE 35 OF THE EURATOM TREATY

### URANIUM MINING, PROCESSING, FUEL FABRICATION AND NATIONAL MONITORING NETWORKS

ROMANIA

20 to 24 August 2012



Reference: RO-12/05

**VERIFICATIONS UNDER THE TERMS OF ARTICLE 35  
OF THE EURATOM TREATY**

FACILITIES: Former uranium mines; uranium processing and nuclear fuel fabrication; national environmental radioactivity monitoring network and its regional laboratories

SITES: Bihor, Banat, Feldioara, Pitești-Mioveni, Pitești, Alba Iulia

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<b>TECHNICAL REPORT</b>
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**ABBREVIATIONS**

ADU	Ammonium DiUranate
AECL	Atomic Energy Canada Limited
ALMERA	Analytical Laboratories for the Measurement of Environmental Radioactivity (network established by the IAEA in 1995)
ANDRAD	(former) <i>Agenția Națională pentru Deșeuri RADioactive</i> (National Agency for Radioactive Waste)
AN&DR	Nuclear Agency and for Radioactive Waste
ANPM	<i>Agenția Națională pentru Protecție Mediului</i> (National Environmental Protection Agency, NEPA)
ANSVSA	<i>Autoritatea Națională Sanitară Veterinară și pentru Siguranța Alimentelor</i> (National Sanitary, Veterinary and Food Safety Authority)
ARPM	<i>Agenția Regională de Protecția Mediului</i> (Regional Environmental Protection Agency, REPA)
ASP	(former) <i>Autoritatea de Sănătate Publică</i> (Public Health Authority)
DSP	<i>Direcția de Sănătate Publică (Directorate of Public Health)</i>
CANDU	CANadian Deuterium Uranium (nuclear power reactor design)
CIPM	<i>Comité international des poids et mesures</i> (International Committee for Weights and Measures)
CNCAN	<i>Comisia Națională pentru Controlul Activităților Nucleare</i> (National Commission for Nuclear Activities Control)
CNE	<i>Centrala Nuclearo-Electrica Cernavodă</i> (Cernavodă Nuclear Power Plant)
CNU	<i>Compania Națională a Uraniului</i> (National Uranium Company)
CRL	CNCAN's Reference Laboratory for radioactivity
DCC	<i>Departamentul de Control Calitate</i> (Department of Quality Control)
DEL	Derived Emission Limit
DG	Directorate-General
DG ENER	Directorate-General for Energy
DSN	<i>Departamentul de Securitate Nucleară</i> (Nuclear Safety Department)
EC	European Commission
EIA	Environmental Impact Assessment
EURDEP	European Radiological Data Exchange Platform
EWS	Early Warning System
FC	<i>Fascicul de Combustibil nuclear</i> (Nuclear fuel bundle)
FCN	<i>Fabrica de Combustibil Nuclear</i> (Nuclear Fuel Plant)
FDO	<i>Foraj De Observație</i> (observation borehole)
GIS	Geographical Information System
GM	Geiger Müller (radiation detector)
GPRS	General Packet Radio Service
HEPA	High Efficiency Particulate Air (filter material)
HPGe	High Purity Germanium (radiation detector)
IAEA	International Atomic Energy Agency
ICP-MS	Inductively Coupled Plasma Mass Spectrometry
ICP-OES	Inductively Coupled Plasma Optical Emission Spectroscopy
ICRP	International Commission on Radiological Protection
IFIN-HH	<i>Institut national de cercetare-dezvoltare pentru Fizică și Inginerie Nucleară – Horia Hulubei</i> (Horia Hulubei National Institute of Research and Development in Physics and Nuclear Engineering)
NaDU	sodium diuranate
NIPH	National Institute of Public Health
IT	Information Technology
ITN	<i>Institutul de Tehnologii Nucleare</i> (Institute for Nuclear Technologies)
IRNE	<i>Institutul de Reactori Nuclear-Energetici</i> (Institute for Nuclear Power Reactors)
ISO	International Organization for Standardization

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JRC	Joint Research Centre (European Commission DG)
LAFC	<i>Laboratorul de Analize Fizico-Chimice</i> (Physico-Chemical Analysis Laboratory)
LEPA	Local Environmental Protection Agency
LI	Line One (refining technological line number one)
LIMS	Laboratory Information Management System
LRPMPC	<i>Laboratorul de Radioprotecție, Protecția Mediului și Protecție Civilă</i> (Laboratory for Radiation Protection, Environmental Protection and Civil Protection, at SCN-Pitești)
LRDP	<i>Laboratorul de Radioprotecție și Dozimetrie Personal</i> (Radiation Protection and Personal Dosimetry Laboratory)
LSC	Liquid Scintillation Counting/Counter (radiation measurement)
MAAPDR	(former) <i>Ministerul Agriculturii, Alimentației, Padurilor și Dezvoltării Rurale</i> (Ministry of Agriculture, Foodstuffs, Forests and Rural Development)
MADR	(former) <i>Ministerul Agriculturii și Dezvoltării Rurale</i> (Ministry of Agriculture and Rural Development)
MCA	Multi Channel Analyser
MEF	Ministry of Environment and Forests
MEG	<i>Monitor Efluenți Gazoși radioactivi</i> (Gaseous Effluents Monitor)
MH	Ministry of Health
MMDD	(former) <i>Ministerul Mediului și Dezvoltării Durabile</i> (Ministry of the Environment and Sustainable Development)
MMP	<i>Ministerul Mediului și Pădurilor</i> (Ministry of Environment and Forests, MEF)
MRA	Mutual Recognition Arrangement
MSR	<i>Manual de Securitate Radiologică</i> (Manual of Radiological Safety)
NaI(Tl)	Sodium Iodide, Thallium activated (gamma radiation detector)
NEPA	National Environmental Protection Agency
NERSN	National Environmental Radioactivity Surveillance Network
NIM	Nuclear Instrumentation Module
NIST	(U.S.) National Institute of Standards and Technology
NPP	Nuclear Power Plant
NRL	(NEPA's) National Reference Laboratory (for radioactivity), National Environmental Radioactivity Laboratory
NUC	National Uranium Company
ODA	<i>Organism Dozimetric Acreditat</i> (Approved Dosimetry Service)
OG	Official Gazette (Official Journal of Romania)
OJ	Official Journal (of the European Institutions)
PC	Personal Computer
PDT	<i>Platforma de depozitare temporară</i> (platform for temporary storage of contaminated solid waste)
PVC	PolyVinylChloride
QA / QC / QM	Quality Assurance / Quality Control / Quality Management
R&D	Research and Development
RAAN	<i>Regia Autonomă pentru Activități Nucleare</i> (Autonomous Administration for Nuclear Activities)
REM	Radioactivity Environmental Monitoring
RENAR	<i>Asociația de Acreditare din România</i> (Romanian Accreditation Association)
REPA	Regional Environmental Protection Agency
RML	Radionuclide Metrology Laboratory (at IFIN-HH)
RP	<i>RadioProtecție</i> (Radiation Protection)
SCDLR	<i>Stația pentru Colectarea Deșeurilor Lichide Radioactive</i> (Station for Collection of Liquid Radioactive Waste)
SCEAR	<i>Stație de Colectare și Evacuare Ape Reziduale</i> (Station for Collection and Discharging of Wastewaters)
SCN	<i>Sucursala de Cercetări Nucleare</i> (Institute for Nuclear Research, at Pitești)
SCPA	<i>Sistem Central de Prelevat Aerosoli</i> (central system for aerosol sampling)

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<i>SE</i>	<i>Stația de Epurare</i> (purification station)
<i>SEDO</i>	Safety Evaluation During Operation (IAEA mission task)
<i>SIPC</i>	<i>Sistem Izocinetic de Prelevare la Coș</i> (isokinetic stack sampling system)
<i>SMI</i>	<i>Sistemul de Management Integrat</i> (Integrated Management System)
<i>SMM</i>	<i>Sistemul de Managementul Mediului</i> (Environmental Management System)
<i>SNN-SA</i>	<i>Societatea Națională Nuclearelectrica SA</i> (National Company <i>Nuclearelectrica SA</i> , Bucharest)
<i>SPEC</i>	<i>Secția de Producție Elemente Combustibile</i> (nuclear fuel elements manufacturing section)
<i>SRPM</i>	<i>Serviciul Radioprotecție Garanții Nucleare și Protecția Mediului</i> (Radioprotection, Nuclear Safeguards and Environmental Protection Service)
<i>SSRM</i>	Surveillance Station of Radioactivity Monitoring (of the LEPAs and REPAs)
<i>STDR</i>	<i>Stația de Tratare Deșeuri Radioactive</i> (Radioactive Waste Treatment Station, belonging to <i>SCN Pitești</i> )
<i>TLD</i>	Thermo Luminescence Dosimeter/Dosimetry
<i>TÜV</i>	<i>Technischer ÜberwachungsVerein</i> (German technical service business)
<i>UPS</i>	Uninterruptible Power Supply
<i>WHO</i>	World Health Organization
<i>ZPI</i>	Zircatec Precision Industries Inc.



## 1 INTRODUCTION

Article 35 of the Euratom Treaty requires that each Member State shall establish 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 <sup>(1)</sup>

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 (at the time of the visit: ENER.D.4, now ENER.D.3) 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, terrestrial and aquatic environment around the site, for all relevant pathways.
- Levels of environmental radioactivity on the territory of the Member State.

On 4 July 2006 the Commission published a Communication in the Official Journal (OJ 2006/C 155/02) with a view to define some practical arrangements for the conduct of Article 35 verification visits in Member States.

From 20 to 24 August 2012 a verification team from the then DG ENER.D.4 visited the former uranium mining, the uranium processing and the nuclear fuel fabrication installations in Bihor, Banat, Feldioara and Pitești as well as parts of the national environmental radioactivity monitoring network in these regions including some of its regional (local) laboratories.

The visit included meetings with representatives of various national authorities having responsibility in the field of radiation protection. A closing meeting was held, with all parties involved during the visit, at the premises of the National Commission for Nuclear Activities Control (CNCAN).

The present report contains the results of the verification team's review of relevant aspects of the radiological environmental surveillance on and around the nuclear sites in Bihor, Banat, Feldioara and Pitești as well as of the regional radiological surveillance in central and western Romania.

The report is based on the verification findings, on information collected during the verification including documents received and on discussions with various persons during the visit.

## 2 PREPARATION AND CONDUCT OF THE VERIFICATION

### 2.1 PREAMBLE

The Commission's request to conduct an Article 35 verification was notified to the Romanian Permanent Representation to the European Union by letter ENER/D4/CG/es Ares(2012) of 3 February 2012. Practical arrangements for the implementation of these verifications were made with the Romanian competent authorities.

### 2.2 PROGRAMME OF THE VISIT

On 20 August 2012 an opening meeting was held at the CNCAN premises in Bucharest where, in conjunction with the Romanian competent authorities and representatives of the site operators, the programme of verification activities was discussed and finalised.

The agreed programme comprised:

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<sup>1</sup> 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).

- The verification of liquid and gaseous radioactive discharges from some of the former Bihor and Banat uranium mining sites as well as from the Feldioara uranium milling and processing site and the Pitești nuclear fuel production site (sampling and monitoring systems, analytical methods, quality assurance and control aspects, reporting);
- The verification of the site-related environmental radiological monitoring programmes as implemented by the operator and the regulator for some of the former Bihor and Banat uranium mining sites as well as for the Feldioara uranium milling and processing site and for the Pitești nuclear fuel production site (technical aspects of monitoring and sampling activities, analytical methods used, quality assurance and control, archiving and reporting).
- A verification of parts of the national environmental radioactivity monitoring/sampling networks (Alba Iulia and Pitești area).

The verifications were carried out in accordance with the programme in Appendix 1.

### 2.3 DOCUMENTATION

In order to facilitate the work of the verification team, a package of information was supplied in advance by the Romanian authorities. Additional documentation was provided during and after the visit. All documentation received is listed in Appendix 2. The verification team notes the comprehensiveness of all presentations made and documentation provided.

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

### 2.4 REPRESENTATIVES OF THE COMPETENT AUTHORITIES AND THE OPERATORS

During the verification visit, the following representatives of the national authorities, the operators and the other parties involved were met:

#### **National Commission for Nuclear Activities Control (CNCAN), Bucharest**

Name	Function
Mrs Borbala Vajda	President (till 21.08.2012)
Mr Constantin Popescu	President (since 22.08.2012)
Mr Cantemir Ciurea Ercau	Director, Nuclear Fuel Cycle Division
Mrs Mihaela Ion	Head, Dept. International Affairs
Mr Nicolae Dumitrescu	Coordinator, Safeguards, Physical Protection and Mining Compartment
Mrs Irene Popovici	Senior expert, Safeguards, Physical Protection and Mining Compartment

#### **National Environmental Protection Agency (NEPA), Bucharest**

Dr Ing Mihail Fâcă	State secretary, NEPA President
Mrs Elena Simion	Head of Environmental Radioactivity Laboratory

#### **Regional Environmental Protection Agency (REPA), Pitesti**

Ms Mariana Ionescu	Director
Mr Milică Geanta	Head of Monitoring Department
Mr Cristian Floroiu	Coordinator of the Environmental Radioactivity Surveillance Station

#### **Regional Agency for Environmental Protection (LEPA), Alba Iulia**

Mrs Mihaela Mih-Dehelean	Executive Director
Mr Nicolai Gheorghhe	Head of Monitoring Service
Mrs Anina Oprița	Coordinator of the Environmental Radioactivity Surveillance

	Station
Mrs Claudia Luca	Technician of the Environmental Radioactivity Surveillance Station

### **National Uranium Company, Bucharest**

Mr Marian Aretu	Deputy General Director
Mr Adam Constantin Dorin	Director
Mr Dan Manea	Chief of Radioprotection Department
Mr Filip Dorin	Head of Environment Protection Office

### **Uranium Milling and Processing Plant, Feldioara**

Mr Cosmin Dorel Toderaş	Director
Mr Tudor Lavric	Technical Director
Ms Stela Popescu	Head Environmental Protection Office
Mrs Adina Sav	Chemical engineer
Mrs Marinela Andrei	Environmental engineer
Mr Răzvan Banciu	Radiation Protection
Mr Nicolae Fogoroş	Responsible Uranium Recovery Station
Mr Radu Rusei	Environmental Protection Office

### **Bihor uranium mining site**

Mr Mihai Harn	Director
Ing Bogdan Gheorghe	Engineer

### **Banat uranium mining site**

Mr Clepan Ştefan	Director
Ing Valentin Calen	Engineer

### **Nuclear Fuel Production Plant Piteşti**

Mr Gheorghe Andrei	FCN Director
Mr Vasile Băilescu	Chief Engineer Technical Direction (FCN)
Mr Sorin Popescu	Chief Engineer Quality Management Direction (FCN)
Mrs Vasilica Olaru	Specialist Engineer in SRPM (FCN)
Mr Tiberiu Ivana	Chief of Radioprotection, Nuclear Safeguards and Environmental Protection Service – SRPM (FCN)
Mr Alexandru Toma	Chief of Laboratory for Radiation Protection, Environmental Protection and Civil Protection (SCN-Piteşti)
Mr Nicolae Dulama	Specialist Engineer of LRPMP (SCN-Piteşti)
Mr Ovidiu Hirica	QA responsible of LRPMP (SCN-Piteşti)
Mrs Mădălina Ticea	Chief of Purification Station (SCN-Piteşti)

## **3 LEGISLATION RELEVANT IN THE CONTEXT OF THE VERIFICATION**

### **3.1 LEGAL PROVISIONS FOR DISCHARGES FROM AND FOR ENVIRONMENTAL RADIOACTIVITY MONITORING AT NUCLEAR SITES**

The discharge and monitoring of radioactive effluents resulting from the operation of a nuclear installation is regulated by *CNCAN* in accordance with the provisions of:

- Law no. 111/1996 on the safe deployment, regulation, authorisation and control of nuclear activities, republished by the Romanian Parliament in 2006 (Romanian Legislation: The safe deployment of nuclear activities, Volume 77, 2006);

and

- Fundamental Norms for Radiological Safety, approved by *CNCAN* President Order No. 14/2000;

as well as the specific provisions of:

- Norms regarding the limitation of the radioactive effluents discharges to the environment, approved by *CNCAN* President Order No. 221/2005.
- Norms regarding the monitoring of radioactive emissions from nuclear or radiological facilities, approved by *CNCAN* President Order No.276/2005.
- Norms regarding the monitoring of environmental radioactivity around nuclear and radiological facilities, approved by *CNCAN* President Order No.275/2005.

These norms set up the following:

- Requirements concerning the assurance of radiological safety of occupational exposed workers, population and environment, in accordance with the provisions of Law no. 111/1996 and in accordance with the 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.
- Requirements for the calculation of the Derived Emission Limits (DEL) and for the monitoring of radioactive discharges, at the source of emission and in the receiving media, in routine conditions and also in emergency situations.

### **3.2 LEGISLATION RELATED SPECIFICALLY TO URANIUM MINING AND MILLING**

With regards to uranium mining and milling, the Romanian nuclear legislation takes into account three objectives:

- To ensure that workers, the public and the environment are adequately protected against the radiological hazards resulting from the exploitation of the uranium mining and milling industries.
- To provide protection during the period of exploration and after the closure of uranium mines or mills.
- To ensure that wastes resulting from the operation of uranium mines and mills tailings are treated as radioactive waste.

Based on Art.5 (1) provisions of Law no. 111/1996 on the safe deployment, regulation, authorisation and control of nuclear activities, republished in 2006, *CNCAN* issued a group of Radiological Safety Norms and Guidelines for uranium and thorium mining and milling as following:

- Radiological Safety Norms – Authorisation procedures for uranium and thorium mining and milling.
- Radiological Safety Norms on occupational radiation protection in uranium and thorium mining and milling.
- Radiological Safety Norms on the management of the radioactive waste resulting from uranium and thorium mining and milling.
- Radiological Safety Norms on decommissioning of uranium and thorium mining and milling facilities.
- Guide on the Criteria of release from *CNCAN* regulatory body of the buildings, material, facilities, dumps, and area contaminated following the activities of uranium and/or thorium ores mining and/or milling in order to allow their use for other purposes.
- Guide on the recommended parameters for the estimation of the effective doses through all exposure pathways.,
- Guide on technical requirements and criteria for design, siting, construction, operation and decommissioning of the uranium and thorium milling waste disposal areas.

### 3.3 LEGAL PROVISIONS FOR NATIONAL ENVIRONMENTAL RADIOACTIVITY MONITORING

#### 3.3.1 Environment

Legislative acts establishing the responsibilities in the field of environmental monitoring of radioactivity *sensu strictu* are:

- Government Emergency Ordinance no. 195/2005 on environmental protection, with subsequent amendments.
- Law no. 265/2006 approving the Government Emergency Ordinance no. 195/2005, regarding the environmental protection with subsequent amendments.
- Ministerial Order no.1978/2010 regarding the organization and functioning of the National Environmental Radioactivity Surveillance Network.
- Governmental Ordinance 21/2004 regarding the National System for the Management of Emergencies.

#### 3.3.2 Foodstuffs

Legislative acts establishing the responsibilities in the field of radioactivity in foodstuffs and feeding stuffs are:

- Regulation no. 178/2002 – laying down the general principles and requirements of food law, establishing the European Food Safety Authority and laying down procedures in matters of food safety.
- Ministry of Health Order no. 1591/2010 on approval of technical norms for national public health programmes in 2011 and 2012.
- Ministry of Health Order no. 381/15.04.2004 approving the “Sanitary norms for safe deployment of nuclear activities”, published in the Official Journal of Romania no. 527/11.06, 2004.
- Order no. 1050/97/1145/505 of the (former) Ministry of Agriculture, Foodstuffs, Forests and Rural Development (*MAAPDR*), National Sanitary, Veterinary and Food safety Authority (*ANSVSA*), MH, National Environmental Protection Agency (*NEPA*) for the approval of the sanitary, veterinary and food safety norms regarding certain contaminants from food of animal and non-animal origin, published in the OG no. 1056/26.11 2005.
- Order no. 855/98/90/2002 of the MH, *MAAPDR*, *NEPA* for the approval of the norms regarding foods and food ingredients treated with ionizing radiation, published in the OG no. 218/25.04, 2002.
- Order no. 1805/286/314/2006 of the MH, *ANSVSA*, *CNCAN* for the approval of instructions regarding the creation of a legal framework for the application of the Council and European Commission Regulations regarding the establishment of maximum levels for radioactive contamination for food and feeding stuffs, after a nuclear accident or in a radiological emergency, for special conditions for export of food and feeding stuffs, following of a nuclear accident or other radiological emergencies as well as conditions that are governing imports of agricultural products from other countries following the Chernobyl nuclear power-station accident, published in the OG no. 41/19.01, 2007.
- Related European Community legislative acts <sup>(2)</sup>.

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<sup>2</sup>

- Commission Regulation (EC) No 1609/2000 of 24 July 2000 establishing a list of products excluded from the application of Council Regulation (EEC) No 737/90 on the conditions governing imports of agricultural products originating in third countries following the accident at the Chernobyl nuclear power station. (OJ L-185, 25.7.2000, p. 27);
- Commission Regulation (EC) No 1635/2006 of 6 November 2006 laying down detailed rules for the application of Council Regulation (EEC) No 737/90 on the conditions governing imports of agricultural products originating in third countries following the accident at the Chernobyl nuclear power-station. (OJ L-306, 7.11.2006, p. 3–9);
- Commission Regulation (Euratom) No. 770/90 of 29 March 1990 laying down maximum permitted levels of radioactive contamination of feeding stuffs following a nuclear accident or any other case of radiological emergency. (OJ L-83, 30.3.1990, p. 78–79); ----- cont'd next page...

