EUROPEAN COMMISSION
DIRECTORATE-GENERAL FOR ENERGY

DIRECTORATE D - Nuclear energy, safety and ITER
D.3 - Radiation protection and nuclear safety

Technical Report of the Verification under the Terms of Article 35 of the Euratom Treaty

POLAND

National monitoring network for environmental radioactivity around the city of Warsaw

27 – 29 June 2016

Reference: PL 16-03

VERIFICATIONS UNDER THE TERMS OF ARTICLE 35

OF THE EURATOM TREATY

FACILITIES:	National monitoring network for environmental radioactivity around the city of Warsaw
LOCATION:	Warsaw
DATES:	27-29 June 2016
REFERENCE:	PL 16-03
TEAM MEMBERS:	Mr A. Ryan (team leader) Mr T. Tollefsen
REPORT DATE :	26 January 2018
SIGNATURES:	

A. Ryan T. Tollefsen

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1 INTRODUCTION

Article 35 of the Euratom Treaty requires that each Member State shall establish the facilities necessary to carry out continuous monitoring of the levels of radioactivity in air, water and soil and to ensure compliance with the basic safety standards[(1)]. Article 35 also gives the European Commission (EC) the right of access to such facilities in order that it may verify their operation and efficiency. The radiation protection and nuclear safety unit (ENER D.3) of the EC's Directorate-General for Energy (DG ENER) is responsible for undertaking these verifications. Directorate-General Joint Research Centre provides technical support during the verification visits and the preparation of the reports.

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.
- 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.

Taking into account previous bilateral protocols, a Commission Communication[2] was published in the EU Official Journal on 4 July 2006 describing practical arrangements for the conduct of Article 35 verification visits in Member States.

1 Council Directive 96/29/Euratom of 13 May 1996 laying down basic safety standards for the protection of the health of workers and the general public against the dangers arising from ionising radiation (OJ L-159 of 29/06/1996) which will be superseded by Council Directive 2013/59/Euratom of 5 December 2013 laying down basic safety standards for protection against the dangers arising from exposure to ionising radiation, and repealing Directives 89/618/Euratom, 90/641/Euratom, 96/29/Euratom, 97/43/Euratom and 2003/122/Euratom (OJ L 13 of 17.1.2014, p. 1)

2 Commission Communication Verification of environmental radioactivity monitoring facilities under the terms of Article 35 of the Euratom Treaty. Practical arrangements for the conduct of verification visits in Member States. (OJ C 155, 4.7.2006, p. 2–5)

2 PREPARATION AND CONDUCT OF THE VERIFICATION

2.1 PREAMBLE

The EC's decision to conduct an Article 35 verification was notified to Poland by a letter addressed to the Polish Permanent Representation to the European Union. The Polish Government subsequently designated the National Atomic Energy Agency (PAA) to lead the preparations for this visit.

2.2 DOCUMENTS

In order to facilitate the work of the verification team, a package of information was supplied in advance by the national authorities. Additional documentation was provided during and after the visit. All documentation received is listed in Appendix 1 to this report. The information thus provided has been extensively used for drawing up the descriptive sections of the report.

2.3 PROGRAMME OF THE VISIT

The EC and the PAA discussed and agreed upon a programme of verification activities, with due respect to the Commission Communication of 4 July 2006 setting out practical arrangements for the conduct of Article 35 verification visits.

At the opening meeting, following an introduction by the verification team outlining the basis and programme for the verification, presentations were given on the following topics:

- the radioactivity monitoring system in Poland *(PAA)*
- the emergency preparedness and response system in Poland *(PAA)*
- implementation of the *"Council Directive 2013/51/Euratom of 22 October 2013 laying down requirements for the protection of the health of the general public with regard to radioactive substances in water intended for human consumption"* in Poland *(Chief Sanitary Inspectorate)*

The verification team notes the quality and comprehensiveness of all presentations made and documentation provided.

The verifications were carried out in accordance with the programme in Appendix 2.