### 3.4 INTERNATIONAL LEGISLATIVE AND GUIDANCE DOCUMENTS

The environmental radioactivity monitoring and the radiological surveillance of foodstuffs follow international legislative and guidance documents from EU, IAEA and Canada <sup>(3)</sup>. ICRP's recommendations are applied as well.

Concerning uranium and thorium mining and milling, *CNCAN* issued the following guidelines:

- Guidelines on recommended parameters to be used for the estimation of effective doses concerning exposure paths.
- Guidelines on criteria for release from *CNCAN*'s authorisation regime, i.e. the use for other purposes of buildings, materials, facilities, dumps and lands contaminated by mining and milling of uranium and thorium ores.
- Guidelines on technical requirements for design, siting, construction, operation, closing and decommissioning of uranium ore facilities, for the storage of uranium ore and the decommissioning of the uranium and thorium milling waste disposal areas.

## 4 ROMANIAN COMPETENT AUTHORITIES

### 4.1 INTRODUCTION

According to the legislative framework in Romania, *CNCAN* is the only authority having responsibility with regard to radioactive discharges.

The main ministries and organizations having different responsibilities in the field of environmental radioactivity monitoring (including the surveillance of food stuffs) are:

- *CNCAN*.
- Ministry of Environment and Forests (MEF), through NEPA.
- Ministry of Health (MH), through the public health authorities and the network of ionising radiation hygiene laboratories co-ordinated by the National Institute of Public Health.
- Ministry of Agriculture and Rural Development (*MADR*).
- National Sanitary Veterinary and Food Safety Authority (*ANSVSA*).
- Nuclear Agency for Radioactive Waste (*AN&DR*).

- 
- Commission Regulation (Euratom) No. 944/89 of 12 April 1989 laying down maximum permitted levels of radioactive contaminants in minor foodstuffs following a nuclear accident or any other case of radiological emergency. (OJ L-101, 13.4.1989, p. 17–18);
  - Directive 1999/2/EC of the European Parliament and of the Council of 22 February 1999 on the approximation of the laws of the Member States concerning foods and food ingredients treated with ionising radiation. (OJ L-66, 13.3.1999, p. 16–23);
  - Directive 1999/3/EC of the European Parliament and of the Council of 22 February 1999 on the establishment of a Community list of foods and food ingredients treated with ionising radiation. (OJ L-66, 13.3.1999, p. 24–25);

- <sup>3</sup>
- 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;
  - IAEA Safety Guide No. RS-G-1.8 “Environmental and Source Monitoring for Purposes of Radiation Protection” (2005);
  - IAEA Safety Guide no. WS-G-2.3 “Regulatory Control of Radioactive Discharges to the Environment” (2000);
  - Canadian Standard CAN/CSA-N288.4-M90-Guidelines for Radiological Monitoring of the Environment (1990);
  - Commission recommendation 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 (2000/473/Euratom);
  - Council Directive 98/83/EC of 3 November 1998 on the quality of water intended for human consumption (transposed by Law no. 458/2002 for the quality of drinking water as modified by Law no. 311/2004, published in the Romanian Official Journal no. 582/2004);
  - Commission recommendation of 20 December 2001 on the protection of the public against exposure to radon in drinking water supplies (2001/928/Euratom);
  - Guidelines for drinking water quality (WHO Recommendations), Chapter 9 - Radiological aspects;
  - Measurement of radionuclides in food and environment (IAEA Guidebook – Technical reports series no. 295).

## 4.2 NATIONAL COMMISSION FOR NUCLEAR ACTIVITIES CONTROL (CNCAN)

The National Commission for Nuclear Activities Control (CNCAN) is a national public institution, acting as a legal entity. It is the national competent authority in the nuclear field and functions under the direct coordination of the Prime Minister.

Since its creation in 1961, CNCAN faced various reorganisations.

The first regulatory organisation in the field of nuclear practices was established in 1961, imposed by Ministerial Order 741/1961. The body was called the Committee for Nuclear Energy of the Council of Ministers. In the same year, within the National Atomic Physics Institute, the Commission for Guidance and Control of the Nuclear Units was created, as a control organism regulated by the Commission of Nuclear Energy.

The Commission changed the name to CNCAN in 1990 by Decree no. 29/1990. In that period CNCAN was under the subordination of the Ministry of Environment. In 1998 CNCAN became an independent body (Law 16/1998).

In 2001, CNCAN moved back under the responsibility of the Ministry of Environment. From 1998 until 2001, CNCAN coordinated the National Environmental Radioactivity Surveillance Network (NERSN). By the Governmental Decision no. 894/2003 and Law 193/2003, CNCAN entered under the direct jurisdiction of the Prime Minister and it became, again, an independent body.

According to the Law no. 111/1996, on the safe deployment, regulation, authorisation and control of nuclear activities (republished), CNCAN is the national competent authority in the nuclear field, with duties in regulation, licensing and control of nuclear practices. It has the following tasks, in particular in the field of environmental radioactivity monitoring:

- To issue regulations for the detailed specification of the general requirements for protection against ionizing radiation, including the procedures for licensing and control activities in the nuclear field.
- To establish, whenever deemed necessary, dose constraints for practices or for certain radiation sources within a particular activity area.
- To examine and approve the siting and construction of nuclear facilities, from the radiation protection point of view.
- To accept the commissioning of nuclear facilities with a potential for contamination outside of their own perimeter, only if the appropriate measures for radiation protection have been taken according to the demographic, meteorological, geological, hydrological and ecological conditions.
- To assess and approve, during the licensing process, the derived emission limits and monitoring programmes of radioactive effluents, proposed by the applicant and to verify their observance, during the practice.
- To assess and approve, during the licensing process, the environmental radioactivity monitoring programme proposed by the applicant.
- It may deploy its own environmental radioactivity monitoring programme in the vicinity of the nuclear / radiological facilities that may have a significant environmental impact, in order to verify the validity of data reported by the licensee.

Art. 2 of Law 111/1996, republished in 2006, stipulates that the provisions of this Law shall apply to the following activities and sources:

- Research, design, possession, siting, construction, assembly, commissioning, trial run, operation, modification, conservation, decommissioning, import and export of nuclear facilities.
- Design, possession, sitting, construction-assembly, commissioning, operation, conservation and decommissioning of the mining and milling facilities for uranium and thorium ores and of the waste management facilities of the waste resulting from the mining and milling of uranium and thorium ores.

In this respect, *CNCAN* authorises siting, operating and decommissioning of nuclear fuel fabrication plant, uranium mines and uranium ore milling mining facilities, inspects each facility with regard to radiation protection of exposed workers, the general population and the environment. It releases, after decommissioning, the certificate of removal under the authorisation regime of *CNCAN* of land to public use.

*CNCAN* has specific responsibilities in radiation emergency situations. According to *Governmental Ordinance 21/2004* and *Governmental Decision 2288/2004*, *CNCAN*'s main support functions in emergency situations are:

- Monitoring of specific dangers and risks, together with their associated negative consequences.
- Informing, notifying, measuring and alerting via *CNCAN*'s Emergency Response Centre and its laboratory "*CNCAN*'s Reference Laboratory for radioactivity, CRL" where the necessary environmental radioactivity measurements are performed. This laboratory is part of the Emergency Response Centre and belongs to the Section for Radiation Emergencies which – within *CNCAN* – is the responsible section for radioactivity monitoring and control programmes. The Emergency Response Centre acts as a support centre performing technical analysis and prognosis of emergency situations with focus on nuclear safety, radiation protection and radiological consequences.

*CNCAN*'s head office is located in Bucharest. *CNCAN* is headed by a President who is also Secretary of State, under the direct coordination of the Prime Minister (see figure 1).

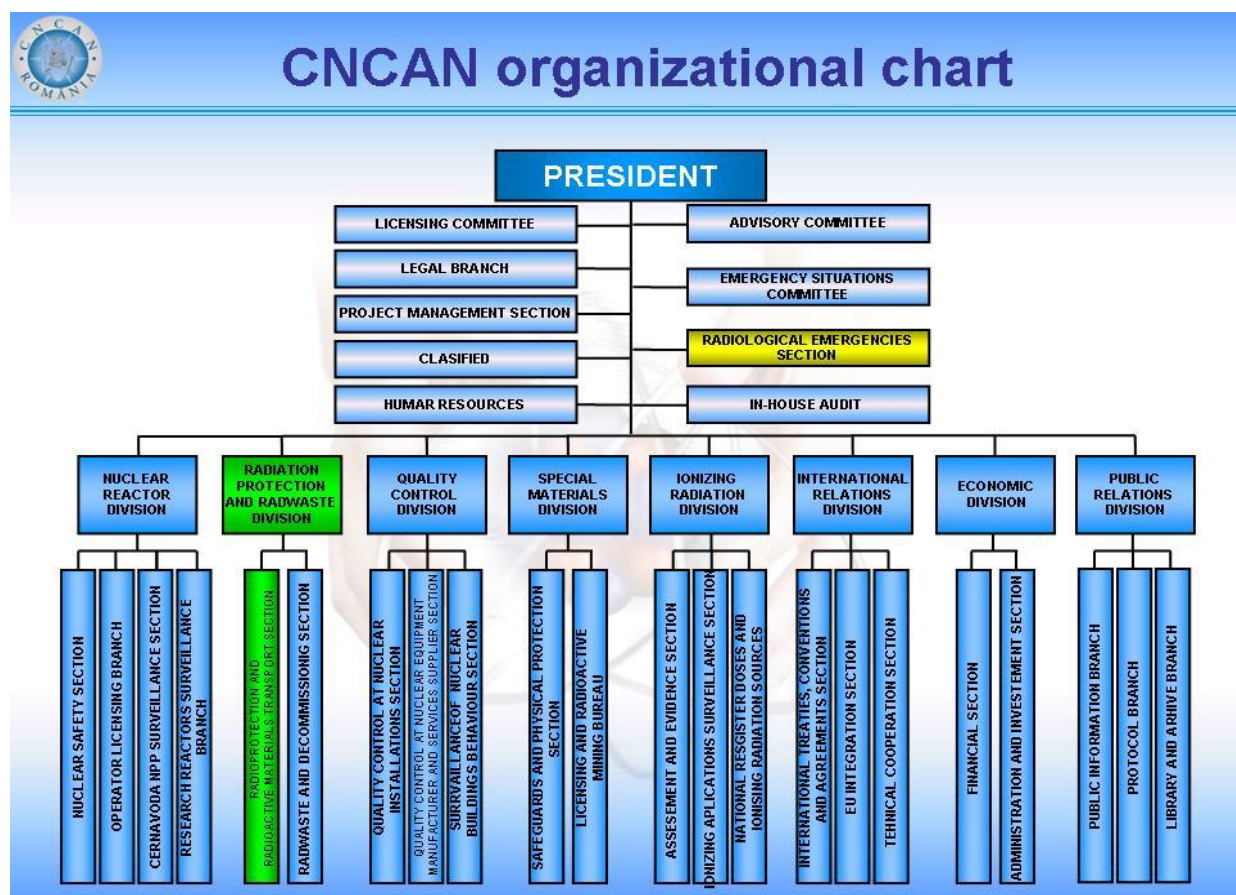


Figure 1: *CNCAN*'s organizational structure

### 4.3 MINISTRY OF ENVIRONMENT AND FORESTS (MEF)

According to the Government Emergency Ordinance no. 195/2005 on environmental protection with subsequent amendments (Art. 47), and approved by Law 265/2006, the Ministry of the Environment (at the time of the visit *Ministerul Mediului și Pădurilor, MMP* – Ministry of the Environment and Forests, MEF), as central authority for environmental protection, is responsible for monitoring and



surveillance of environmental radioactivity all over the national territory, with the general purpose of ensuring compliance with regulations, and protecting the population and the environment against harmful exposure to radiation.

The ministry is the competent authority for issuing environmental agreements and licenses for major nuclear facilities: nuclear power plants, research reactors, nuclear fuel production plants and final storage of spent nuclear fuel.

Regional and Local Environmental Protection Agencies are the competent authority for issuing environmental agreements and licenses for uranium mines and milling facilities,

The legislative framework empowers the MEF for licensing practices and activities resulting in release of radioactivity to the environment. The environmental permit issued by the (former) Ministry of the Environment and Sustainable Development (*MMDD*) is based on an Environmental Impact Assessment (EIA) Study and several prerequisite licenses, issued by other authorities, such as:

- National Commission for Nuclear Activities Control.
- Ministry of Health.
- Ministry of Labour, Family and Social Protection.

According to the law, MEF has responsibilities in emergency situations and co-operates with the General Inspectorate for Emergencies, the specialised organisation in the Ministry of Administration and Interior empowered to co-ordinate at national level the prevention and management of emergency situations. The General Inspectorate also co-ordinates the development and implementation of emergency plans in nuclear fuel production plants and uranium mines and milling facilities. MEF has representatives in the technical expert groups and also in the National Committee for Emergencies, the top-level decisional structure in emergencies.

Specific provisions for environmental monitoring are established in the Law 111/1996 republished, on the safe deployment, regulation, authorisation and control of nuclear activities:

“Article 37 – (1) The central environment protection authority shall organize, under the law, the environment radioactivity surveillance network on the territory of Romania, providing the necessary information flow for the integrated monitoring system of the environment parameters.

(4) Whenever necessary, the central environment protection authority shall notify *CNCAN* and the Ministry of Interior and Administrative Reform on its findings in the monitoring activity exercised by it, and shall collaborate with these in order to set up the necessary measures to be taken.”

In order to fulfil its legal obligations regarding monitoring and off-site emergency planning and response, MEF organises and operates under its authority the National Environmental Radioactivity Surveillance Network (NERSN, see figure 2), which is a part of the National Environmental Integrated Monitoring System.

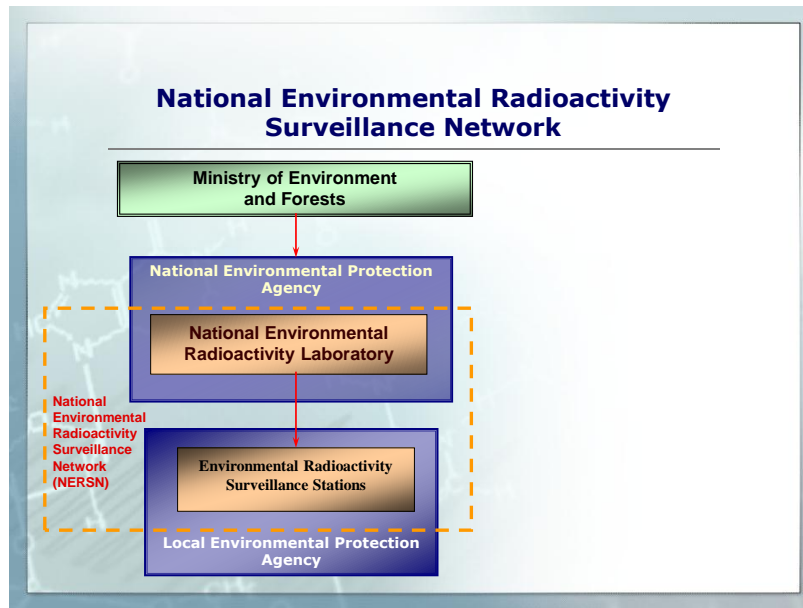


Figure 2: National Environmental Radioactivity Surveillance Network (NERSN)

The National Environmental Protection Agency (NEPA, see Chapter 5.3.1), is a technical support organization belonging to MEF.

At present, NERSN comprises 37 stations distributed over the Romanian territory and the central NRL in Bucharest, at NEPA. The NERSN has specific responsibilities:

- To support an adequate radiological surveillance program to control and assure compliance with regulations.
- To provide rapid detection and early warning.
- To provide data needed in emergency management.

The detailed description of NERSN Stations (location, monitoring programmes) is given in Chapter 10.

Operating under its authority both the NERSN stations and the meteorological network, MEF has the responsibility of providing radiological data and the meteorological prognosis in case of a nuclear accident or radiological event with actual/potential radioactive material release to the environment.

#### 4.3.1 National Environmental Protection Agency (NEPA)

Within the former Ministry of Environment and Sustainable Development (MMDD), now Ministry of Environment and Forests (MEF; *Ministerul Mediului și Pădurilor, MMP*), the National Environmental Protection Agency (NEPA; *Agenția Națională pentru Protecția Mediului, ANPM*) was created as the central environment protection authority in order to ensure technical support and to coordinate the National Integrated Monitoring System, including the National Environmental Radioactivity Surveillance Network (NERSN). In this respect, NEPA operates a reference laboratory for radioactivity (NRL). This laboratory ensures the scientific and methodological coordination of NERSN.

NEPA shall notify *CNCAN* and the Ministry of Interior and Administrative Reform of its findings on the monitoring activity exercised by it, and shall collaborate with these in order to set up any necessary measures to be taken.

#### 4.3.2 Regional and local environmental protection agencies

Regional and Local Environmental Protection Agencies (REPA: *Agenția Regională pentru Protecția Mediului, ARPM*; LEPA: *Agenția pentru Protecția Mediului, APM*) under the Ministry of Environment and Forests check the environmental radioactivity outside controlled areas of nuclear

fuel production plants and uranium mines and milling facilities. Their actions and methods (with regard to radiological monitoring) are co-ordinated by NEPA.

During this verification mission LEPA Alba Iulia and REPA Pitești were visited (see Chapters 10.3.2.1 and 10.3.2.2).

#### **4.4 MINISTRY OF ECONOMY, TRADE AND BUSINESS**

The Ministry of Economy, Trade and Business, by *SC Conversmin SA*, is the competent authority for the management of public financial resources for decommissioning and remediation of uranium mining environment affected by uranium mining activity.

#### **4.5 MINISTRY OF HEALTH**

In accordance with Law 95/2006, the Ministry of Health (MH) is the central authority for public health, coordinating public health assistance.

In Romania, responsibility is established according to the provisions of the Nuclear Law 111/1996, on the safe deployment, regulation, authorisation and control of nuclear activities. According to Art. 39 of this Law, the Ministry of Health is responsible for organising the surveillance network of radioactive contamination of marketed food products, including drinking water, as well as other goods designated to be used by the population, except border control of imported foodstuff.

Its main responsibilities in addressing environmental monitoring and public health issues are:

- Environmental monitoring.
- Issuing health regulations or advising on regulations with public health impact.
- Coordinating controls and inspections for regulation enforcement.
- Acting as regulatory body for goods with potential health impact.
- Elaboration of public health programmes, financing and coordination of implementation.

For the accomplishment of these tasks MH activities are coordinated and implemented by a network consisting of:

- The National Institute of Public Health and its regional Centres located in Bucharest, Iași, Cluj, and Timișoara.
- The national network of 42 local Public Health Directorates (*DSP*), responsible for local implementation of national policy and programmes for public health. Eighteen of the DSPs include in their structure laboratories for radiation hygiene dealing with ionizing radiation measurements for several specific districts.

The Ministry of Health shall inform *CNCAN* and other interested institutions of its findings on its monitoring activities, and collaborate with these in order to establish the joint actions called for.

##### **4.5.1 National Sanitary Veterinary and Food Safety Authority**

The National Sanitary Veterinary and Food Safety Authority (*Autoritate Națională Sanitar-Veterinară și pentru Siguranța Alimentelor, ANSVSA*), is a specialized institution of the central public administration and the regulatory authority in the area of sanitary, veterinary and food safety (Governmental Decision no. 130/2006, published in the Romanian Official Gazette no. 90/ 31.01.2006), being under Government subordination and under the co-ordination of the Prime-Minister. In the year 2009, based on the new organization through the provisions of Government Decision No. 1415/2009 concerning the organization and functioning of NSVFSA and the units under their coordination, the competences in the radioactive field remained the same. As a necessity to improve the activity in the field of food safety, the authority was reorganized in 2011, by the Government Decision No. 283/2011, but the competences of NSVSFA in the control of the degree of radioactive contamination of food and feeds remained unchanged.

ANSVSA has the following competences:

- Strategy, with the view to ensure and guarantee the health of animals, public health, animal protection, environmental protection and food safety.
- Regulation, for the setting-up of the juridical framework and elaboration of regulations (specific for the activities in the areas of sanitary-veterinary and of food safety).
- Administration of structures in subordination, to coordinate and manage the services of the sanitary-veterinary and food safety area all over the country.
- Official surveillance and control of the market.

The activities of ANSVSA are illustrated in several annual programmes approved by ANSVSA's President, such as:

- Strategic Programme for Sanitary Veterinary Surveillance.
- Programme for surveillance actions, prevention and control of animal diseases, diseases transmissible from animals to humans, animal and environment protection.
- Programme for surveillance, prevention and control in the field of food safety.

ANSVSA has the following structure:

- The main body within ANSVSA is the Institute for Hygiene and Veterinary Public Health, located in Bucharest, which includes the Laboratory of Nuclear Analysis Techniques.
- Sanitary Veterinary and Food Safety Directorates have been installed at county level. Within these, 14 territorial laboratories operate, spread over the Romanian territory, to perform inter alia radioactivity analysis.
- Sanitary veterinary and food safety units ("*circumscripție*") are functioning at local (zonal) level.

#### **4.6 NUCLEAR AGENCY AND RADIOACTIVE WASTE**

The Nuclear Agency and Radioactive Waste (*Agenția Nucleară și pentru Deșeuri Radioactive – AN&DR*) was established in 2009 by Governmental Decision No.1437/2009. AN&DR is a public institution under the subordination of the Ministry of Economy. By law, this body is the national authority in charge of coordinating the activities for the safe management of radioactive wastes, including those resulting from decommissioning of nuclear and radiological installations (also uranium mining and milling). It develops a strategy on this item, which is part of the national strategy for the energy sector in Romania that has to be approved by the Ministry of Economy.

The budget of AN&DR is established at ministerial level. AN&DR's activities are financed by the waste producers.

#### **4.7 NATIONAL URANIUM COMPANY**

The National Uranium Company S.A. was set up by the Government's Decision no. 785 of 2 December 1997, modified by Government Decision no 729/2004. It is state owned and directly financed by the Ministry of Economy, Trade and Business Environment. The Company administers the uranium mineral resources of Romania and deals with geological research and exploitation activities of uranium ores, ore processing and refining of concentrates, including transportation and marketing of these materials.

The National Uranium Company focuses its activities on two branches: one regarding the mining activities mainly in three regions of Romania: Banat - (western Romania), Bihor - (north-western) and Suceava - (north) regions; the second branch concerns uranium milling and processing activities in the Feldioara plant (central Romania).

The company also aims at restoring the areas affected by uranium exploitation and milling, and at promoting efficient means for environmental protection in the zones under exploitation. Quality conditions are in accordance with international standards concerning the final product. The company

ensures the necessary supply of  $UO_2$  powder in a form that can be sintered, to produce the nuclear fuel for the Romanian Nuclear Power Plant, Cernavodă NPP.

Presently, the mines from Suceava County are the only uranium ore producer in Romania, and ensure enough uranium supply for the Cernavodă NPP for another eight to ten years. It was proposed to close the mines in Banat County in 1997; the monitoring of the final closure of all their branches is still ongoing. The closure of the mine in Baița Bihor has started.

Ore from the uranium mines is/was not milled at the mining locations themselves, but transported by railway to the Feldioara milling plant. After processing, the resulting uranium dioxide is transported from Feldioara by authorised trucks under nuclear safeguards control to Pitești, where nuclear fuel elements are produced.

## **5 MONITORING OF RADIOACTIVE DISCHARGES AND ENVIRONMENTAL RADIOACTIVITY AT FORMER MINING SITES IN ROMANIA**

### **5.1 URANIUM MINING IN ROMANIA - HISTORY**

Around 1950, (like in other East-European countries), uranium exploration was subject of a joint venture between the Soviet Union and the National Uranium Company. Large geological surveys were performed in the south-western (Banat county) and north-western (Bihor county) regions of Romania.

In 1952, uranium mining commenced as an open-pit excavation, in the Bihor region (Băița Plai). Around 1960 the exploitation of uranium continued by opening underground excavation mines at two other important sites in the Bihor region (Avram Iancu mine) and in the Banat region (Dobrei, Natra and Ciudanovița mines).

All uranium ore from this exploitation had to be delivered to the Soviet Union. The total amount estimated to have been transported until 1963, to the then USSR, was about 20 000 tons.

The Romanian-Soviet Union joint venture ended in 1963, all transport of uranium outside the country's borders was stopped. From then onward, "*Organizația Expediția Geologică*" was responsible for uranium exploitation in Romania.

After 1963, Romanian authorities expanded the geological exploration and discovered new uranium deposits in northern Romania, in the Moldova region (Crucea, Botușana and Tulgheș-Primatar mines).

In 1976, the Feldioara plant was built for the extraction of uranium from the ore (using the depression alkaline leaching technique).

Uranium transfer from the Bihor and Banat mines to the processing plant at Feldioara started in 1977. First samples of yellowcake (ammonium diuranate) were produced.

Between 1983 and 1985 the Crucea – Botușana mines were commissioned as well as the uranium ore delivery to Feldioara.

In 1996 the first genuine Romanian batch of uranium dioxide powder was used in the CANDU-6 type Unit 1 reactor at the Cernavodă NPP.

Currently, the uranium needed for the normal life cycle of the two CANDU reactors presently in operation at the Cernavodă NPP is ensured by the  $U_3O_8$  and sodium diuranate (NaDU) stocks produced and stored at the Feldioara processing plant.

Recently, a new uranium deposit containing a few thousand tonnes of uranium ore was identified in the Tulgheș – Primatar area (Harghita and Neamț counties), in the central part of the Oriental Carpathians. A possible mining exploitation is still under negotiation.

### **5.2 BIHOR MINES SITE**

Responsibility for the Bihor mines is with the Bihor Branch of the National Uranium Company (NUC), located at Stei, Bihor County.

The location of the mines is some 15 km south-east of the town of Stei. During times of operation, the uranium ore was transferred to Feldioara (National Uranium Company Bucharest, Feldioara Branch) for further processing to yellowcake and purified uranium dioxide.

The mines are currently in the process of being closed down, which will be followed by decommissioning, environmental remediation, and proper environmental monitoring.

### 5.2.1 Short history of the Bihor mining activities

1950 - 1954: Large geological survey works in the Bihor County, within the Romanian – Soviet Union Joint Venture Company named "*Sovrom Kuartit*".

1952 - 1953: Start of mining for uranium ores at the Bihor Branch within the “Baița Plai” open pit.

1963: “*Organizația Expediția Geologică*” is the new company that follows the joint venture *Sovrom Kuartit*'s activity.

1952 - 1964: All uranium ore is dispatched to the Soviet Union for further processing and enrichment. During this period no uranium ore processing activities is ensured in Romania. The mining activities at the Bihor mines are both surface and underground. The access is by shafts or adits from mountain slopes. At the surface some radiometric sorting is ensured with waste rocks being stored in large surface dumps.

1964: End of uranium ores exports to the Soviet Union. After that the uranium ore is mined and stored at the mining site.

After 1963: Commissioning of the Avram Iancu underground mine, some 7 km away from the Baița mine. At the Avram Iancu mine the underground works are dug to a depth of 400 m via 2 shafts.

Starting 1978: The stored and currently mined uranium ore is transferred to the Feldioara processing plant for yellowcake production. The delivery is ensured by truck and then by rail, using 50 tons capacity railway wagons. Some 70 old waste rock dumps are registered only at Baița open pit.

December 2008: Last dispatch of uranium ore from Bihor to Feldioara plant, after that the production is stopped .

### 5.2.2 Mines' closing down

1998: A new department dealing with the closing down of old uranium mines and remediation of the areas affected by uranium geological and mining activities, is opened within the headquarters of NUC.

1998: The Avram Iancu underground mine in Bihor is closed down and put into "care and maintenance status".

The first government approval for closing down and environmental remediation is published allowing drawing of the Technical Project for the closing works, at the Avram Iancu mine.

Further to this, the first government approval is set for closing down and environmental remediation of the mine.

2005: The first works for closing down are realised at the Avram Iancu mine, following a Closing Out Plan (a feasibility study for mines), approval by the authorities, drawing up a Technical Project for the works, and after getting the funding system operational (funding from the state budget).

2008: The ore production is cancelled in Bihor.

At present: The main activity is linked to the closing out procedures of the underground mines and the environmental restoration of affected surfaces. Surface and underground mining had an environmental impact at all mine locations, but only within the mining areas and not on the surrounding villages.

Mine water flows freely from underground; treatment of this water with uranium recovery is foreseen. The plant projected at the Avram Iancu site will be working with an ion exchange technique, and will be similar to those used at the Crucea and Banat mines.

Mine flooding problems are not expected in the following years, as the mine water flows out from the mine adits at higher levels.

After treatment of mine waters, the recovered uranium yellowcake will be transferred to Feldioara processing plant under the nuclear safeguards regime.

The monitoring of all mine waters is undertaken by sampling and transfer of liquid samples to the Feldioara environment laboratory, no facilities for analysis being on the site.

Some mine water samples (collected from 3 adits) are transferred monthly to a laboratory in Oradea (at the Local Environment Protection Agency) and analysed for total salts, pH, chlorides and sulphates, as well as for suspended and organic matter. No important chemical pollution is registered, the impurity values being in the range of the present standards for waters discharged to the environment.

2012 - 2013: The Closing Down Technical Project for the Baița Plai mines will be finalised, enabling remediation works to start at the Baița open pit. For the Avram Iancu mine, the Closing Down Technical Project was modified in 2011.

Now, the main activities are the conservation of underground mines, closing down and environmental remediation of the mining facilities as approved by a governmental decision, under *S.C. Conversmin S.A.* coordination (a department of the Ministry of Economy dedicated to closing down all mines in Romania).

Depleted mines and mining works from the geological exploration programme are to be closed in the following years.

The *Conversmin* organisation ensures the funding system for closing down works at the Bihor former mines, based on an annual, approved programme.

### **5.2.3 Quality of liquid discharges**

In future, mine water will be pumped from underground, and treated by an ion-exchange technique followed by uranium separation; then the water will flow into surface waters.

The nuclear regulatory body sets derived limits for the uranium content in water released to the environment: currently the regulatory discharge limit for uranium is 0.1 mg per litre and the one for radium is 0.05 Bq per litre.

There is no laboratory for environmental samples' analysis at the Bihor site. All environmental samples are transferred to the Feldioara Branch environmental laboratory for uranium and radium determination.

In future, according to the mine closing plan, a modern water treatment plant shall ensure a high yield of radionuclides' separation. The transfer of uranium and radium separated waste products outside the mine's area will be the preferred option for long time mine water treatment.

### **5.2.4 Former Avram Iancu uranium mine - Verification**

The team verified activities performed at the former Avram Iancu uranium mine, situated in the Bihor massive, Occidental Carpathians. Access to the former mining site is controlled; this part of the valley is not inhabited. The site is divided in an eastern and western part, which are connected by a gallery of 2.5 km. The team visited the eastern part of the site and observed a number of dumps on the western slopes of the valley.

A large part of the dumps stem from geological exploration, only a smaller part from mine exploitation; every gallery has one to two dumps. Currently, to avoid spreading of any contamination via the river in the valley, the operator commissioned work to place wire cages with boulders (wall building; on-going work) with a view to stabilise the dumps. It is planned to reshape the sites in order

to avoid water entering the galleries; the project is designed by a specialised institute. The team noted that several survey galleries (in particular Shafts Nr. 75 and Nr. 09) are covered with concrete thus making entry impossible. Control channels to collect water were on the side of such entrances.

In 2012 a flood affected the area, which confirms the importance of the stabilising task.

Surface water is monitored once per month, 100 m downstream of the former working site, by appropriate sampling. The team visited this surface water and sediment sampling point. Samples are sent to the Feldioara laboratory for analysis. The impact of the site remediation work on the water quality is assessed. For the remediation project institutional control is foreseen (the Ministry of Economy has a general monitoring programme for all mines). In Romania altogether about 300 galleries exist, 65 of them have to be remediated).

The team verified that gallery no. 12 (several hundred metres downstream from the main site) was closed after ca. 3 m from the entrance by a concrete wall.

*The verification team encourages quick implementation of stabilising tasks. It suggests covering the wire cages used for stabilisation works with concrete, since rusting of the metal wires that keep the boulders in the 'cages', which would considerably reduce stability, cannot be excluded.*

### 5.3 BANAT MINES SITE

Responsibility for the Banat mines is with the Banat Branch of the National Uranium Company Bucharest. The administration office is located at Oravița, Caraș-Severin County.

The type of nuclear material produced during operation was impure sodium diuranate obtained by 'decontamination' of mine waters at two plants (Ciudanovița and Lisava). The material was transferred to the Feldioara Branch of the National Uranium Company Bucharest for further processing. The potential annual throughput of the installation was up to 1500 kg impure sodium diuranate (35 to 50% humidity).

Currently closing-down works are being undertaken at the mines.

#### 5.3.1 Short history of the Banat mining activities

1950 - 1957: Large geological survey works are undertaken in the Banat County (South-West of Romania, near the Oravița town area).

1950 - 1954: Large geological survey works by gamma logging within the Bihor County -NW of Romania.

1952 - 1953: Start of mining for uranium ores at the Bihor Branch within the “Baița Plai” open pit and at the “Natra” and “Ciudanovița” mines – Banat Branch.

1963: “*Organizația Expediția Geologică*” is the new company that follows the joint venture *Sovrom Kuarțit*'s activity.

1952 - 1964: All the uranium ore is dispatched to the Soviet Union for further processing and enrichment. During this period no uranium ore processing activities are carried out in Romania.

All mining at the Banat mines is underground, the access being by shafts; at the surface some radiometric sorting is ensured with sterile rocks being stored in large surface dumps.

1964: End of uranium ores' exports to the Soviet Union. After that, the uranium ore is mined and stored at the mine site.

After 1963: Commissioning of the Dobrei underground mines.

At the Banat mines underground works are dug to 700 m depth via 11 shafts.

The 3 main mines are spread over 6 km.



Starting 1978: The stored and the recently mined uranium ore is transferred to the Feldioara processing plant for yellowcake production. The delivery is ensured by rail, using 50 ton capacity railway wagons.

### 5.3.2 Mines' closing down

1997: Cancellation of ore production.

1997 - 1998: A Phare study is done dealing with the closing down and restoration of the Ciudanovița mine.

2005: Similar to the situation at the Avram Iancu mine, Bihor, the first works for closing down are realised after the Closing Down Plan (a feasibility study) was approved by the authorities and when the funding system was operational.

At present the main activity is linked to the closing down procedures of the underground mines Ciudanovița, Dobrei and Natra and the environmental restoration of affected surfaces.

Mine water pumped from underground is treated by uranium recovery at two plants at the Lisava and the Ciudanovița site using an ion exchange technique. The recovered uranium yellowcake is transferred to the Feldioara processing plant under the nuclear safeguards regime.

In the years to come step by step mine flooding is foreseen.

Monitoring of all waters is undertaken by sampling and transfer of liquid samples to the Feldioara environmental laboratory.

In a similar way as for the Bihor uranium mines, the conservation of the underground mines, closing down and environmental remediation of the mining facilities as approved by the governmental decision, is co-ordinated by *S.C. Conversmin S.A.* Closing down depleted mines and mining works from the geological exploration programme will follow.

### 5.3.3 Quality of liquid discharges

Mine water pumped from underground is subject to uranium separation and then flows into surface waters.

At the Banat mines, mine waters are pumped through two main shafts at Ciudanovița and Lisava; two water treatment plants are in operation having a total capacity of 2500 m<sup>3</sup> per day;

The nuclear regulatory body sets "derived limits" for the uranium content in water releases to the environment (*CNCAN* authorisation no VJ-19-2010 issued for dismantling of the Banat former mines); both, at the Lisava and the Ciudanovița plants the regulatory uranium discharge limit is 0.1 mg per litre and the radium limit is 0.05 Bq per litre.

Currently, there is no laboratory for the analysis of environmental samples at the Banat site. In future, a new upgraded water treatment plant shall ensure a higher separation yield for radionuclides.

### 5.3.4 Former Lisava uranium mine - Verification

The verification team visited the former Lisava uranium mine, located between Brădișoru de Jos and Ciudanovița. The entrance to the site is guarded by security staff with dogs. Entry prohibition signs warn against access.

Detailed explanations about the on-going work and the operation of the liquid discharge decontamination station were given.

The underground mine was closed in 1997. The maximum depth is -400 m; currently the tunnels are flooded to a depth of -130 m. A 5 km long tunnel links the Lisava mine (there at -60 m) with the Ciudanovița mine (there at -70 m), providing the Lisava mine with fresh air.

At the Lisava site, mine waters are pumped out at three stations in several steps (at -130 m, -60 m and +143 m). The water exit is at shaft no 3 (at +342 m); this shaft originally was used for production. The mine shaft entrance is of wooden construction. The pumps are accessible, however, not submerged.

Access and maintenance is rather difficult. The water flow is some 700 m<sup>3</sup>/day, depending on rainfall. Ciudanovița has a similar system with a water flow of ca 400 m<sup>3</sup>/day.

The system is currently being changed and in future shaft no 4 will be equipped with service-free underwater exhaust pump. It is foreseen to have 2 pipes for connection to the underwater pumps (two are already in place). Work will begin after flooding of the rest of the mine up to +180 m; this will be done in steps of 6 months and will take a few years.

Shaft 4 is a concrete construction and was originally the ventilation shaft; now it is under rehabilitation for new use. The shaft entrance is at 418 m above sea level, the shaft leading 138 m down to level +180 m; the link to the Ciudanovița mine is closed up to +80 m, however, in a water permeable way in order to allow a common increase of the water level at both mining sites.

Shaft 4 will not be closed when the new treatment plant is fully operational. An access system will stay in the shaft; at Ciudanovița access is possible by a 'bulb' device. Ventilation will operate only when miners enter for service work; using PVC pipes that have a diameter of ca. 50 cm.

The experts' opinion (collaboration with *Wismut*, Germany) is that when reaching the +180 m level, the radiation level will be low (currently there are relatively high concentrations in mine waters).

The possibility to raise the water level to +280 m is currently discussed; this would depend on the U concentration of the mine waters.

The team verified the treatment procedure. Mine water is piped from the shaft to settling pools (four pools in series; they will be renewed and two new ones will be added). From there the water is pumped to a 'balancing pool' (a ca. 70 cm diameter tube under the ceiling of the building) from where it enters the resin filled tanks from below.

The old treatment plant is from 1975 and an iron construction; originally it was used for recovering uranium from waters for exploitation (not for cleaning), having a uranium content of 3-4 mg/l. In the beginning the treatment efficiency was only 30 – 40%. The system consists of two batteries, each one with three tanks of 5 m<sup>3</sup> each, filled to 4 – 4.5 m<sup>3</sup> with resin: four tanks are for U recovery, two are for removing Ra (the new plant will have individual handling). Operation is up to 6 months per line, then an elution step follows.

The mine water inflow sampling point located at a pipe in the building, below (i.e. after) the balancing pool, and the outflow water sampling point just outside the treatment building.

The resin from the process is treated using brine to eluate uranium; the yellow cake produced this way is transported to Feldioara in drums, 1-2 times per year, controlled by the IAEA and Euratom safeguards regimes. Sediments from the settling pools are currently not handled; in future they will be placed on a new small dump for drying.

All water is treated, the current treatment system will be changed (e.g. made of stainless steel) and extended. The upgraded treatment plant should be ready in 1 ½ years. An on-site lab for analysis of samples is planned (currently surface water samples and samples from before and after treatment all go to Feldioara, once per quarter, for uranium and radium determination).

Around the site 4 holes have been drilled (to -60 m level) for control of ground water contamination. When the flooding reaches -60 m weekly samples will be taken; the monitoring programme for further flooding steps will be decided later. In the area the groundwater level is at +200 m (therefore the level of +180 m for flooding was recommended by hydrologists).

There are 32 surface water measurement points inside and outside the area (for all points the contamination is below the limits). Waters (surface and from springs) are not used in the area for drinking or irrigation, but local staff admitted that animals may use them.

In addition to the monitoring programme by the 'operator', the LEPA Caraș-Severin takes environmental samples twice per year (outside the mining area), under a special monitoring programme; these samples are first measured for gross beta activity at SSRM Reșița (LEPA Caraș-Severin) and then gamma spectrometrically at SSRM Craiova (REPA Craiova)..

With regard to the mine access there are concrete cappings on all adits; only the pumping stations are accessible for service.

The team verified the presence of an old ore dump, where until 1978 all ore was just dumped on site and only the best quality ore was transported to the Soviet Union. After 1978 the extracted ore was transported to Feldioara by train. The dump (ca. 4 ha) reaches from near the public road (that leads from Brădişoru de Jos to Ciudanoviţa) several 100 metres into the mine terrain, approximately to the location of the still used railroad tracks. After use it was partly covered with concrete, partly left open; drainage water could seep in, thus, some 1-2 m of top soil must be excavated. The plan for remediation includes moving one half of the dump on top of the other half; then a compacted clay cover would be placed on the now open half; after putting drains all the contaminated material would be moved to that place, which would then be covered with clay and soil, and finally, partly naturally, re-vegetated. The team was told that many local tree species are deep rooting.

With regard to the current hydrological situation the Natra Creek flows underneath the small sterile dump and the larger old ore heap, thus its waters have a relatively high uranium content. This is one of the reasons why all radioactive dumps will be removed and all material moved to just one place.

*The verification team points out that care should be taken with regard to the soil structure of the ore heap cover. It should be considered to deliberately plant low rooting species of trees with a view to avoid soil destruction (and thus high permeability) by naturally growing, indigenous, deep rooting trees. The team also would like to allude to the necessity of keeping the knowledge about the site, in order to avoid accidental uses of contaminated sites in the distant future, and the problems involved in such a long-term task. Future monitoring programmes would have to take account of any such changes.*

## **6 MONITORING OF RADIOACTIVE DISCHARGES AND ENVIRONMENTAL RADIOACTIVITY AT THE FELDIOARA URANIUM MILLING AND PROCESSING SITE – DESCRIPTION AND VERIFICATION**

### **6.1 INTRODUCTION**

The Feldioara uranium milling and processing plant is situated in the centre of Romania, in Braşov County. It is located 8 km west of the town of Feldioara and approximately 2 km northeast of the village of Crizbav. It covers an area of 583 hectares. The plant was commissioned in 1978.

Several criteria were applied for placing the site in this area: the relatively isolated neighbourhood; the presence of forests (which was seen as an advantage regarding security); the harmonious morphology and geohydrology.

The main activities at the Feldioara site concern the milling and processing of the natural uranium ore extracted from Romanian mines and the refining of the uranium concentrate with a view to producing uranium dioxide, which is the main component to produce CANDU 6 fuel elements for the Cernavodă NPP. The nuclear fuel elements are produced at the Piteşti nuclear fuel plant *FCN (Fabrica de Combustibil Nuclear)*, which is the authorised Romanian CANDU fuel element manufacturer. Since 1996 all nuclear fuel for the Cernavodă NPP is produced in Romania.

The Feldioara site processes uranium ore from two mines, Botuşana and Crucea. The ore arrives by train at the uranium receipt station where a qualitative and a quantitative check is performed, including measurement of the uranium content of the ore.

The transport of the uranium ore from the receipt station to the milling site is done by a conveyor belt.

At the milling station the ore is crushed in a wet process to 50 mm chunks and then milled to 0.1 mm size particles. This powder is further processed to leach out the uranium; the substance remaining after drying and filtering ("Yellow cake") is transported in drums by truck to another building situated in the neighbouring area. There it is dissolved in nitric acid, calcinated and reduced chemically to produce uranium dioxide. The  $UO_2$  is delivered in form of a powder to *FCN Piteşti* for further processing.

The uranium quality produced at the Feldioara site has been accepted by the CANDU technology supplier in Romania.

The construction of a new production plant using new technology to improve the uranium dioxide production is still under discussion.

From a radiation protection point of view the Feldioara site is split into two zones (together forming the "sanitary protection zone"):

- The **controlled zone**, delimitedated by a concrete fence. The radiological surveillance of the environment is done via dose rate probes situated at different points on the perimeter and by measurement of the degree of contamination of surfaces, tools, equipment and people. Accumulated solid and liquid radioactive discharges are monitored as well as aerial discharges.
- The **surveillance zone**, reaching out between the concrete inner fence and the barbed wire fence forming the outer border of the site. In this zone, radiological environmental monitoring is performed especially for the settling ponds, wells, soil and vegetation. This zone contains several forests which include ponds. The area is guarded.

The uranium leaching process leads to liquid wastes, which are piped to tailings ponds situated in the surveillance zone for sedimentation. From the final tailings pond the liquids are piped to a purification station. After removing most of the uranium and some of the Ra-226 using ion exchange resins the liquids are treated additionally for removing other environmentally toxic components (heavy metals etc., before being discharged into the Olt River.

In total, 500 persons work on the Feldioara site (including all auxiliary tasks). The verification team was told that production is organised in campaigns.

## **6.2 MONITORING OF RADIOACTIVE DISCHARGES**

### **6.2.1 General**

The verification team re-inspected the Feldioara site (a first verification took place in 2008), in particular the production area, the laboratory, the settling ponds, and the discharge purification installation. The radiation protection section at the site employs 15 staff. The site still gave the impression to urgently need renovation, at least with regard to building structures of the uranium production site (yellow cake).

### **6.2.2 Liquid discharge monitoring**

The verification team received a full explanation of the discharge monitoring facilities at the site.

All waters, including rain water and waters coming from various uses such as toilets, after conventional purification go to one liquid discharge system. The liquids are piped to a pond (Cetățuia 2 lake) that contains all contaminated waters. The lake is divided into two compartments, the first compartment was completely full with sediments whilst the second compartment was in operation. Cetățuia 1 lake is an artificial pond at a somewhat higher altitude with non-contaminated water that serves feeding the plant with clean water for "industrial" purposes.

After a first sedimentation in Cetățuia 2 the remaining liquid is piped to another pond (Mitzop pond) for further settling. The waters from this pond are "decontaminated" in the decontamination building in a first step (old plant) by ion exchange treatment to remove most of the uranium (99.5%). Radium is also removed to a certain extent.

All lakes/ponds mentioned above are located near the plant in the surveillance zone.

#### **6.2.2.1 Decontamination/treatment building ('old' plant)**

The decontamination building of the plant is locked for physical protection. Generally, operating times are about nine months per year (three month per year the station is shut-down due to holidays and low temperatures); apparently the natural evaporation of water in the discharge pond does not necessitate a higher frequency.

The team re-verified the 'old' plant which had not changed much since the 2008 verification. There the effluent from the Mittelzop pond is pumped to a concrete tank (100 m<sup>3</sup>) at a level higher than that of the building. From there the effluent goes by gravity to the treatment tanks. There are two treatment lines in parallel, each with four columns (three of which are for sorption of uranium and one is for elution). Each column has a diameter of 2.5 m and a height of 10 m. Decisions on ending a purification process are based on checks of the purification capacity. According to a specific order, valves are set such that after termination of a purification task the last column in the purification process is bypassed and set for regeneration. The column that has been recently regenerated is then set as the first column, receiving fresh input from the pond (cycles of two weeks). The purification efficiency for uranium is some 99.5%.

For regeneration the resin is eluted with NaCl brine (three pools of 18 m<sup>3</sup> each, with different concentrations; there is a fourth pool with fresh brine). The eluate which contains the uranium is transported in tanks to the plant. There uranium is precipitated using NaOH. Resulting supernatant water flows for new treatment to the treatment installation. The resulting uranium precipitate is recycled into the uranium production process.

#### 6.2.2.2 Decontamination/treatment building ('new' plant)

In a second step the treated water is pumped to the new plant for treatment of conventional pollutants (chemical indicators, e.g. molybdenum). This second treatment has only a small effect on the remaining (very small) uranium and radium content.

The team visited this brand new very modern plant in which the water in a first step is treated in mixed bed filters using different sands, activated carbon (anthracite) and microfilters. By this technique all particles >5 µm (e.g. colloids) are removed. In the next step the liquid is treated by ultrafiltration to remove "everything" bigger than 0.03 µm. In a last step reverse osmosis is applied to the pre-treated water. This is done in the neighbouring building with high pressure pumps, using 21 horizontal tubes (each 7 m long). A modern control room allows full system control (*Siemens Simatic* multi panel touch screen; several PCs including one for video surveillance).

After treatment in this new plant, the cleaned waters are piped to the Olt River that flows several kilometres east-northeast of the Feldioara plant. The discharge limits are defined by the Ministry of Environment and were renewed in 2006 for a period of six years. The discharge for pollutants other than U and Ra are set by the norm NTPA 001/2002 - Technical Regulation for Water Protection - introduced by Governmental Decision no. 188/2002 for approval of norms regarding the condition for discharge of wastewater into the aquatic environment, with modifications. Samples of liquid waste are taken on site and off site before release to the Olt River. At the Olt River there are two sampling points, one at 1 km upstream and one at 1.2 km downstream of the discharge point (Rotbav village).

#### 6.2.2.3 Tailings ponds

The verification team was shown the large tailings ponds. At the time of the visit, security staff were patrolling the area. Access to the location is possible only using a 4-wheel drive car. The pond area is owned by the National Uranium Company S.A. Part of the land in the surveillance zone belongs to the Feldioara municipality.

The bottom of the ponds is made of a clay layer, sealed with bitumen.

At the time of the verification, one of the compartments of Cetățuia 2 was full, and the second one was partially filled.

The pond for final sedimentation has a maximum depth of 12 m. The pond dam has a high density 1.5 mm polyacrylamid foil liner to avoid erosion by waves. The pond is filled via a channel that links the Cetățuia II with the Mittelzop pond. Water from Cetățuia II, compartment 2, is pumped via a floating pump station into that channel.

From this pond the liquid is pumped with a constant flow into a 100 m<sup>3</sup> intermediate reservoir. The water from the pond is pumped via several tubes with outlet points at various levels. Any overflow is led back to the pond by gravity. From this basin the liquid is led by gravity to the purification plant.

Control samples are taken either at the exit point of the intermediate reservoir or at the entrance point to the purification plant. Several flow meters record liquid flow rates.

#### 6.2.2.4 Olt River discharge point

The Olt River discharge point was not included in the current verification. For the purpose of completeness we include the description stemming from the verification in 2008.

Originally a basin for mixing with river water was built. However, studies showed that the activity discharged to the river stayed the same. Thus, the mixing process was stopped. Now the basin is only used for sampling purposes.

The pipe leading underground to the river has a length of 1 km. According to information supplied by the water authority, the Olt River flow rate is between 85 and 300 m<sup>3</sup>/second. Depending on operating conditions and/or the authorisation, the discharge flow rates are between 40 and 240 m<sup>3</sup>/hour. The pipe has a valve in order to facilitate shutting off the flow in case of repair work. *CNCAN* asks the operator to test full discharge capacity once per year.

*CNCAN* has established maximum limits for the uranium and radium content in liquid waste before being discharged to Olt River at 0.600 mg/litre for uranium and 0.250 Bq/litre for radium

*With regard to liquid discharges the verification team acknowledges the improvements achieved. It has no additional suggestions to those of the 2008 verification.*

### 6.2.3 Gaseous discharge monitoring

The Feldioara plant is in operation 10 months per year (i.e. except July and August) and monitoring of gaseous discharges is done only when the installation is running.

Before any releases to the environment the air at the production sites is filtered. These filters are scrubbed with water (that goes into the liquid discharge system).

For technical reasons aerial discharges are only relevant in case of extraordinary events. Even in such a case, all radioactivity would be deposited in the immediate surroundings, the area furthest away being the forest surrounding the site. The sampling schemes currently available for aerial discharge and on-site deposition sampling are listed in table 1. All the exhaust samples are measured by the Surveillance Station of Radioactivity Monitoring (SSRM) of the LEPA Braşov; the deposition samples are taken by and measured at the Radiation Hygiene laboratory at Braşov (the Feldioara plant being informed about the results). An emission limit for uranium has been defined by *CNCAN* (44 kg annually). Due to the procedure applied stopping discharges in case of high concentrations is not possible.

Since at the time of the first visit to the site in 2008, the site was not in production the team could not verify the operating monitoring devices at that verification. This was the major reason to re-verify the Feldioara production site in 2012. The SSRM Braşov however, was part of the 2008 verification.

The team visited the roof of the fabrication building and verified the aerial monitoring procedure in place which involves manual sampling with analysis of the sample in the laboratory.

Table 1: Sampling points for aerial discharges and deposition

Sampling point	Uranium concentration		Total alpha and beta concentration
	µg/l	µg/m <sup>3</sup> month	
Exhaust drying stack ("R")	weekly	monthly	monthly
Exhaust ventilation stack (level 5 m)	weekly	monthly	monthly
Exhaust ventilation stack (level 10 m)	weekly	monthly	monthly
Exhaust ventilation stack (level 15 m)	weekly	monthly	monthly
Exhaust stack UO <sub>2</sub>	weekly	monthly	monthly
Exhaust stack U <sub>3</sub> O <sub>8</sub>	weekly	monthly	monthly
Exhaust mixing chamber	weekly	monthly	monthly
Exhaust filtering stack	weekly	monthly	monthly
Exhaust drying stack ("E")	weekly	monthly	monthly
Deposition on radioprotection terrace	monthly	monthly	monthly
Deposition at the ponds	monthly	monthly	monthly

Nine exhaust locations at the roof where aerial discharges from the production building are released after passing through HEPA filters were seen. For monitoring, a plastic tube with a filter is placed at the exhaust location to be monitored and a pump sucks air coming out of that exhaust (20 litres per minute, manually 'counted' 5 minutes). The pump used is from *F&J Specialty Products, USA*, with a rotameter for flow rate measurement. The calibration certificate from *Metrolab s.r.l.* was dated 15.12.2011. The pump is old and very heavy and will be replaced. Monitoring is done only during production times, twice per year – spring and autumn (production is running 24 hours a day); samples are taken when a line is in use, under the responsibility of the Radiation Protection Department that decides when a sample has to be taken. Schematics of the ventilation system were presented. For measurements (monitoring), special filters of ca. 5 cm diameter are used. After the air sampling, the filters are placed in a (marked) envelope, which is stapled closed and passed on to the site's environmental laboratory. Three persons do the monitoring job. No electricity is available on the roof and electric power has to be supplied by laying a cable from a lower floor. When the uranium concentration in a HEPA filter increases to a level higher than the permitted limit a request to change the HEPA filter is issued; in such a case the uranium is recovered from the HEPA filter and recycled to production.

The team received a demonstration of such air sampling at location LI U<sub>3</sub>O<sub>8</sub>.

Online monitoring of aerial discharges has not been installed due to technical problems that could be expected in setting up such a system, and due to the necessity of having expensive devices for radioactive emissions with very low probability and radiological relevance.

*The verification team recommends installing automatic system(s) for aerial discharge monitoring (or at least sampling) during times of production, in case the new plant under discussion is built.*

### 6.3 OPERATOR'S ENVIRONMENTAL RADIOACTIVITY MONITORING PROGRAMME

The Operator's Environmental Radioactivity Monitoring Programme was not included in the current verification. For the purpose of completeness the description taken from the 2008 verification is reproduced below..

#### 6.3.1 On-site monitoring

##### 6.3.1.1 Air

Monitoring of radon concentrations and dry deposition on site is done according to the procedures in place and according to the local monitoring programme for working areas in force at the Feldioara

plant. With regard to environmental effects all impact estimates are based on the gaseous emission monitoring (see chapter 7.2.3).

#### 6.3.1.2 Dose rate and dose

Gamma dose probes (TLDs) are placed on several high voltage pylons placed along the roads crossing the Feldioara site. The probes are situated at a height of one meter from the ground and measurements are performed once per year.

#### 6.3.1.3 Waters

Altogether there are 19 wells located in the sanitary protection zone and its proximity. The sampling scheme for various waters on site the Feldioara plant is described in table 2.

Table 2: On-site water sampling scheme for the Feldioara plant

Sampling point	Type of water	Frequency
"Bazinet"	Residual water	Daily
Settling pond Cetățuia 2 lake	Residual water	Weekly
Supply treatment station	Residual water	Weekly
Disposal treatment station	Residual water	Weekly
Tap at sanitary unit	Drinking water	Monthly
Well 21	Ground water	Monthly
Well 1	Ground water	Monthly
Well 2	Ground water	Monthly
Well 3	Ground water	Monthly
Well 11	Ground water	Monthly
Well 12	Ground water	Monthly
Well 13	Ground Water	Monthly
Well 10	Ground water	Bi-monthly
Well 4	Ground water	Bi-monthly
Well 5	Ground water	Weekly
Well 5 bis	Ground water	Bi-monthly
Well 6	Ground water	Bi-monthly
Well 6 bis	Ground water	Monthly
Well 7	Ground water	Quarterly
Well 8	Ground water	Quarterly
Well 9	Ground water	Quarterly
Cetățuia lake	Surface water	Quarterly
Well 207 (waste storage)	Ground water	Quarterly

#### 6.3.1.4 Vegetation and soil samples

There are two soil and vegetation sampling points on-site which are sampled twice a year.

For soil sampling a frame of 30x30x5 cm is used; for vegetation samples the same area is cut with a sickle.



### 6.3.2 Off-site monitoring

#### 6.3.2.1 Dose and dose rate

Gamma dose probes (TLDs) are placed on several high voltage pylons placed along local streets and national roads in the surroundings. The probes are situated at one meter height from the ground and measurements are performed once per year.

#### 6.3.2.2 Drinking water

Currently in Rotbav Village there are four wells selected by the Feldioara plant to sample drinking water monthly. At the time of the Feldioara site construction all drinking water supplies were from individual wells; however, now a municipal water supply system pumps water from the mountains in the east.

#### 6.3.2.3 River water and sediment

There are four surface water and sediment sampling points, two along the Olt River, the main river in the area, one upstream (at Feldioara) and one downstream (at Măieruş) of the discharge pipe from the decontamination plant. One sampling point is at the river Rotbăşel, one at river Crisbăşel, two small brooks in the area. Sampling is performed quarterly; samples are analysed by the Feldioara laboratory.

Sampling locations and the corresponding programme have to be agreed by LEPA Braşov. CNCAN has established maximum limits for the uranium and radium content in river waters at 0.01 mg/litre for uranium and 0.04 Bq/litre for radium.

#### 6.3.2.4 Soil and Vegetation

There are some 10 sampling locations for vegetation and soil outside the plant, situated between the main buildings of the Feldioara plant and the Olt River. Sampling is done twice a year.

For soil sampling a frame of 30x30x5 cm is used; for vegetation samples the same area is cut with a sickle. Agricultural soil is sampled to a depth of 20 cm.

In addition – once a year at fifteen points soil and vegetation samples are taken with a view to check the transport route for uranium ore. The respective sampling locations are situated at the Feldioara train station and along the railroad connecting the station with the plant.

### 6.4 THE FELDIOARA ENVIRONMENTAL CONTROL LABORATORY (DESCRIPTION AND VERIFICATION)

The team was informed that a re-organisation took place at the Feldioara plant and in 2009 a single laboratory group was set up to deal with samples from the site and also from other uranium production related areas.

The section ensures the analysis of most of the environmental samples taken at all mining branches of the mining company in order to cover the annual monitoring programme of each mine. This part of the work programme includes also sampling at the uranium mines of the Suceava branch, at the former Banat mines and at the former Bihor mines, in parallel to the mines' own sampling programmes. Sampling is always performed at the same places that are used by the respective mine. In addition, with regard to the local monitoring at the Feldioara plant, the laboratory analyses various samples from the site.

Six persons work in the environmental laboratory, four laboratory technicians and two engineers. Annually, the laboratory undertakes a large number of sample analyses such as:

- Analysis of uranium in waters.
- Analysis of Ra-226 in waters.
- Analysis of uranium in sediments.
- Analysis of Ra-226 in sediments.
- Analysis of Ra-226 in soil.

- Analysis of natural uranium in vegetation.
- Analysis of Ra-226 in vegetation.
- Gamma dose rate readings.

Another task of the laboratory is the development and testing of procedures before implementing them in the local laboratories.

There are different procedures used for natural uranium and Ra-226 determination in water, soil, sediment, and vegetation.

Having received this information, the team verified the laboratory.

#### Sample reception/preparation

The laboratory handles water and aerosol samples, which, upon their arrival at the laboratory are registered on paper in a log book. For water samples the laboratory always keeps the same sampling bottle for each location (coded on the bottle and on the lid). A procedure for decontamination of these bottles before sampling exists.

Water sampling equipment is stored in the laboratory. For water evaporation, a new sand bath is used in a small *Asalair Carbo 900* exhaust unit. Air filters are treated with a solution of  $\text{HNO}_3$  (6 M) under a chemical hood, using a glass pipette. At the time of the verification there were no soil, vegetation or sediment samples to be treated; the Bihor branch samples were already performed. Normally vegetation samples undergo calcination. A *Lenton* chamber furnace, a *Reypa* drying oven for sample preparation and a balance, type *Kern ALT 220-4N* are also present.

#### Radon measurements

Ra-226 is measured via ingrown Rn-222. Glass vials (labelled with the sample code), containing the water samples with the radium are put into a *Pylon WG1001* water degassing unit for extraction of radon from the water in the vial to a Lucas scintillation cell using  $\text{CO}_2$ . For this, the laboratory has 19 cells (*Model 300A, Pylon Electronics, Ottawa, Canada*). The laboratory owns two *Pylon AB-5* measuring devices: The one present in the lab (serial no. 2261) had a quality control sign '27.06.12' and a label indicating that a recalibration had taken place on 9 May 2009. At the time of the verification the second device was in Canada for calibration. Samples undergo a minimum of 3.5 hours measuring time. In the lab, a *Genitron Alpha Guard* monitor is available for radon determinations, in particular in air. According to the procedure shown to the team, the devices need calibration every half year. Both *Pylon AB-5* measuring devices were bought from *S.C. Mecro System S.R.L.*, Bucharest, Romania (representing *Pylon* in Romania), which has also been given a service contract. The devices are guaranteed for 5 years.

#### Uranium measurements

Spectrophotometric determination of uranium in water samples is performed with a *Varian Cary 50 Bio* UV-visible spectrophotometer (quality assurance label dated 21.05.2010) using data evaluation on a PC (volume correction). The team received a demonstration of such a measurement. Calibration is performed with a uranyl-nitrate standard solution with known concentrations and a blank reference sample 'whenever necessary'. At the time of the verification it was not possible to perform a printout, since no printer cartridge was available, thus manual 'printouts' were made. Data transfer to the Environmental Protection Department is electronically. Calibration sources are prepared directly by the laboratory that has an according authorisation from *CNCAN*. For data archiving the laboratory keeps paper records (in addition to electronic ones) 'in case of no power'.

Radium measurement results are signed-off by the chemist, uranium results by a technician; this is done in the IT system, with date and time.

#### Alpha/beta measurements

Gross alpha/beta measurements are performed using a device from *Protean Instruments Corporation* with a single sample counter. The device is stopped during radon measurements. A background measurement is performed each morning. According to Romanian legislation calibrations are

performed every three years at the site by the National Metrological Institute using Sr-90/Y-90 and Am-241 sources. A quality certificate label (date 26.07.12) was on the device and the calibration certificates from the *CIPM MRA* laboratory RML (Radionuclide Metrology Laboratory at *IFIN-HH*) were available. For measurements, three readings are performed for each sample (10 minutes each), then an average is calculated. All data are noted in a laboratory book (measurement values, background, weight, etc.), and in parallel data calculation etc. is performed on a PC.

For contamination measurement the laboratory has several *Thermo Electron Corporation FHT111M* contamination monitors available (one of them new, one an old *Frieseke & Höpfner CONTAMAT*). The butane counting gas is supplied by *Canberra Romania*.

Gamma dose rate measurements are performed using a *Thermo Electron Corporation FH40G-L10* survey meter.

To measure the content of uranium in air an air sampler type *F&J*, activated by a *GAST* pump with a *F&J* rotameter for flow measurement is used. Within 5 minutes 100 litres of air are pumped through a filter. This device is also used for aerial discharge monitoring (description see Chapter 7.3.2).

#### Quality assurance

The laboratory and the research section do not yet have *RENAR* accreditation; however, ISO 17025 accreditation is planned and the first steps have been taken, involving *CNCAN*. Feldioara has periodical internal audit sessions for QC.

The verification team were shown the QC system manual of the National Uranium Company S.A., made for its Feldioara branch which contains all procedures for the local laboratory and the research section. These procedures are developed by the research section. After agreement by the company's QC department, the QC inspector, and the directors, the procedures are sent to *CNCAN* for approval.

In particular, the verification team was shown the procedures for Ra-226 determination in water, soil, sediment, and vegetation.

The laboratory has calibration sources manufactured by *IFIN-HH*, Magurele, Bucharest; *New England Nuclear*, USA; *Radiochemical Amersham*, UK; *New Brunswick Laboratory*, USA; as well as some from the former Soviet Union and the Czech Republic

The Feldioara laboratory takes part in inter-comparison exercises with laboratories from the Public Health Directorate but not in international ones.

#### Archiving, data handling and reporting

The laboratory has an archive for soil, vegetation and sediment samples (ashed) at the Feldioara research sector. The archive boxes were well labelled for ease of identification.

All data are kept on paper and on a PC. The local mining zones reports are sent monthly to the National Uranium Company. Consolidated reports are sent monthly to the National Uranium Company, to the regional public water authority, as well as to the Feldioara city administration.

An annual report containing local and sector results is sent to *CNCAN* via the company headquarters. The reports are handed over to the Feldioara plant administration.

Every two years an evaluation of the radiological risk factors is commissioned by the plant from an accredited company. This includes the radiological impact, an occupational study, etc.. The reports are handed over to the Feldioara plant administration.

At the end of 2008 a study of the environmental impact of the Feldioara plant was performed. It was a requirement of the LEPA Brasov and part of the new environmental authorization procedure. In summary, the study presents the situation as it was in 2008 for the plant sites and the "sanitary" area. The conclusions are that pollution due the mill is limited to the controlled zone and that no important environmental impact could be registered outside of the plant (fenced area) or in the Olt River, within the last years.

*The verification team encourages all efforts to modernise the laboratory and to achieve ISO 17025 accreditation.*

## 7 NUCLEAR FUEL FABRICATION PLANT IN PITEȘTI, MIOVENI – DESCRIPTION AND VERIFICATION

### 7.1 GENERAL INFORMATION

The Nuclear Fuel Plant Pitesti (*FCN Pitești*) is a subsidiary of *Societatea Națională Nuclearelectrică S.A. (SNN-SA)* which is a state-owned company reporting to the Ministry of Economy and Commerce.

*SNN-SA* has two subsidiaries:

- *CNE (Cernavodă Nuclear Power Plant)*, operating unit 1, unit 2 and the auxiliary services at the Cernavodă Nuclear Power Plant.
- *FCN Pitești*, the nuclear fuel plant, qualified manufacturer for CANDU 6 type nuclear fuel.

*FCN* is part of the nuclear site (called *SCN-FCN* platform) formed by:

- Institute for Nuclear Research (*SCN Pitești*).
- Nuclear Fuel Plant (*FCN Pitești*).
- Nuclear Agency and for Radioactive Waste (*AN&DR*).

The platform is located a few kilometres outside the town of Mioveni, in the district of Argeș, some kilometres from Pitești, 130 km northwest of Bucharest, 150 km from the Feldioara Conversion Plant and ca. 370 km from the Cernavodă nuclear power plant (Cernavodă NPP). The site is a wooded area at a level of 420 to 450 m above sea level and about 150 m above the Doamnei River.

The *SCN-FCN Pitești* platform occupies an area of about 47.9 hectares. Of this, the surface of the *FCN Pitești* site is approximately 2.33 hectares, which includes 0.75 ha for the plant and ancilliary buildings.

*FCN Pitești* fabricates nuclear fuel bundles of the CANDU-6 type (with 37 elements), based on natural uranium for the Cernavodă NPP. Currently, the production fully covers the needs of the NPP operation.

*FCN Pitești* has adopted a continuous working system, organised in one, two or three shifts, with an average of about 300 working days per year and planned outages for maintenance, vacation and legal holidays. At the time of the verification the plant was in operation.

Production is split into two parts:

- The pellets section (Halls I and III) in which pelleting, grinding and stacks forming takes place, 8 or 16 hours/day, from Monday to Friday; and Hall II, in which sintering is performed 24 hours/day.
- The assembling section - Halls IV and V, with operation 16 hours/day from Monday to Friday.

From a radiological point of view *FCN Pitești* is set up in two zones:

The **controlled area** which includes Halls I, II, III, IV and V and their annexes, a covered platform for temporary storage of nonconforming nuclear material and contaminated radioactive waste (*PDT*), the storage area for uranium dioxide powder, the storage area for nuclear fuel bundles, the Physico-Chemical Analysis Laboratory (*LAFC*), the Radiation Protection and Personnel Dosimetry Laboratory (*LRDP*), the storage area for zircaloy-4, and the ecological incinerator (in operation, for testing only, from June to December 2006) and which is currently disconnected from the utilities.

The **supervised area** that includes the remaining locations of the *FCN* site ,amongst others:

- The Administrative Building.
- The Hall for Mechanical Processing (HPM).
- Storage facilities of oils, carpentry workshop, mini-trucks station, compressors station, dedicated space for storage of gas cylinders - oxygen, argon, nitrogen, hydrogen, helium, methane, acetylene, rolled magazine, materials and spare parts warehouse ;
- Central storage of materials.

Raw materials and auxiliary materials used in the nuclear fuel bundles manufacturing process are:

- Natural uranium dioxide (UO<sub>2</sub>) sinterable powder, 210 tonnes per year (for 10 800 nuclear fuel bundles production), packed in 200 l stainless steel barrels;
- Strips, wires, bars and tubes made of zircaloy-4, beryllium metal, various gases (hydrogen, nitrogen, helium, argon), substances classified in the category of drug precursors, zirconium oxide.

Raw materials and auxiliary materials are stored in separate storage areas within *FCN*, dangerous substances and precursors are stored in specially designated areas.

As of 1 August 2012 (i.e. at the time of the visit) *FCN Pitești* had 422 employees.

## 7.2 HISTORICAL OVERVIEW

1970 - 1983: The Institute for Nuclear Technologies (*ITN*) is set up by the Romanian Ministers Council Decision no. 447/22.04.1972. The department named Nuclear Materials and Fuel Elements and Structures is in charge to develop techniques, technologies and equipment dedicated to nuclear fuel manufacturing.

1974 - 1976: The *FCN Pitești* buildings are built and the new facility belonging to *ITN* is named *SPEC* (Nuclear Fuel Elements Manufacturing Section), being commissioned in 1976.

1983: *ITN* turns into the Institute of Energetic Nuclear Reactors (*IRNE*) and since 1983 produces nuclear fuel in the nuclear fuel elements manufacturing section (*SPEC*). *IRNE* is coordinated by the State Committee for Nuclear Energy (*CSEN*).

1983 - 1990: 31707 CANDU 6 type nuclear fuel bundles containing a total amount of about 600 t uranium are manufactured. In those years, the CANDU-6 fuel technology development and its manufacturing is realised only through own efforts on national level.

Jan 1990: *CSEN* is replaced by the newly created National Administration of Electricity (*RENEL*) which assumes responsibility for the entire energy program in Romania, including also the nuclear energy under the Nuclear Power Group (*GEN*).

31 Jan 1992: The Nuclear Fuel Elements Manufacturing Section (*SPEC*) is separated from *IRNE* and a new company is established - Nuclear Fuel Plant (*FCN Pitești*) subordinated to *RENEL-GEN* until 1998.

1992 - 1994: A technical and technological development programme assisted by the Canadian companies AECL (Atomic Energy Canada Limited) and ZPI (Zircatec Precision Industries Inc.) is implemented.

Oct 1994: The fuel bundles of the demonstration batch - 202 pieces - are manufactured under the supervision of AECL and ZPI, out of which, 66 bundles are included in the initial load of the Cernavodă NPP's Unit 1 reactor.

Dec 1995: *FCN Pitești* is licensed by AECL and ZPI as producer/supplier of CANDU-6 type nuclear fuel according to the 'CSAZ-299.2' standard, the production capacity being 23 nuclear fuel bundles per day.

Starting 1996: Regular shipments of nuclear fuel to Cernavodă NPP take place.

Summer 1998: *RENEL* splits up and forms the National Company *Nuclearelectrica SA (SNN-SA)* that takes the responsibility to produce nuclear-based electricity using nuclear fuel. *SNN-SA* consists of two subsidiaries: *CNE Cernavodă* and *FCN-Pitești*.

18 December 2001: The programme for doubling the production capacity (from 23 to 46 nuclear fuel bundles per day) is approved by the management of *SNN-SA*.

21 Sep 2004: Manufacturing of the nuclear fuel dedicated to the initial load of the Cernavodă NPP's Unit 2 reactor begins.

Oct 2006: First shipment for loading the core of Cernavodă NPP's Unit 2.

- Dec 2006: The work for the plant rehabilitation meant to double the manufacturing production is finalised.
- Sep 2007: *FCN Pitești* is certified by *TÜV Thüringen* for applying the Environmental Management System (*SMM*) in accordance with the ISO 14001:2005 standard.
- 24 Jun 2008: *FCN Pitești* successfully performs the 100th shipment of nuclear fuel to Cernavodă NPP.
- 2008: The plant rehabilitation works continue in order to improve the working conditions and for optimisation of nuclear fuel fabrication.
- 2008 - 2009: Hall V that belongs to the assembling section is constructed.
- 2009 - 2011: Hall I is rehabilitated in order to change the activity from recycling of nonconforming nuclear material with natural/depleted uranium to  $UO_2$  'green pellets' fabrication.
- Sep 2010: A new certificate is issued for *FCN Pitești* by *TÜV Thüringen* (re-certification) for applying the Environmental Management System (*SMM*) in accordance with the ISO 14001:2005 standard (expiration date September 2013).
- Mar 2011: Manufacture of the 100 000th nuclear fuel bundle.
- 9 Nov 2011: *FCN Pitești* receives the Environmental License based on Governmental Decision no. 1061/2011, published in the Official Gazette no. 793 from 9 November 2011 (valid until 28 February 2015).
- 15 Nov 2011: Successful shipment no. 150 with nuclear fuel bundles to Cernavodă NPP.
- 19-30 Nov 2011: Successful IAEA mission for Safety Evaluation During Operation (SEDO) at *FCN Pitești*.
- 2012: Elaboration and signing of communication protocols between *FCN Pitești*, the Regional Agency for Environmental Protection Pitești (*ARPM Pitești*), *SNN-SA* and the Minister of Environment and Forests (*MMP*).

### 7.3 SHORT DESCRIPTION OF PRODUCTION PROCESS

The production of nuclear fuel bundles of the CANDU 6 type is performed with equipment that is included in authorisations for nuclear activities issued by *CNCAN*. The nuclear technology manufacturing flow also is authorised by *CNCAN*.

$UO_2$  sinterable powder is supplied by *CNU Feldioara* and is received by *FCN Pitești*, which performs complex technical quality control that serves the technological process of manufacturing  $UO_2$  sintered pellets.

The manufacture of  $UO_2$  sintered pellets is based on a specific  $UO_2$  powder metallurgic technology consisting mainly of the following processes:  $UO_2$  powder conditioning (compaction, granulating, mixing lubricant), followed by pressing obtaining  $UO_2$  green pellets; sintering of  $UO_2$  green pellets; grinding, washing and drying of  $UO_2$  sintered pellets followed by quality inspections (microstructure, chemical analysis - U/O ratio, metallic/non-metallic impurities, isotopic composition, immersion density, dimensions, surface defects); stacks forming followed by quality inspections (stack assembly, stack length, surface defects, cleanliness); and transfer to the assembling area for nuclear fuel bundles fabrication.

The structural elements (end caps, end plates, pads, spacers, sheaths) are manufactured from zirconium alloy (zircaloy-4) and other materials, by the following operations: turning, punching, graphite glazing, brazing.

The nuclear fuel elements are obtained from tubes coated with graphite and end chamfered,  $UO_2$  sintered pellets stacks and zircaloy-4 end caps, by welding the end caps in a helium atmosphere.

A nuclear fuel bundle (*FC*) is obtained by assembling 37 nuclear fuel elements with two end plates (by welding).

After the final quality control of each nuclear fuel bundle they are temporarily stored in special areas, authorised and controlled by *CNCAN*.

The production capacity is about 12 000 *FC* per year (46 fuel bundles per day) and is determined by flow forming equipment and technology. The production capacity is stipulated in the Environmental License based on Governmental Decision no. 1061/2011 and in the nuclear fuel production authorisation issued by *CNCAN*. The real annual production output is determined by the amount of nuclear fuel bundles needed for the operating reactor units of Cernavodă NPP, usually about 10 800 *FC* per year (that means 15 shipments to CNE-Cernavoda); these are obtained from about 210 tonnes of  $UO_2$ /year.

About 5% of the produced  $UO_2$  sintered pellets are scrap and, under nuclear safeguards control, are sent to *CNU* Feldioara for recycling in order to recover uranium in the form of  $UO_2$  sinterable powder, which is transferred back to *FCN Pitești*.

## 7.4 RADIOACTIVE DISCHARGE MANAGEMENT

### 7.4.1 Limits for radioactive discharges

#### 7.4.1.1 Air

Gaseous radioactive pollutants from technological processes are released via three dispersion stacks (stationary emission sources). They are monitored continuously, online, by gaseous effluents monitors (*MEGs*). Dispersion stack no. 1 additionally has an isokinetic stack sampling system (*SIPC*).

The derived limits for emission of radioactive gaseous effluents from *FCN Pitești* stacks as imposed by *CNCAN* in the authorisations for processing nuclear raw materials and nuclear fuel production are given in table 3.

Table 3: Derived aerial discharge limits for the stacks of *FCN Pitești*.

	Before 2011	From 1 January 2011 onward
Volume of Radioactive Gaseous Effluent	max. $2 \cdot 10^9 \text{ m}^3 / \text{year}$	max. $10^9 \text{ m}^3 / \text{year}$
Uranium concentration	max. $5 \mu\text{g U/m}^3$	max. $5 \mu\text{g U/m}^3$ and $15 \mu\text{g U/m}^3$ for short time, 24 hours per month, with the condition that max 0.8 kg uranium are released that month
Radioactive concentration	max. $0.125 \text{ Bq/m}^3$	max. $0.125 \text{ Bq/m}^3$ and $0.375 \text{ Bq/m}^3$ for short time, 24 hours per month
Uranium quantity	max. 10 kg U/year	max. 5 kg U/year

#### 7.4.1.2 Water

Table 4 shows the parameters and limits of radioactive liquid effluents from *SCEAR* to be transferred to the purification station (*SE-SCN*) as imposed by *CNCAN* authorisations for processing nuclear raw materials and nuclear fuel production.

Table 4: Liquid effluent parameters and limits for transfer to the purification station

Volume of radioactive liquid effluent	max. $2000 \text{ m}^3/\text{year}$
Uranium concentration	max. 1 mg U/L
Uranium quantity	max. 2000 g U/year
Acidity (pH)	6.5-8.5

Quality indicators of domestic waters and liquid radioactive effluents (radioactive industrial wastewater) discharged to *SE-SCN* must be below the maximum permissible concentrations set out in the operating rules of *SE-SCN*.

#### 7.4.2 Regulatory discharge authorisation documents in force

##### 7.4.2.1 *FCN Pitești*

Discharge authorisations for *FCN Pitești* are laid down in:

- Environmental License issued by Ministry of Environment and Forests (*MMP*) based on Governmental Decision no. 1061/2011, published in the Official Gazette no. 793 from 9 November 2011 (valid until 28 February 2015);
- License no DN/23/2012 for processing nuclear raw materials, issued by *CNCAN*, valid between 31 January 2012 and 30 January 2014;
- License no DN/24/2012 for production of nuclear fuel CANDU 6 type with natural uranium, issued by *CNCAN*, valid between 31 January 2012 and 30 January 2014.

##### 7.4.2.2 *SCN Pitesti*

The discharge authorisations for *SCN Pitești* are given in the Environmental License no 1/2006 issued for *SCN* based on the Governmental Decision no 1252 of 27 September 2006. Currently, *SCN* is in the process of renewing the license, based on a dose constraint of 1  $\mu\text{Sv}/\text{year}$  for individuals of the population due to discharges of wastewater containing U-238 to the Doamnei River.

#### 7.4.3 Operator's discharge monitoring programme (liquid and airborne)

##### 7.4.3.1 Monitoring of liquid radioactive effluents

The monitored parameters are uranium concentration, U quantity and the volume of liquid radioactive effluents.

The uranium concentration for each discharge to *SE-SCN* is determined by the *SCN* laboratory, based on a contractual agreement. The other parameters are determined by *FCN*.

##### 7.4.3.2 Monitoring of radioactive gaseous effluents

The monitored parameters are the volume of gaseous radioactive effluents, the U concentration, U activity, and U quantity.

For samples taken with SIPC, the uranium quantity is determined monthly by the *SCN* laboratory, based on a contractual agreement. The processing of the data from the *SCN* laboratory and other parameters are determined by *FCN*.

The radioactive effluents monitoring programme for the *SCN* platform is approved by *CNCAN*.

#### 7.4.4 Aerial discharge Management

The verification team received detailed information on monitoring of aerial discharges and could verify the various facilities.

The general system of ventilation and exhaust at *FCN Pitești* consists of local subsystems which include: a fresh air suction duct, air conditioning units, ducts for routing the technological air and the conditioned air to working areas, used air evacuation ducts from working areas, air filtration batteries and the exhaust stack for gaseous effluents. The volume of air circulated is up to 100 000  $\text{m}^3/\text{h}$ .

The production facilities, Halls I, II and III and the physico-chemical analysis laboratory (*LAFC*) are connected to the technological ventilation system, which is connected to the general ventilation system. The general ventilation system for Halls I, II and III and the physico-chemical analysis laboratory (*LAFC*) releases the filtered air through the main dispersion stack (stack no. 1; height 17 m, rectangular cross section 5.4  $\text{m}^2$ ), located near Hall III. Currently that part of the ventilation system



belonging to *L AFC* is under reconstruction. In order to monitor the uranium concentration in gaseous effluents, the dispersion stack no. 1 is equipped with an isokinetic stack sampling system (*SIPC*) and with a monitor for gaseous effluents (*MEG1*). The tubes with the collected samples from *SIPC* are analysed monthly in the Laboratory for Radiation Protection, Environmental Protection and Civil Protection of *SCN Pitești (LRPMPC-SCN)* based on a contractual agreement.

The ventilation system of the assembling section consists of two subsystems: a general ventilation system discharging the filtered air from the assembling area into the atmosphere through dispersion stack no. 2 (height 12 m, diameter 0.8 m), which is equipped with a monitor for gaseous effluents (*MEG2*); and a technological ventilation system discharging the filtered air from Hall V - loading area (only exhausted air resulting from the operation of loading pellets into zircaloy-4 sheaths) to the atmosphere through dispersion stack no. 3 (height H 12 m, diameter 0.35 m), which is also equipped with a monitor for gaseous effluents (*MEG3*). The flow of radioactive gaseous effluents through dispersion stack no. 2 is about 15 500 m<sup>3</sup>/h and through dispersion stack no. 3 about 2500 m<sup>3</sup>/h. The *MEG*'s are complex systems for continuous sampling and monitoring radioactive gaseous effluents; they are fitted with an alarm for the uranium content and with appropriate warnings (sound and light). The *MEG*s are connected to the centralised computer data entry of *LRDP*. It is planned to install isokinetic sampling systems also at stacks 2 and 3.

The *FCN Pitești* ventilation systems are complex systems that include a ventilation station, central air handling, chillers, fans, caissons, routes, filters; pre-filters arranged individually or in batteries, filter cloth, etc. The filters used in the ventilation systems are filters with high efficiency, type HEPA (High Efficiency Particulate Air), a class specific for high retention 'H13' (i.e. 99.95%). The changing of filters, pre-filters and filter cloth within the *FCN Pitești* ventilation systems is performed periodically following specific procedures.

*The verification team encourages ensuring regular service and calibration of the monitors for gaseous effluents (MEG, procedure CN-RP-70) e.g. by a service contract. The team supports plans to install isokinetic sampling systems also for stacks 2 and 3.*

#### **7.4.5 Liquid discharge management**

The water and sanitation services for the entire *SCN-FCN* platform are ensured by the Nuclear Research Institute (*SCN Pitești*), a subsidiary of the Autonomous Administration for Nuclear Activities (*Regia Autonomă pentru Activități Nucleare, RAAN*) that holds the water management license no. 308 of 17 December 2009, issued by the "Romanian Waters" National Administration - Argeș – Vedeia Branch.

The water supply for *FCN Pitești* is ensured from the water system of the whole *SCN-FCN* platform.

Wastewater disposal at *FCN Pitești* is managed via the communal sewage network system, apart from industrial sewage systems. A sewage treatment line (length = 2.2 km and diameter = 300 mm) leads communal wastewater to the purification station (*SE-SCN*).

Industrial wastewater is collected in tanks. Depending on the results of sample analyses (uranium content and pH; the water quality indicators must be within the limits provided in the protocols of operation of *SE-SCN*), these waters are discharged via the industrial sewage system (length = 1.87 km, pipe diameter = 250 mm) to the *SE-SCN* purification plant, respectively transferred to the radioactive waste treatment station (*STDR-SCN*) for treatment and uranium recovery. Discharges to the sewer system are made only in shift I.

Industrial wastewater contaminated with low concentrations of uranium, from production activities and quality control laboratories, is collected in six stainless steel tanks of 10 m<sup>3</sup> each installed in the Station for Collecting Liquid Radioactive Waste (*SCDLR*) of *FCN Pitești*, located in the Pellets Section (-5 m level).

Liquid radioactive waste (i.e. industrial waste water with a uranium concentration > 1 mg U/L) is transferred to *STDR-SCN* for uranium recovery. After precipitation with trisodium phosphate and ammonia, followed by decantation, filtration and drying, the resulting uranyl phosphate (solid and dry) is returned to *FCN Pitești* under nuclear safeguards control. Uranium recovery efficiency is about

99.9%. The amount of natural uranium recovered in the overall balance of the plant is under control of nuclear safeguards performed by the International Atomic Energy Agency (IAEA) and the European Atomic Energy Community (Euratom). Decanting of supernatant is performed in two tanks with a volume of 25 m<sup>3</sup> each, for potential radioactive wastewater collection; samples are taken for chemical analysis.

Radioactive industrial wastewaters or liquid radioactive effluents with uranium concentrations below 1 mg U/L are collected at the Station for Collection and Discharging of Wastewater (*SCEAR*) in three tanks of 60 m<sup>3</sup> each, and – after control of the release parameters uranium content and pH – based on a contractual agreement are released to the *SE-SCN*. The annual volume of domestic and industrial wastewater discharged to the *SE-SCN* is about 12 500 m<sup>3</sup>.

Rainwater is discharged through a separate sewerage system in a temporary retention basin with a volume of 1750 m<sup>3</sup>. This system is owned and monitored by *SCN Pitești*.

*FCN Pitești* has the following stations for collection and discharging of radioactive liquid waste and radioactive liquid effluents (radioactive industrial wastewater) - see also Appendices 3 and 4:

The **Station for Collection of Liquid Radioactive Waste** (*SCDLR*) belongs to the Pellets Section and consists of six stainless steel tanks with a volume of 10 m<sup>3</sup> each. In *SCDLR* the liquid radioactive waste from the centrifuge installation, the contaminated waters from Halls I, II and III as well as those from the Physico-Chemical Analysis Laboratory (*LAFC*) are collected.

Liquid Radioactive Waste from pellet grinding operations within *FCN Pitești* is separated from grinding sludge by centrifugation and sedimentation in open sedimentation basins. Grinding sludge recovered after separation of water is periodically sent under nuclear safeguards control to the *CNU Feldioara* conversion plant for uranium recovery.

After the centrifugation and sedimentation process, radioactively contaminated wastewaters are discharged from the station as follows:

- 'liquid radioactive waste' (i.e. radioactively contaminated wastewater that contains more than 1 mg U/L) is transported by an *FCN* tanker to *STDR-SCN* in order to recover uranium; the output is uranyl phosphate.
- 'liquid radioactive industrial wastewater' (i.e. wastewater contaminated with uranium in a concentration below 1 mg U/L) is transferred to the *SCEAR* station for collection and discharging.

There is an automatic reading system for pH and the volume of the waste water tanks, equipped with an automatic alarm.

The **Station for Collection and Discharging of Wastewater** (*SCEAR*) is a station consisting of 3 tanks with a volume of 60 m<sup>3</sup> each (designed to catch any accidental leakages) and provided with sensors and three pumps, two of which (with a flow rate of 45 m<sup>3</sup>/h) serve to discharge the radioactive liquid effluents (radioactive industrial wastewater) to the *SE-SCN* and one pump (with a flow of 20 m<sup>3</sup>/h) to drain the collected communal water. The pH value and the concentration of uranium (whose value must be less than 1 mg U/L) are determined in the station. The discharge parameters for liquid radioactive effluents (radioactive industrial wastewater) as required for the industrial sewage system are listed in the rules of operation of the *SE-SCN*.

The necessary measurements are made both, at the *LRPMPC-SCN* and at *LAFC*. The frequency of determinations is laid down in the contract between *SCN Pitești* and *FCN Pitești*.

Transfer of liquid radioactive effluents (radioactive industrial wastewater) collected in the storage tanks of *SCEAR* to the *SE-SCN* is performed in a controlled manner, only in shift I and only after receiving the report of the measurement from *LRPMPC-SCN*.

Thus, *FCN Pitești* does not discharge liquid radioactive effluents directly into a surface water. Derived limits (uranium concentration, pH) for liquid radioactive effluents and the annual maximum volume are specified in *MSR* authorisations issued by *CNCAN* for processing nuclear materials.

*The verification team recommends covering the open sedimentation basins with a lid.*

## 7.5 OPERATOR'S ENVIRONMENTAL RADIOACTIVITY MONITORING PROGRAMME (ON-SITE AND OFF-SITE)

### 7.5.1 On-site programme

The on-site environmental radioactivity monitoring programme is described in the Manual of Radiological Safety (MSR) approved by *CNCAN*, a document under quality management that defines the radioprotection programme and the waste management programme under the Romanian legislation in the fields of nuclear, sanitary, environmental and labour safety. The samples are measured by *FCN Pitești* laboratories following the control plans and specific procedures and by the Laboratory for Radiation Protection, Environmental Protection and Civil Protection at *SCN Pitești (LRPMPC-SCN)* based on a contractual agreement (relevant results are sent half-yearly to *FCN Pitești*). An overview of the on-site environmental sampling programme is given in Appendix 5.

The organisational structure responsible for environmental protection is the Nuclear Safety Department (*DSN*) that reports to the *FCN* Manager.

The activities for Waste Management and Environmental Protection are provided by the Nuclear Safeguards and Environmental Quality Department and the measurements for environmental radioactivity are performed by the Laboratory of Radioprotection and Personnel Dosimetry (*LRDP*) from the Radioprotection, Nuclear Safeguards and Environmental Protection Service (*SRPM*) that belongs to the Nuclear Safety Department and by the Physico-Chemical Analysis Laboratory (*LAFC*) which is part of the Department of Quality Control (*DCC*).

The organisation chart for environmental protection is shown in figure 3.

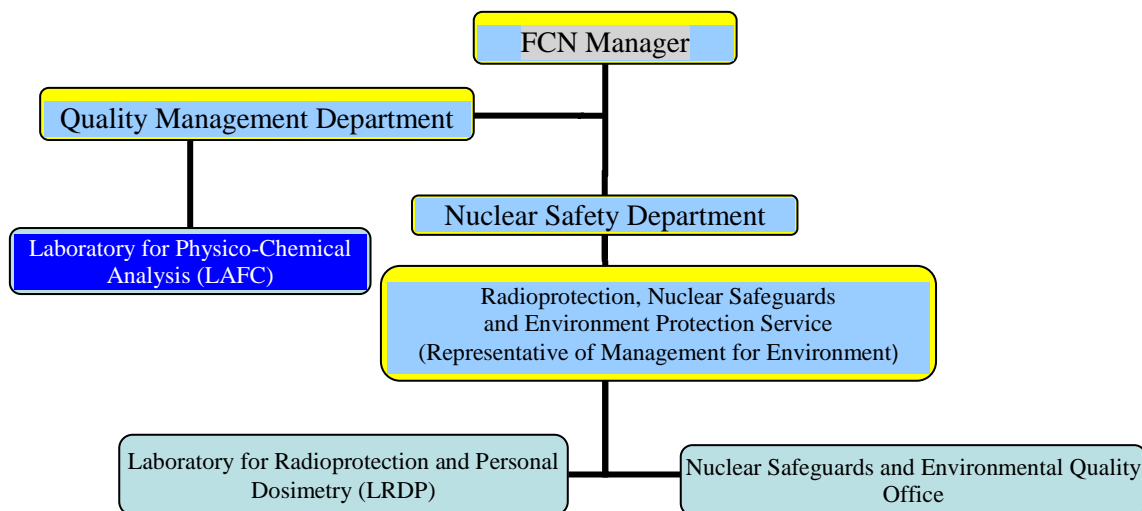


Figure 3: organisational diagram for environmental protection at *FCN Pitești*

The verification team received detailed information about the environmental protection programme and could verify some of the installations and sampling points.

#### 7.5.1.1 External gamma dose and dose rate

On the perimeter fence of *FCN Pitești* gamma dose is measured by *Dozimed SRL*, Bucharest (contractual agreement), using ten TLDs placed at 1 m above ground and which are changed monthly. The 'administrative control limit' is 1 mSv/year; until now, it has never been exceeded. In case of the dose being exceeded, the measures are: 1) changing position of nuclear material in stores and the PDT, 2) access for visitors and contractors is temporarily limited. In addition, badges with dosimetric film are placed at the sampling points of the central system for aerosol sampling (*SCPA*), measuring the gamma dose around buildings that have production facilities (contract with *Dozimed SRL*, Bucharest).

There are four such locations with monthly change of the badges. An 'administrative control limit' is not set; the detection limit is 100  $\mu\text{Sv}/\text{film}$ . Investigations would be initiated in case the measured value per film is over the detection limit; until now, this has not happened.

Besides that, at the *FCN Pitești* perimeter fence gamma dose rate is measured at sixteen points at 1 m above ground with *Thermo FH-40-G10* dose rate survey meters supplied by the Radiation Protection and Personal Dosimetry Laboratory (*LRDP*). For this task once a week a staff member uses such a hand-held instrument and walks along the fence taking measurements at defined points. The reason for this procedure is quicker detection of any increase in dose-rate e.g. due to storage of some radioactive material too close to the fence, compared to the method with the TLDs. The 'administrative control limit' is 0.5  $\mu\text{Sv}/\text{h}$ . At the time of the verification all the dose rate meters were showing background values.

Also at points set by the radiation protection service as '*FCN* supervised environmental areas' within the site perimeter gamma dose rate is measured in a similar weekly routine by *LRDP*. The 'administrative control limit' is 0.5  $\mu\text{Sv}/\text{h}$ .

*Verification does not give rise to specific remarks.*

#### 7.5.1.2 Air

At *FCN Pitești* the Radiation Protection and Personal Dosimetry Laboratory (*LRDP*) carries out specific analyses of the radioactivity content of air by the central system for aerosol sampling (*SCPA*) using fixed paper filter samplers (*Roots* type vacuum pumps) for outdoor air around the *FCN Pitești* production buildings. There are three monitoring points located outside the Halls I, II and III.

Samples are taken daily and measured for gross alpha activity after 24 hours (to allow significant reduction of the radon decay products) in the *LRDP*.

The administrative control limit set for gross alpha concentration of radioactivity is 0.1  $\text{Bq}/\text{m}^3$  (reduced from 0.11  $\text{Bq}/\text{m}^3$  as of 1 January 2012).

*Verification does not give rise to specific remarks.*

#### 7.5.1.3 Water

The verification team was informed that at *FCN Pitești* groundwater from the observation borehole (*FDO*) and water from the platform for temporary storage of contaminated waste (*PDT*) are checked and analysed monthly for uranium content and pH by the Physico-Chemical Analysis Laboratory (*LAFC*). Domestic waters, sewage, water from Vieroși Lake (which is located on the site) as well as drinking water from the entire *SCN-FCN* platform are monitored by *SCN Pitești*; relevant results are sent half-yearly to *FCN Pitești*.

*Verification does not give rise to specific remarks.*

#### 7.5.1.4 Soil and vegetation

The sampling point for soil and vegetation is located in the south-west part of the enclosure of the *FCN Pitești* perimeter, opposite to the wing linking the administrative pavilion and the Assembling Section. Soil samples are taken twice per year (1 kg, depth 0 to 5 cm) for the determination of gross beta activity and uranium content by the Laboratory for Radiation Protection, Environmental Protection and Civil Protection (*LRPMPC-SCN*), based on a contractual agreement.

In the latest contractual agreement with *SCN Pitești*, in force since 1 July 2012, the number of soil and vegetation monitoring points within the *FCN Pitești* perimeter was increased to two.

Additionally, there are annual campaigns to measure surface contamination on site by performing direct beta measurements. For that purpose the site perimeter is divided into ten lots, which in turn are divided into networking sites measuring 2 to 2 m.

*Verification does not give rise to specific remarks.*

## 7.5.2 Off-site programme

Off-site environmental radiological monitoring covers soil, 'spontaneous' vegetation, sediment, surface water and groundwater. A few locations have been chosen as sampling points. Analysis is generally for gross beta; for soil and vegetation samples gamma spectrometry is also performed and the uranium concentration is determined. Sampling frequencies are twice a year (soil and vegetation) and monthly (waters).

## 7.6 LABORATORIES INVOLVED IN PITEȘTI SITE MONITORING

### 7.6.1 General issues

#### 7.6.1.1 Sampling, sample preparation

On-site environmental samples, except soil and vegetation, are taken by *LRDP* and *LAFC* personnel or by staff involved in operation of the Station for Collection and Discharging of Wastewaters (*SCEAR*) and the Station for Collection of Liquid Radioactive Waste (*SCDRL*).

The samples are taken in prescribed quantities, identified, labelled and registered based on *FCN Pitești* procedures and sent to the relevant laboratory (*LRDP*, *LAFC* or *LRPMPC-SCN*) for preparation and measurement:

- Outside air samples (deposition on filter paper) from the central system for aerosol sampling (*SCPA*) or manual pumps are transferred to *LRDP* for determining the radioactivity concentration. The samples don't need preparation; they are measured for alpha activity after 24 hours to allow a reduction in radon decay products.
- The tubes with the samples from the isokinetic stack sampling system (*SIPC*) are sent to *LRPMPC-SCN*.
- The liquid samples (approx. 1 L each) for measurement of uranium concentration and pH from *SCDRL*, *SCEAR*, the drilling observation, and from the pit placed on the temporary storage platform for contaminated waste (*PDT*) are sent to *LAFC* and/or *LRPMPC-SCN*. The preparation of liquid samples is performed following *LAFC* procedures.
- The soil and vegetation samples (approx. 1 kg each) are taken by *LRPMPC-SCN* personnel and – after registration at *FCN Pitești* – are sent to *LRPMPC-SCN* for measurements.
- The gamma dose rate measurements along the *FCN Pitești* perimeter are performed by *LRDP* personnel. There are no samples in this case.
- The measurements for beta contamination of soil surfaces in annual campaigns inside the *FCN Pitești* perimeter are performed by *LRDP* personnel. There are no samples in this case.
- The TLDs from the *FCN Pitești* fence perimeter and the film dosimeters exposed outside the production buildings are sent to Approved Dosimetry Service (*ODA*) Bucharest, which is notified by *CNCAN* for performing the measurements; *ODA* sends the results to *FCN Pitești*. The TLDs and the films are prepared for measurement following *ODA* procedures.

#### 7.6.1.2 Archiving

With regard to document archiving, inside the archive of the Nuclear Safety Department (*DSN*) there is a sub-archive for environmental protection documents (bulletins, measurements sheets, registers, contracts, decisions, assessments, analysis, questionnaires, balances, studies, plans, reports, etc.) that are kept following an *FCN Pitești* procedure.

The samples taken by *FCN Pitești* personnel are kept at *LRDP* respectively at *LAFC* following *FCN Pitești* procedures.

#### 7.6.1.3 Quality management

The Manual of Radiological Safety (*MSR*), the procedures for environmental management, administrative procedures and radioprotection procedures related to environmental radioactivity are elaborated, analysed, advised, approved, distributed, withdrawn, kept, archived and eventually

destroyed by the document control department in conformity with the quality management implemented in the Environmental Management System (*SMM*) that is part of the Integrated Management System (*SMI*) of *FCN Pitești*.

The *FCN Pitești* laboratories have no formal accreditation from national authorities, but for uranium analysis inter-comparison campaigns with others laboratories are performed.

#### 7.6.1.4 Reporting

The environmental radioactivity measurements inside *FCN Pitești* (liquid radioactive effluents for discharging, soil, vegetation, tubes with samples from the isokinetic stack sampling system (*SIPC*) installed on the main stack), and on-site or off-site the *SCN-FCN* platform are performed by *LRPMPC-SCN*. The results are sent to *FCN Pitești* as part of the contractual agreement between *SCN Pitești* and *FCN Pitești*. All further reporting is done by *FCN Pitești*.

The Regional Environmental Protection Agency (*ARPM*, REPA) Pitești receives:

- Quarterly reports (a report on discharges with data on liquid radioactive effluents, liquid radioactive waste, incinerable solid radioactive waste, non-incinerable solid radioactive waste, gaseous radioactive effluents and a report on concentrations of pollutants in the environment).
- Half-yearly reports (on controls with regard to water infiltration in the observational drilling at a depth of 18 metres and determination of uranium in groundwater).
- Annual reports (a report on monitoring of environmental radioactivity and a report for environmental monitoring, additionally posted on the *FCN* website).

Twice per year a report on the radiological security of occupationally exposed workers and once per year (in January) a report for radiological security of occupationally exposed workers, the population and the environment and a report on solid radioactive waste management are sent to *CNCAN*.

*Nuclearelectrica SA*, Bucharest (*SNN-SA*) receives quarterly and half-yearly reports on environmental protection.

*Verification does not give rise to specific remarks.*

#### 7.6.2 *FCN Pitești* Radiation Protection and Personal Dosimetry Laboratory (*LRDP*)

The Radiation Protection and Personal Dosimetry Laboratory (*LRDP*) employs eight persons (among them three engineers) that are involved in environmental radioactivity measurements; other main activities are dosimetric measurements for controlled and supervised areas, and measurements for personal TLDs.

From the Nuclear Safeguards and Environmental Quality Department three engineers are involved in environmental protection. A Management Representative for the Environment is named by the *FCN* manager.

The following equipment is available:

- Low background automatic alpha/beta counter *TENNELEC series S5E*.
- Manual alpha counter (*Scintillation alpha*).
- Portable spectrometer (identification of radionuclides) to measure dose and dose rate.
- Portable survey meter for contamination and dose rate measurement.
- Portable monitor with interchangeable alpha / beta / gamma probes.
- Portable contamination probe for alpha and beta-gamma measurement of surface contamination.
- Manual pumps, programmable pumps, personal air sampler, etc.

*Verification does not give rise to specific remarks.*

### 7.6.3 FCN Pitești Physico-Chemical Analysis Laboratory (L AFC)

The laboratory has 13 persons (4 chemists and 9 technicians). Three staff members of the Physico-Chemical Analysis Laboratory (L AFC), a chemist and two technicians, perform the sample preparations as well as the determinations of uranium and pH in liquid samples. The other chemists and technicians are involved in chemical analyses under quality control and in the reception of raw materials.

For uranium determinations L AFC uses SCINTREX-UA3, a uranium analyser based on fluorimetry. This instrument is dedicated to determination of low concentrations of uranium in liquid samples. The measurement procedure (MMC653), sample registry and documentation on calibration of the method (ICP-092 standard, traceable to NIST) were readily available in the laboratory.

The laboratory is also equipped with devices for inductively coupled plasma mass spectrometry (ICP-MS) and inductively coupled plasma optical emission spectroscopy (ICP-OES).

*Verification does not give rise to specific remarks.*

### 7.6.4 SCN Pitești Characterization of Radioactive Wastes and Nuclear Materials laboratory (CROWN)

The CROWN (Characterization of Radioactive Wastes and Nuclear Materials) laboratory was created within the Radiation Protection, Environment Protection and Civil Protection Laboratory to provide services in the field of radiological characterisation of materials from licensed nuclear practices for clearance or classification as radioactive waste.

The Radiation Protection, Environment Protection and Civil Protection Laboratory is the main developer of research projects within the National R&D Program for Environmental Protection which is financed by the Government ordinance no. 144/1999. This programme has the following objectives:

- Assessment of the environmental impact of nuclear activities;
- Study of radiation effects on the human body;
- Development of radiation measurement methods with applications in radiation protection;
- Elaboration of studies, analyses and technical solutions, development of methods, techniques and technologies for nuclear installations' decommissioning;
- Public information for nuclear energy acceptance;
- Development of a system for training and certification of personnel in the field of radiological safety.

Between November 2005 and February 2007 the CROWN laboratory's infrastructure was upgraded; the new analysis methods are to be accredited through a research project financed by the national R&D authority.

The CROWN laboratory's technical procedures include radioactive contamination determination by direct and indirect methods, determination of activity concentration by gamma spectrometry and ambient equivalent dose rate  $H^*(10)$  determination by direct measurement.

#### 7.6.4.1 Quality assurance

The quality assurance system is structured in accordance with the requirements of the Romanian standard SR EN ISO CEI 17025:2005; the technical procedures are designed in accordance with applicable national and international standards.

Quality control for each method is performed by scheduled measurements of radioactive test sources and of the environmental background. The laboratory holds certified reference materials which are used to perform internal checks of the measurement method's performances.

Since 20 March 2006 the Radiation Protection Laboratory is designated by CNCAN as notified laboratory for the following activities:

- Direct measurement of radiation fields.

- Radioactive contamination determination.
- Identification and quantitative determination of gamma emitting radionuclides.
- Determination of Sr-90 content in milk, dairy products and fish.
- Determination of uranium content in urine.
- Determination of uranium content in workplace air.
- Determination of atmospheric air radioactivity.
- Determination of natural uranium content in water, soil and vegetation.
- Determination of gross beta activity.
- Radioactive samples measurement by liquid scintillation beta spectrometry.
- Determination of Sr-90 content in aqueous samples.
- Determination of actinides content in aqueous samples, soil, aerosols filters and biological samples, by alpha spectrometry.
- Determination of isotopic composition of materials containing uranium by gamma spectrometry.
- Radiological characterisation of materials by in situ gamma spectrometry.

The notification letter lays down the field of activities, the equipment and the clauses for maintaining the quality of the testing laboratory; it is valid until 6 April 2015.

The laboratory participates systematically in inter-comparisons and proficiency tests organised by IAEA and other national or international organisations. It participated e.g. in:

- IAEA-IRMM EC Interlaboratory Comparison on natural radioactivity, Cs-137 and Sr-90 in soil, 2010;
- IAEA-CU-2009-04 ALMERA Proficiency Test: Determination of gamma emitting radionuclides in simulated air filters, 2009;
- IAEA-CU-2008-04 ALMERA Proficiency Test Determination of Naturally Occurring Radionuclides in Phosphogypsum and Water, 2008;
- In-Situ Intercomparison Scenario International Measurement Campaign; In-Situ Gamma Spectrometry and Dose Rate Measurements in Emergency Situations, Wiener Neustadt, Austria, 2007;
- IAEA-CU-2006-03 World-wide open proficiency test on the determination of gamma emitting radionuclides, 2006;
- IAEA-CU-2006-04 ALMERA proficiency test on the determination of gamma emitting radionuclides, 2006
- Regional Authority of Public Health, Banska Bystrica, Slovakia, Intercomparison Exercise on radionuclides in “Dudvah’s sediment”, 2005-2006;
- IAEA Proficiency Test for determination of anthropogenic  $\gamma$ -emitting radionuclides in a mineral matrix, 2001-2002;
- IAEA – 315 Intercomparison on radionuclides in marine sediment, 1994;
- IAEA – 373 Intercomparison on radionuclides in grass, 1993;
- IAEA – 300 Intercomparison on radionuclides in marine sediment, 1993;
- IAEA – 135 Intercomparison on radionuclides in the Irish Sea, 1992;
- IAEA – 134 Intercomparison on radionuclides in cockle flesh, 1992;
- IAEA – 375 Intercomparison on radionuclides in soil, 1991;
- IAEA – 367 Intercomparison on Marshall Islands' sediment, 1991;
- IAEA – 368 Intercomparison on Mururoa Atoll sediment, 1991.



#### 7.6.4.2 Equipment

The laboratory operates a gamma spectrometry system based on a *Canberra* HPGe detector with nominal relative efficiency of 25% and a nominal resolution of 1.8 keV, a *Canberra InSpector type 1270* MCA with incorporated high voltage supply, a lead shielded enclosure and a *DTK Pentium* PC. Spectrum management software is *Canberra Spectroscopy Assistant V 2.0* (2001), and gamma analysis is done with *Canberra Genie 2000*. The energy range covered is 30 to 1718 keV.

For mobile use the laboratory has a hand-held radiation measuring device with spectrometric capabilities, based on a *Canberra InSpector 1000* device with a 1.5"x1.5" NaI(Tl) detector (energy range 50 keV to 3 MeV) and an incorporated GM detector (energy range 30 keV to 1.4 MeV). Nuclide identification is with *Canberra Genie 2000*; spectrum storage capacity is more than 256 spectra.

For (gross) alpha and beta measurements a low background gas flow proportional counter (model *MPC 9300, Protean Instrument Corporation*) using P-10 Argon-Methane as counting gas and with a window thickness of 80  $\mu\text{g}/\text{cm}^2$  is available. The device has a very low background. The counting efficiency for Sr-90/Y-90 is 55%, for Am-241 it is 42%. *Protean's PICNET* software is installed on a PC.

The laboratory also has a portable radiation / contamination meter (*Thermo Scientific* model *FH40 GL10*) with incorporated GM detector and external probes model *FHZ 120 A* and *FHZ 140*. For dose rate measurements the energy range is 45 keV to 1.3 MeV, the measuring range is 0.01  $\mu\text{Sv}/\text{h}$  to 9.99 mSv/h.

A liquid scintillation counter (*Packard*, model *TRI-CARB 2100 TR*) is available as well.

For characterisation of radioactive materials a mobile system is used based on an *Ortec ISO-CART/ISOTOPIC* system with versatile transport and manipulation features including a loading and weighing cell, and on an *Ortec* HPGe detector. The shield has Pb and W collimators; a turntable option supports drums up to 450 kg. The MCA is an *Ortec digiDART*, the PC a *Dell Latitude D520* laptop; software used is *Ortec ISOTOPIC-32* and *GammaVision*.

Three spectrophotometers are available, a *Hach DR/2000* (wavelength range 400-900 nm), a *Shimadzu UV-1650PC* (wave length range 190-1100 nm) and a *Varian Cary-50 UV-VIS* (wave length range 190-1100 nm).

The verification team noted the availability of a (not certified) uranium standard (Uranium ICP Standard 1000  $\mu\text{g}/\text{mL}$  from *ULTRA Scientific Analytical Solutions*) that is used on a regular basis for the preparation of dilutions. Such diluted samples are used for spectrophotometer checks.

The laboratory produces U-solutions for various calibration/control tasks (including for the measurements of discharge samples) from a reference uranium stock solution. This solution is supplied by *LAFC* from *FCN*; it is not traceable to an independent standard and certified.

The verification team noticed inconsistencies between measuring, reporting and sampling dates. On a randomly selected page of the record book for U-content measurements in water samples, records No's. 272, 287 and 289 for November 2011 the measuring, or reporting dates were earlier than the sampling dates.

In addition the search for documentation regarding participation in international (IAEA) inter-comparison exercises took a long time.

The following minor comments do not effect on the appropriateness of the environmental control conducted by the operator.

*The verification team recommends using a certified reference solution for calibration of the UV-VIS spectrophotometry system. The team also recommends to improve documentation for registration on sampling, measuring and reporting dates.*

*The verification team supports regular participation in international inter-comparison exercises for quality assurance purposes; however, it suggests to improve archiving of documentation of such participation in order to make it readily available.<sup>4</sup>*

## **8 INDEPENDENT CONTROL BY THE REGULATOR WITH REGARD TO URANIUM MINING AND IN THE INDUSTRIES RELATED TO URANIUM AND NUCLEAR FUEL PRODUCTION**

### **8.1 INTRODUCTION**

The Romanian authorities exercise an environmental radiological control and monitoring of all uranium mining and milling installations as well as the nuclear fuel production sites and of their surrounding territories.

Within the authorisation process *CNCAN* approves discharge limits, derived from annual dose limits; it assesses and approves the plans for discharges of radioactive substances. In cooperation with the local Environment Protection Agencies *CNCAN* also establishes the monitoring locations and maximum allowed concentrations for radioactive pollutants such as uranium and radium in environmental media.

Environmental authorisations are issued by the central authority for environmental protection on the basis of the criteria defined by the laws in force. In consultation with *CNCAN* and the Ministry of Health they are completed with specific authorisation and control criteria.

In practice, the regulator runs his own monitoring programme including the controlled area of the sites and their surroundings, using mostly the same sampling points as those used by the operator (including for food and vegetation).

Milk sampled in 'uranium' areas originates mostly from small private farms and is monitored by the local milk producers.

### **8.2 OCCUPATIONAL HEALTH ASPECTS**

*CNCAN*, from a radiological point of view continuously follows the personal health monitoring of all workers in the uranium mining, uranium processing and fuel fabrication industries regarding the application of legal requirements. Similar attention is given to environmental protection.

*CNCAN* also assesses the radiological risks of uranium mining. In some cases, these risks constituted the technical basis to close uranium mines.

### **8.3 NEPA'S PROGRAMME**

With regard to uranium mining and production related activities the SSRMs (the radiological laboratories of the LEPAs and REPAs) – besides their routine programmes with regard to national environmental radioactivity monitoring – have specific monitoring programmes in place. These programmes are elaborated by the local laboratory (SSRM) from LEPA or REPA in close collaboration with NEPA. They are streamlined to the local conditions.

With regard to the uranium milling and processing site at Feldioara the responsible body is the SSRM of LEPA Braşov (verification in 2008; see Technical Report RO-08/06). Its programme takes into account that the network of water bodies in the Braşov region is very dense and many rivers cross the land in the vicinity of the Feldioara site. Thus, on the Olt River (the main river of the region) nine sampling points have been installed upstream and downstream of the Feldioara site discharge pipe. Two other small rivers and one lake are also sampled. The SSRM of LEPA Piteşti is in a similar way involved in the off-site environmental radioactivity monitoring of the nuclear fuel fabrication plant at Piteşti.

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<sup>4</sup> According to *SCN Piteşti* the recommendations were implemented after the verification.

#### **8.4 CONTROL ACTIVITIES BY THE PUBLIC HEALTH DIRECTORATE**

With regard to some radiological hazardous areas, surveillance programmes are carried out (e.g. foodstuff monitoring, drinking water, population and occupational health aspects) by the local public health authorities.

For example, at the Feldioara uranium milling and processing site, the Public Health Directorate of Braşov samples and measures the aerosols and deposition at the window of the Feldioara's monitoring Laboratory. The public health authorities and the plant operator are informed about the results of these measurements.

The programmes and the laboratories of these authorities were not part of this Article 35 verification.

### **9 NATIONAL MONITORING OF ENVIRONMENTAL RADIOACTIVITY - DESCRIPTION AND VERIFICATION**

#### **9.1 GENERAL**

Continuous monitoring of environmental radioactivity on the Romanian territory is carried out by several organisations. A major part of the national monitoring is performed by the National Environmental Protection Agency (NEPA) and the Local/Regional Environmental Protection Agencies (LEPA / REPA). NEPA has a reference laboratory for radioactivity (NRL), which ensures the surveillance through a national environmental radioactivity surveillance network (NERSN), consisting of nine '24 hours', and twenty-eight '11 hours' radiological laboratories<sup>5</sup> (Surveillance Station of Radioactivity Monitoring - SSRM) of the LEPAs and REPAs (see figure 4) and through the automatic early warning system for radiation in the environment (EWS). EWS supports routine radiological surveillance and provides monitoring data needed in emergency situations. Data from EWS are provided also to the EURDEP system managed by JRC-Ispra.

The NERSN standard monitoring programme of these 37 laboratories includes measurements of air, water, vegetation, uncultivated and cultivated soil.

Within the modernisation process, NEPA started a few years ago, among other improvements a LIMS to be used by the NRL, LEPAs and REPAs, also for the data transfer to NEPA. Currently it is in the test phase.

In the NERSN laboratories each day three (11 hours) and four (24 hours) background measurements are performed with regard to the air filter analysis devices; a visual quality control chart allows efficient quality management. When 'higher' values than expected occur the sample has to be re-measured.

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<sup>5</sup> '24 hours' programme means four series of aerosol sampling and measuring per day; and '11 hours' signifies two series of aerosol sampling and measuring per day.

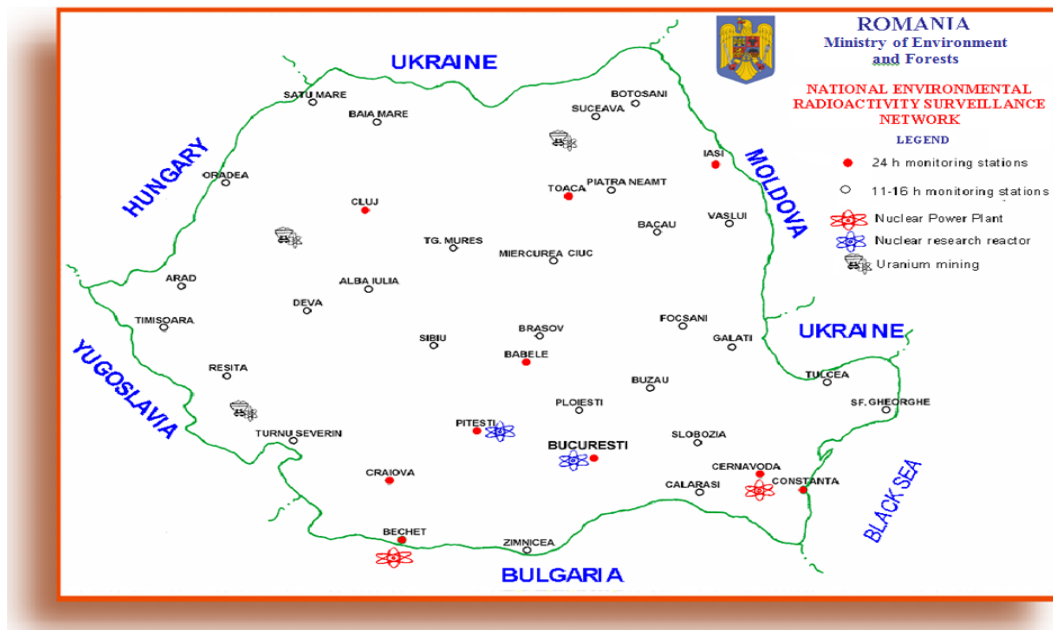


Fig. 4: NERSN network of 37 SSRM laboratories in local LEPAs

## 9.2 AUTOMATIC SYSTEMS

Romania operates automatic systems for the monitoring of ambient gamma dose rate all over the country and particularly at locations close to NPPs (Cernavodă in Romania and Kozloduy in Bulgaria).

### 9.2.1 Ambient gamma dose rate monitoring networks

Altogether, the automatic ambient dose rate monitoring system comprises 88 stations, spread over the national territory and close to NPPs, all with real time data transmission.

Data from 49 of these ambient gamma dose rate measurement stations (early warning system) are sent daily to the EC through the EURDEP platform; an additional 39 ambient gamma dose rate measurement stations ('new' system) are installed.

#### 9.2.1.1 For the national territory – 'old' system

All of NERSN's laboratories still operate dose rate monitoring devices of the 'old' system, based on detectors produced by *IFIN-HH* (type *TIEX*, using GM tubes; connected to a base station). Each base station displays instant data (four second intervals) and hourly averaged data. Data transmission to NRL Bucharest is daily by manually sending the values (thus the system is not completely automated). The system is planned to stop operation by the end of 2014.

#### 9.2.1.2 For the national territory – 'new' system

The 'new' system is composed of 39 ambient dose rate monitoring stations. The dose rate probes are from *Umwelt- und Ingenieurtechnik GmbH (UIT GmbH)*, Dresden, Germany, model *HNQ24*. Each detector consists of two GM tubes and has a measuring range of  $0.03 \mu\text{Sv/h} - 10 \text{Sv/h}$ . For dose rates of  $10 \text{Sv/h}$  up to  $100 \text{Sv/h}$  the monitor will show a minimum of  $10 \text{Sv/h}$ .

The operating temperature range is  $-40$  to  $+70^\circ\text{C}$ .

The device also registers some meteorological data.

The detectors can store up to 4096 gamma dose rate values. The values and meteorological data are sent to NRL, the network coordination centre, by using GPRS as the main data link, and by satellite (*Orbcomm System*) as back-up. The gamma dose rate values are sent every 60 minutes under normal conditions and every 5 minutes in case of an alarm.

For routine and alarm situations the data are sent in real time. Furthermore, they are stored in the local database on the SSRM's PC in the local LEPA.

A solar panel provides electric power for the detector devices.

#### 9.2.1.3 Automatic stations at LEPA Alba Iulia

At the Local Environmental Protection Agency, Alba Iulia, the verification team noted the presence of both, the 'old' and the 'new' system for ambient gamma dose rate monitoring.

The location can be globally seen as very good (wide valley). Locally, the nearest building is ca. 10 m away; the probes are mounted ca. 1 m above ground.

The old *IFIN TIEX* device (manually logged and with notebook) serves as backup for the new system.

The new system (station number AAMS-25) is set up in the backyard/garden area of the LEPA in a fenced and locked area. It contains two model *HNQ-24* probes (Serial No 077/06 and 038/06), mounted ca. 10 cm apart. As in the other stations visited during the former verifications, the detectors are slightly shielded by the solar panel.

With regard to the measurements (including meteorological data provided by the devices on the meteo mast) the team received a demonstration on the PC screen: time trend for dose rate (probe 1 and 2), temperature, humidity, wind speed, rain, and pressure.

*The verification team suggests improving the installation of the 'new' gamma dose rate probes to avoid any shielding effects, e.g. by the solar panel.*

#### 9.2.1.4 Automatic station at REPA Pitești

At the Regional Environmental Protection Agency, Pitești, the verification team noted the presence of a 'new' dose rate monitor with the probe mounted in the garden of the REPA building, rather close to high trees.

*The verification team remarks that timely cutting of the trees should be considered in order to avoid distorting effects for the measurement.*

### 9.2.2 Automatic surface water monitoring

The automatic water radioactivity monitoring network of Romania comprises five submersible "intelligent" probes installed along the Danube River. They are manufactured by *UIT GmbH* and use a 2"x2" NaI(Tl) detector for measurement. An Am-241 source is embedded to allow energy stabilisation (avoiding energy drifts due to temperature fluctuations). The nominal measuring range is 0.01 to 100 MBq/m<sup>3</sup>. Data storage in the device is up to 10 years, in a local computer with 40 GB storage capacity; data are sent to the network coordination centre at NRL by GPRS. The frequency of data transmission is programmable; in normal conditions it is twice daily, under emergency conditions every hour.

No station of the automatic water radioactivity monitoring network was included in the verification visit.

## 9.3 LABORATORY BASED NETWORK

The description of the laboratory based system for the monitoring of environmental radioactivity is largely based on the Technical Report of the 2008 verification mission.

### 9.3.1 Sampling and measurement programme

#### 9.3.1.1 Air

In 2006, through a EU Phare project Romania received 18 new aerosol samplers (max. capacity 30 m<sup>3</sup>/h) which have been installed in SSRM stations. If technically possible, the old devices are used as backup samplers.

The 'new' devices (type *VOPV-10*, made by *VF s.r.o.*, Slovakia) use a centrifugal pump with a processor controlled high-speed induction motor, a flow meter, a control unit, and a keyboard. A 2x16 character alphanumeric display that can show the current airflow, the total sampled volume from the start of the system, the sampled volume in a selectable time interval, the total number of operating hours from the start, temperature and pressure of the sampled medium, the status and error messages, and the current sampling time. After a power supply failure the device automatically restarts when power supply is restored.

The connection to an external PC via an RS-485 interface is possible. The operational temperature range is from -20°C to +50°C. The device uses glass fibre filters (retention coefficient 90%). The frequency of filter change is 5 hours; there are 4 filters/day for SSRM stations with 24 hour programme and 2 filters/day for SSRM stations with 11 hour programme.

The filters are analysed in the local laboratory (total beta). Beta measurements are performed at intervals of 3 minutes, 20 hours and 5 days after the end of sampling. This method allows to take into account the radioactive decay of radon and its decay products and to have a rough idea about the presence of long half-life radionuclides. Gamma spectrometric analysis is performed on all the filters from each month (if the local laboratory does not have the capability the filter material is sent to a LEPA/REPA laboratory suitably equipped, e.g. Constanța, Craiova, Iași, Baia Mare, Arad or NEPA).

Beta measurement results are reported separately in *Excel* format and stored centrally at NEPA Bucharest. The results are transmitted daily to EURDEP and yearly to the REM data base at JRC Ispra.

#### 9.3.1.2 Precipitation (wet and dry deposition)

Precipitation (dry and wet deposition) collectors are situated in the SSRM (LEPA) yards. The samples are taken daily. When it does not rain, the collector is washed with 1 litre of distilled water according to written procedures.

In the case an analysis of tritium is foreseen 250 ml of the original rain sample (avoiding the distilled water) are separated and specially treated. This sample has higher priority than the ones for total beta and gamma spectrometric analysis.

For total beta analyses the remaining sample is evaporated and the residue is measured on the same day for 1000 seconds and again after 5 days for 3000 seconds.

For gamma spectrometric analyses all samples collected in one month are combined, the evaporation residue is measured at the end of the month.

Beta measurement results are reported separately in *Excel* format and stored centrally at NEPA Bucharest. The results are transmitted daily to EURDEP and yearly to the REM data base at JRC Ispra.

#### 9.3.1.3 Ground water

A one litre sample is collected every day. After evaporation, the residue is measured for total beta the same day, for 1000 s.

#### 9.3.1.4 Surface water

NERSN performs surface water monitoring for the whole territory, including the Danube River. Water is collected daily at different locations all over Romania. All the sampling points are situated on the rivers in the vicinity of cities.

One litre samples are collected daily. For gross beta analysis the water is evaporated and the residue is measured on the same day, for 1000 seconds; after 5 days the sample is measured again for 3000 seconds.

For beta and gamma spectrometric analyses the daily samples of a month are combined.

#### 9.3.1.5 Drinking water

National monitoring for drinking water is carried out by the Ministry of Health (MH) network of ionizing radiation hygiene laboratories, according to provisions of art 38, 39 of Law no. 111/1996 based on the methodology elaborated by the National Institute of Public Health (NIPH) Bucharest. Three to five litres of drinking water are sampled on a quarterly basis. For screening purposes gross alpha and beta activities are measured. In cases where gross activity levels are higher than the accepted levels, K-40, Cs-137, Sr-90, Ra-226, natural uranium and in certain cases Po-210 are measured.

For nuclear facilities related monitoring, the radioactivity of drinking water is assessed monthly. For water sampled in the surroundings of the NPP, gross alpha and beta as well as tritium are measured monthly; in cases where annual gross activity levels are higher than the accepted levels, Cs-137 and Sr-90 are determined. For water coming from a mining or a nuclear fuel processing zone, gross alpha and beta are measured on a quarterly basis; in cases where gross activity levels are higher than the accepted levels, natural uranium, Po-210 and Ra-226 are measured.

#### 9.3.1.6 Soil

In the Standard monitoring programme, at the NERSN stations uncultivated soil is sampled weekly; sample size is 10 cm x 10 cm x 5 cm. The samples are dried. After 5 days a beta measurement of 3000 seconds is performed. Gamma spectrometric analysis is performed on a yearly basis (the sample from July).

#### 9.3.1.7 Vegetation

In the Standard monitoring programme, sampling of vegetation is done in the network's SSRM yards. Between 1<sup>st</sup> of April and 31<sup>st</sup> of October, once every week, vegetation on one square meter is collected and dried. After 5 days a gross beta measurement of 3000 seconds is performed. Gamma spectrometric analysis is performed on a yearly basis (the sample from June).

#### 9.3.1.8 Foodstuffs

National monitoring of foodstuffs is carried out by the Ministry of Health (MH) through the network of ionizing radiation hygiene laboratories, in accordance with the requirements of Law no. 111/1996. Details on methodological issues such as type of foodstuff, frequency of sampling and source of food sampled are set up by the surveillance methodology elaborated by NIPH Bucharest, responsible for technical coordination according to provisions of the ministerial order for the national programme for public health. Additionally, according to the *Joint Ministerial Order no. 1805/286/314/2006* of the Ministry of Health on the implementation of the regulation regarding radioactive contamination of foodstuff and feeding stuffs, ANSVSA is responsible for:

- Monitoring the level of radioactivity of food and feed after a nuclear emergency or accident.
- Checking imported food at the borders.
- Designating the network of specialised laboratories.
- Publishing the information on those designated laboratories in the Official Journal.

The MH network carried out a surveillance of main food stuffs from the market and individual households around sites and mixed diet from suitable institutions, according to the 473/2000 Recommendation. This covered milk, mixed diet and individual foodstuffs.

#### 9.3.1.9 Milk

For the national monitoring programme MH's laboratories measure 10 litres of milk quarterly from the local dairies of each district in the country for gross beta and K-40 measurements. Yearly a gamma spectrometric analysis is performed and the content of Sr-90, Ra-226, and in some cases Po-210 is determined.

For nuclear facilities related monitoring 10 litres of milk from local farms, markets or dairies are taken on a quarterly basis. Gross alpha, gross beta and K-40 are measured. On milk collected in the surroundings of the NPP a quarterly analysis with regard to e.g. Cs-137 and Sr-90 is performed. For

mining or nuclear fuel processing areas, natural uranium, Po-210 and Ra-226 is measured every three months.

#### 9.3.1.10 Mixed diet

For the national monitoring programme MH's laboratories sample daily 2 – 3 meals served in schools, kindergartens and some other canteens. On quarterly bulked samples gross beta and K-40 are determined. Yearly the content of Cs-137, Sr-90, Ra-226, and in some cases Po-210 is measured.

For nuclear facilities related monitoring the quantity and the sampling procedure is the same as above, however the origin of the foodstuff differs. Gross beta, gross alpha and K-40 determinations are performed quarterly on the bulked samples. In the NPP area Cs-137 and Sr-90 is measured quarterly. For mining or nuclear fuel processing areas, natural uranium, Po-210 and Ra-226 are measured quarterly.

#### 9.3.1.11 Individual foodstuffs

For the national monitoring programme, the following products are sampled quarterly: 7 kg meat, 5 kg fish, 3 – 5 kg cereals, flour or bread, 10 kg carrots, 5 kg cabbage, 6 kg potatoes, 5 kg tomatoes, 5 kg peppers, and 10 kg apples.

The radionuclides assessed annually are: K-40, Cs-137, Sr-90, Ra-226 and in specific cases Po-210.

For nuclear facilities related monitoring the quantities are the same as above, however sampling is quarterly, mainly from local producers. Gross alpha and beta and K-40 are assessed. Cs-137 and Sr-90 are measured in the NPP's area. For mining or nuclear fuel processing areas natural uranium, Po-210 and Ra-226 are measured.

Mushrooms are sampled not as part of the routine programme but as part of some research studies on the Cs-137 impact after Chernobyl and with regard to heavy metal contamination.

### 9.3.2 NEPA co-ordinated laboratories

After the Chernobyl accident in 1986 the monitoring network (NERSN) consisted of 47 laboratories all over the country. In 2000 it was reduced to 37.

NEPA's reference laboratory, NRL, gathers the results of all the gross beta measurements from the local LEPA-SSRM laboratories that are co-ordinated by NRL.

NRL transmits daily reports to the Ministry of the Environment and Forests (MEF) and other governmental organisations.

Other results e.g. on gamma spectrometry, radon and thoron are compiled by the laboratories and a monthly report is sent to NRL.

Based on the monitoring data, NRL prepares an annual report and distributes it to the relevant national authorities. Data are also transmitted to the EC REM database.

In the course of the 2012 verification the laboratories of SSRM at LEPA Alba Iulia and SSRM at REPA Pitești were visited.

#### 9.3.2.1 SSRM at LEPA Alba Iulia

The radiological laboratory (SSRM) of the LEPA Alba Iulia has 36 staff members, two persons work permanently in the radiological laboratory.

NEPA will try to obtain accreditation for all LEPAs.

#### Sampling devices

The aerosol sampler filter head (mounted on the outside wall of the laboratory building) for filter change is accessible via a small unprotected staircase; this leads to a non-negligible risk of falling during filter change, in particular in winter when the stairs are covered with snow or ice.



### Sample registration and preparation

Upon arrival all samples are registered in a sample registration book with sample code (consisting of a running number), the date, item and signature; registration in the book started on 1 March 2012.

In addition, currently for testing all LEPAs also run a new laboratory information management system (NEPA LIMS, currently version 4.8.0). The team received a demonstration of the registration of a recent deposition sample. The system covers both, sample analyses and automatic measurements. It gives information on the status of the laboratory ('normal', 'intensive'), and includes all work programmes ('what to do'), thus allowing a control of the LEPAs by NEPA from off-site. The system is web based and still undergoing testing; NEPA hopes that it will be ready by the end of the year; a consortium is responsible for progress checking. With regard to the samples to be analysed the system allows bar code printing of all relevant data, a color code (red – orange – cyan) gives quick information on the state of the analysis. A reporting function is also included in the system (reports will be printed, signed, scanned and reloaded). The LIMS has an integrated GIS and data warehouse function. Some laboratory devices have a direct data interface to the system.

A number of balances (*Precisa 300A*) are available. Once per year these undergo checks by the national metrological institute. At the time of the verification, annual check labels were on the device, e.g. 'RO-12 DDO', but no stamp of the institute.

Evaporation of water samples takes place in a chemical hood using infrared lights, in ceramic bowls (ca. 18 cm diameter; 8 devices), with a protective net.

A muffle furnace (*itm CT02*) for ashing of vegetation samples (400°C) is available.

Staff also prepare samples for gamma spectrometry (to be performed at LEPA Arad).

### Beta measurements

For gross beta measurements the laboratory has a single sample counter with NIM frame (*FAN*, model *SI614*), high voltage supply (model *I135M*) and scaler (*FAN*, model *1043*).

Every day a 100-second background measurement is performed (marked in the logbook), followed by a 'calibration' with a Sr/Y source.

Air samples (sampled for 5 hours) are measured three minutes after the end of sampling (measuring time 1000 sec). If the result is larger than 10 Bq/m<sup>3</sup> a re-measurement is done; if this results in a value < 10 Bq/m<sup>3</sup>, staff assumes that the reason was Rn (respectively its short lived decay products). Calculations are performed on PC with *Excel* as well as on paper using a hand calculator; the latter is done for the 'old' version data base, the reason being frequent power failures.

### Sample tracing

The team traced analyses of air filters from 1 September 2010. For the 03:00-08:00 h sample the values in the log book and in the *Excel* table were the same; for the 09:00-14:00 h sample the values for the immediate measurement as well as for the measurements after 20 hours and 5 days showed the same values in the log book and in the *Excel* table.

### Various

Reporting from LEPA to NEPA is performed via *Excel* sheets. The programme used allows only one value to be input manually; all other values are calculated thus, reducing input errors.

*The team encourages the installation of a common LIMS for NEPA and the LEPAs.*

*With regard to the occurrence of electric power problems the verification team suggests installing a suitable Uninterruptible Power Supply (UPS) device in order to guarantee power for the most important equipment .*

#### 9.3.2.2 SSRM at REPA Pitești

The SSRM unit at REPA Pitești is housed in a large modern building. The Surveillance Station of Radioactivity Monitoring (SSRM) is part of the Monitoring Department. Altogether, REPA Pitești

employs some 40 staff, 10 of whom work in the Monitoring Department. Of those three physicists (the head of the laboratory) and two technicians are working in the radiological unit, the SSRM.

SSRM Pitești provides environmental radiation monitoring for the Argeș region that covers the nuclear fuel fabrication plant in Mioveni, Pitești. Their surveillance program includes:

- Daily sampling of surface water (in particular from the river Doamnei, which is a few km from the plant) and ground waters, cultivated and uncultivated soil and grass; measurement of gross beta activity in the lab; for gamma spectrometry the samples are sent to the NEPA laboratory in Bucharest;
- Collecting air samples (on the roof of the LEPA building in Pitești), 4 samples of 5 hours aspiration, each day; measurement of gross beta activity.

Aerosol sampling with a *VOPV-10 K0547-04* digital air sampler (flow rate range 4-12 m<sup>3</sup>/h) is located on the roof of the building.

The verification team inspected the sample registry and the instrumentation used for determination of gross beta activity in water and aerosol samples. Working instructions for the *Thermo Scientific FHT 1100* counter used for this purpose were readily available in the laboratory. The calibration source used for quality control (Sr-90, EM1 No.160206-355130, Inspectorate for Ionizing Radiation, Praha, Czech Republic) had been re-certified on 27 July 2012 by the Romanian Radionuclide Metrology Laboratory. For the operation of the equipment an uninterruptible power supply was available.

The Monitoring Department operates an electronic database developed and maintained by NEPA. The verification team received a presentation of the test version of the new LIMS system (*Env.Rad network ver. 4.8.0*) which is foreseen to use a barcode reader for sample identification and will provide web access.

*The verification does not give rise to any specific remarks. The team encourages the installation of the new LIMS system.*

### 9.3.3 MINISTRY OF HEALTH LABORATORIES

In accordance with the *Ministerial Order no. 1688/2004* of MH on national public health the responsible body for technical coordination and drafting the surveillance methodology for foodstuff and drinking water, including with regard to radioactivity, is the National Institute of Public Health (IPH) in Bucharest.

The national public health network consists of 19 Ionizing Radiation Hygiene laboratories, covering the entire national territory, technically coordinated by the four regional Institutes of Public Health.

Ministry of Health laboratories were not part of this verification visit.

### 9.3.4 FOOD SAFETY LABORATORIES

Samples are taken for almost all food and feed products such as products of animal origin: milk and dairy products, as well as meat, fish, honey; feeding stuffs; forest fruit; cultivated or wild mushrooms; water used in the technological process of food processing or in animal farms; dehydrated products (additives, ingredients for food industry).

The sampling frequency is quarterly or twice a year. The samples are analysed for Cs-134 and Cs-137 in a laboratory controlled by the National Sanitary, Veterinary and Food Safety Authority (*Autoritatea Națională Sanitară Veterinară și pentru Siguranța Alimentelor, ANSVSA*), e.g. the Laboratory of Nuclear Analysis Techniques belonging to the Hygiene and Veterinary Public Health Institute in Bucharest. These laboratories are notified by *CNCAN* to perform such measurements.

A determination of the radioactive contamination level can also be performed at the express request of an individual. The laboratory analyses are performed by official veterinary surgeons or by state inspectors authorised for this purpose.

The radioactivity tests for food and feed (Cs-134 and Cs-137) are accredited by the Romanian accreditation body, *RENAR*, according to ISO 17025:2005.

Food safety laboratories were not part of this verification visit.

## 10 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 uranium mining sites in Bihor and Banat, the uranium milling and processing site at Feldioara, the nuclear fuel production site at Pitești, 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. However, the verification team notes that with regard to the situation at some of the former uranium mines remediation work is on-going and significant changes can be expected in future.
- (2) A few pertinent suggestions and recommendations are formulated. These aim at improving some aspects of discharge monitoring and environmental radioactivity surveillance with regard to uranium production sites and the national monitoring system. The recommendations do not discredit the fact that environmental radioactivity monitoring around uranium production sites as well as the verified parts of the national monitoring system for environmental radioactivity are in conformity with the provisions laid down under Article 35 of the Euratom Treaty.
- (3) The verification findings and ensuing recommendations are compiled in the ‘Main Conclusions’ document that is addressed to the Romanian competent authorities through the Romanian Permanent Representative to the European Union.
- (4) The Commission services ask the Romanian competent authority to inform them of any progress or significant changes with regard to the situation at the time of the verification. In particular, they will closely follow up the progress made with respect to point (2) above.
- (5) The present Technical Report is to be enclosed with the Main Conclusions document.
- (6) 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

## VERIFICATION PROGRAMME

**Art. 35 verification Romania – 20 to 24 August 2012**  
**Feldioara uranium production facility (re-verification), Pitești fuel**  
**fabrication plant, national monitoring system in visited areas, former**  
**uranium mining activities in Central Romania**

## PROGRAMME OF ACTIVITIES

	Team 1	Team 2
Sun, 19 Aug	Travel to Bucharest	
Mon, 20 Aug	Opening Meeting in Bucharest (CNCAN)	
	transfer to Feldioara	transfer to Pitești specific presentation meeting for Pitești site
Tue, 21 Aug	verification of Feldioara uranium production plant lab verification of Feldioara uranium production plant aerial monitoring travel to Alba Iulia	verification at Pitești fuel fabrication plant – discharge monitoring (operator) verification at Pitești fuel fabrication plant – laboratory(ies)
Wed, 22 Aug	verification of facilities of the national monitoring system for environmental radioactivity in the area verification of former uranium mining related sites in Alba Iulia region travel to Banat	verification at Pitești fuel fabrication plant – on-site environmental monitoring (operator) verification at Pitești fuel fabrication plant – off-site environmental monitoring (operator)
Thu, 23 Aug	verification of former uranium mining related sites in Banat region	verification at Pitești fuel fabrication plant – environmental monitoring (regulator) verification of facilities of the national monitoring system for environmental radioactivity in the area
Fri, 24 Aug	Travel to Bucharest	Travel from Pitești to Bucharest
	Closing meeting (CNCAN)	
Sat, 25 Aug	Return	

Team 1: C. Gitzinger, E. Henrich

Team 2: I. Turai, E. Hrneck

**APPENDIX 2**

**DOCUMENTATION**

See also the Art. 35 Technical Reports for Romania 2007 and 2008, Appendix 2.

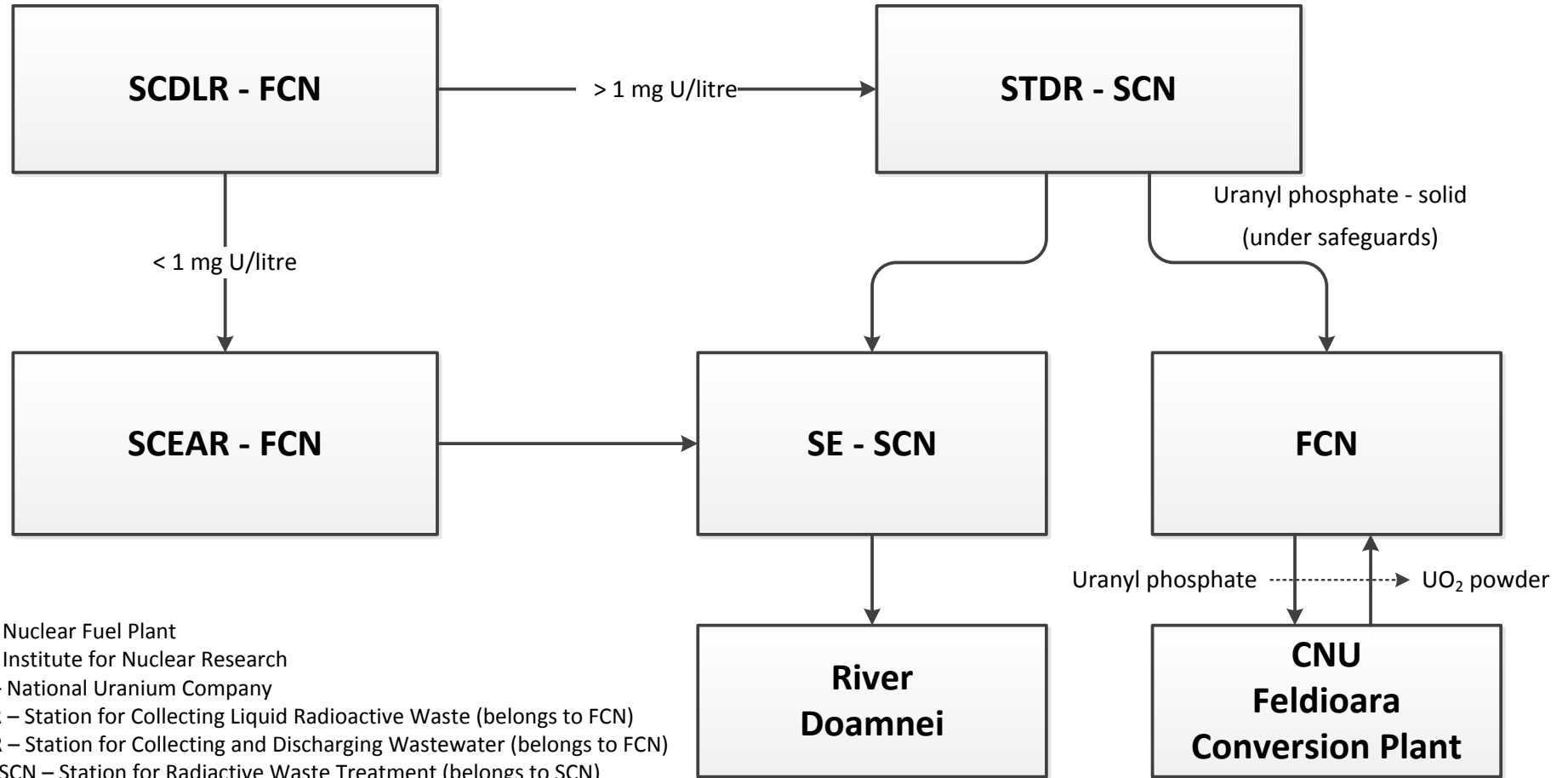
**Documents received**

- Filled-in questionnaire
- Various procedural documents for the Feldioara site
- Various power point presentations
- Various presentations and schemes for the Pitești site

**Web sites consulted**

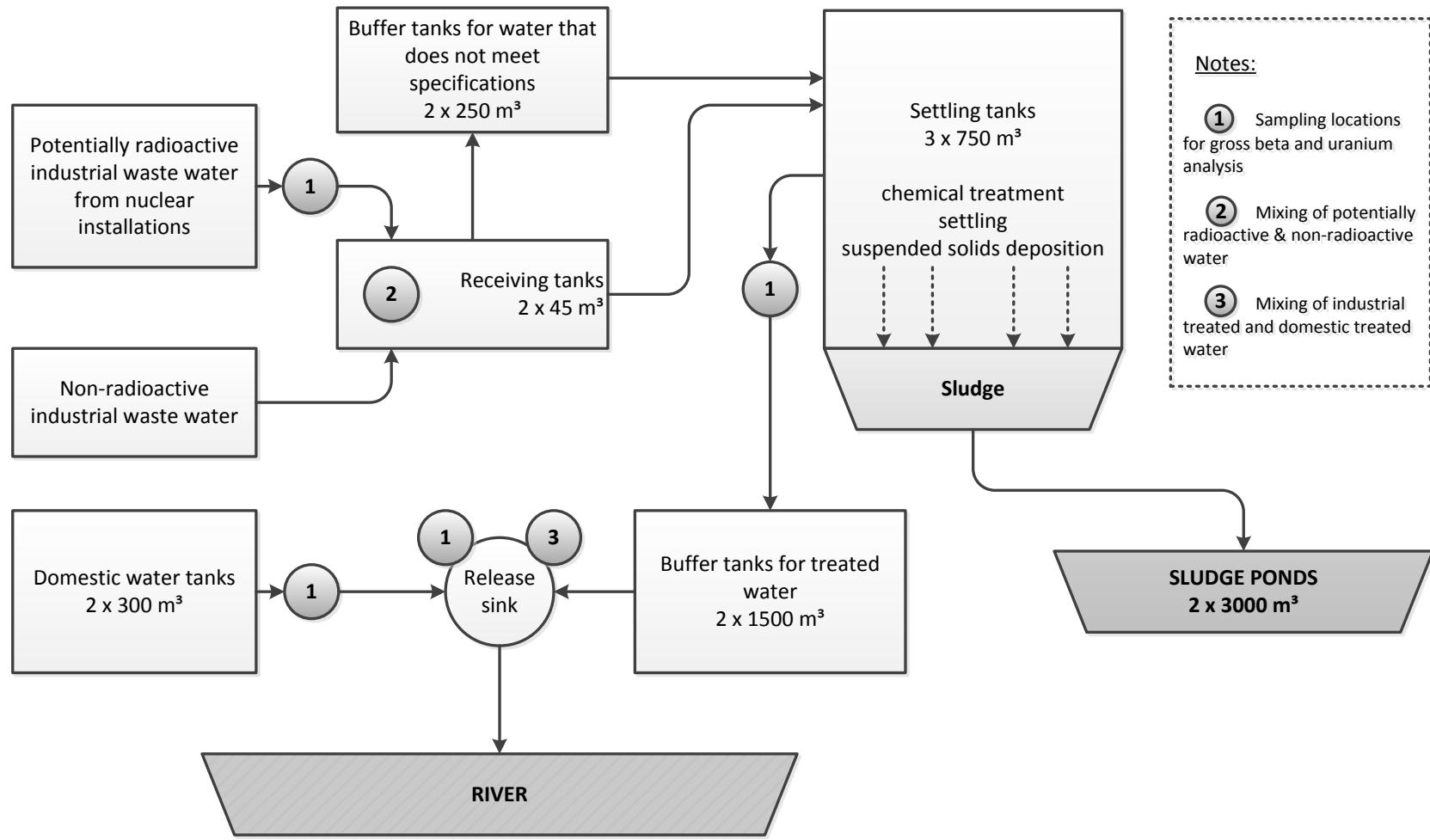
- National Commission for Nuclear Activities Control (*CNCAN*) [www.cncan.ro](http://www.cncan.ro)
- National Environmental Protection Agency (NEPA) [www.anpm.ro](http://www.anpm.ro)
- Institute of Public Health [www.ispb.ro](http://www.ispb.ro)
- Nuclear Agency & Radioactive Waste [www.andrad.ro](http://www.andrad.ro)
- National Uranium Company [www.cnu.ro](http://www.cnu.ro)

**Pitești Nuclear Fuel Plant – Liquid radioactive waste management**



FCN – Nuclear Fuel Plant  
 SCN – Institute for Nuclear Research  
 CNU – National Uranium Company  
 SCDLR – Station for Collecting Liquid Radioactive Waste (belongs to FCN)  
 SCEAR – Station for Collecting and Discharging Wastewater (belongs to FCN)  
 STDR-SCN – Station for Radiative Waste Treatment (belongs to SCN)  
 SE-SCN – Purification Station (belongs to SCN)

**Pitești Nuclear Research Institute – Industrial Waste Water Circulation in the Waste Water Treatment Plant**



**Notes:**

- ① Sampling locations for gross beta and uranium analysis
- ② Mixing of potentially radioactive & non-radioactive water
- ③ Mixing of industrial treated and domestic treated water

**Pitești Nuclear Fuel Plant – Discharge and on-site environmental monitoring locations**