The following representatives of the national authorities and other parties involved were met:

National Atomic Energy Agency - Radiation Emergency Centre

Krzysztof Dąbrowski	Director
Paweł Lipiński	Senior specialist
Mariusz Jazgarski	Specialist
Joanna Klimowicz	Specialist

Chief Sanitary Inspectorate - Department of Water Health Safety

Anna Kamińska	Director
Agnieszka Strzemieczna	Chief Specialist

General Veterinary Inspectorate

Anna Romaniak	Senior inspector

National Veterinary Research Institute - Department of Radiobiology

Jarosław Rachubik	Senior specialist

Institute of Meteorology and Water Management

Andrzej Czuryłowski	Senior Specialist

Central Laboratory for Radiological Protection

Krzysztof Isajenko	Deputy Director

Institute of Nuclear Chemistry and Technology

Leon Fuks	Senior researcher

Sanitary Epidemiological Station (Warsaw) - Radiation Hygiene Section

Małgorzata Donten	Head

3 MONITORING PROGRAMMES AND RESPONSIBLE ORGANISATIONS

3.1 INTRODUCTION

The fundamentals of the nuclear safety and radiological protection system in Poland dealing with the environmental radioactivity monitoring system consist of:

- recognising and assessing the national radiation situation by means of the coordination (including standardisation) of works performed by local stations and units measuring the level of radiation dose rate, amount of radionuclides in chosen elements of the natural environment and in drinking water, foodstuffs and feeding stuffs;
- maintaining suitable services prepared to recognise and assess the national radiation situation and to respond in case of radiation emergencies (in cooperation with other competent authorities and services operating within the framework of the national emergency response system);
- performing tasks aimed at the fulfilment of obligations of the Republic of Poland resulting from treaties, conventions and international agreements with regard to nuclear safety and radiological protection, and bilateral agreements on early notification in case of nuclear accidents and cooperation with Poland's neighbouring countries in nuclear safety and radiological protection and also for the purpose of assessment of the state of nuclear facilities, radioactive sources, waste management, nuclear safety and radiological protection systems which are located outside the territory of Poland.

The above tasks, according to the Atomic Law Act, are carried out by the President of the National Atomic Energy Agency (PAA)[3], a central body of the governmental administration, competent for nuclear safety and radiological protection matters. The Act of Parliament on Atomic Law of 29 November 2000 (last amendment on 11 February 2016) - (original: Journal of Laws of 2001 No. 3 pos.18, amendments: Journal of Laws of 2014 Item 1512 and of 2015 Item 1505 and 1893, Journal of Laws of 2016 Item 266) Ustawa Prawo Atomowe z dnia 29 listopada 2000 r. (Dz.U. 2001 Nr 3 poz. 18, zmiany: Dz.U. z 2014r. poz. 1512, z 2015 r. poz. 1505 i 1893 oraz z 2016 r. poz.266) and its accompanying executive acts regulate the activities of the PAA President. The PAA President fulfils his duties through the National Atomic Energy Agency which operates under his direct management. The internal organisation of the PAA is set forth in the statute granted by the Minister of the Environment.

The entities involved in the radiation protection area in Poland comprise:

- Environmental radioactivity monitoring;
  - Chief Inspectorate of Environmental Protection subordinated to the Ministry of the Environment;
  - President of the National Atomic Energy Agency (PAA) via the Radiation Emergency Centre CEZAR supervised by the Minister of the Environment;
- Radiological surveillance of food stuffs and feeding stuffs;
  - Chief Sanitary Inspectorate under Ministry of Health;
  - Regional Sanitary Inspectors under Chief Sanitary Inspectorate;

[3] Exceptionally, the PAA President's supervision over activities involving ionizing radiation sources is not required in case of the applications of X-ray devices for the purposes of medical diagnostics, interventional radiology, surface radiotherapy and radiotherapy of non-cancerous diseases. The supervision over the said activities is exercised by the national provincial sanitary inspectorates (or services in charge which report to the Minister of National Defence and Minister of the Interior).

- General Veterinary Inspectorate under Ministry of Agriculture and Rural Development;
- President of the National Atomic Energy Agency (PAA) via Radiation Emergency Centre CEZAR supervised by the Minister of the Environment;

– Nuclear and radiological emergency preparedness;

- Ministry of Interior – national level;
- Regional Governors (voivodships) – regional level under the Ministry of Interior and Administration (Regional Governors provide financing of the Regional Sanitary-Epidemiological Stations);
- Licensees – facility (local) level;
- President of the National Atomic Energy Agency (PAA) via Radiation Emergency Centre CEZAR supervised by the Minister of the Environment – advisory role.

The figure below shows the general structure and information flow between the main Polish entities involved in radiological protection.

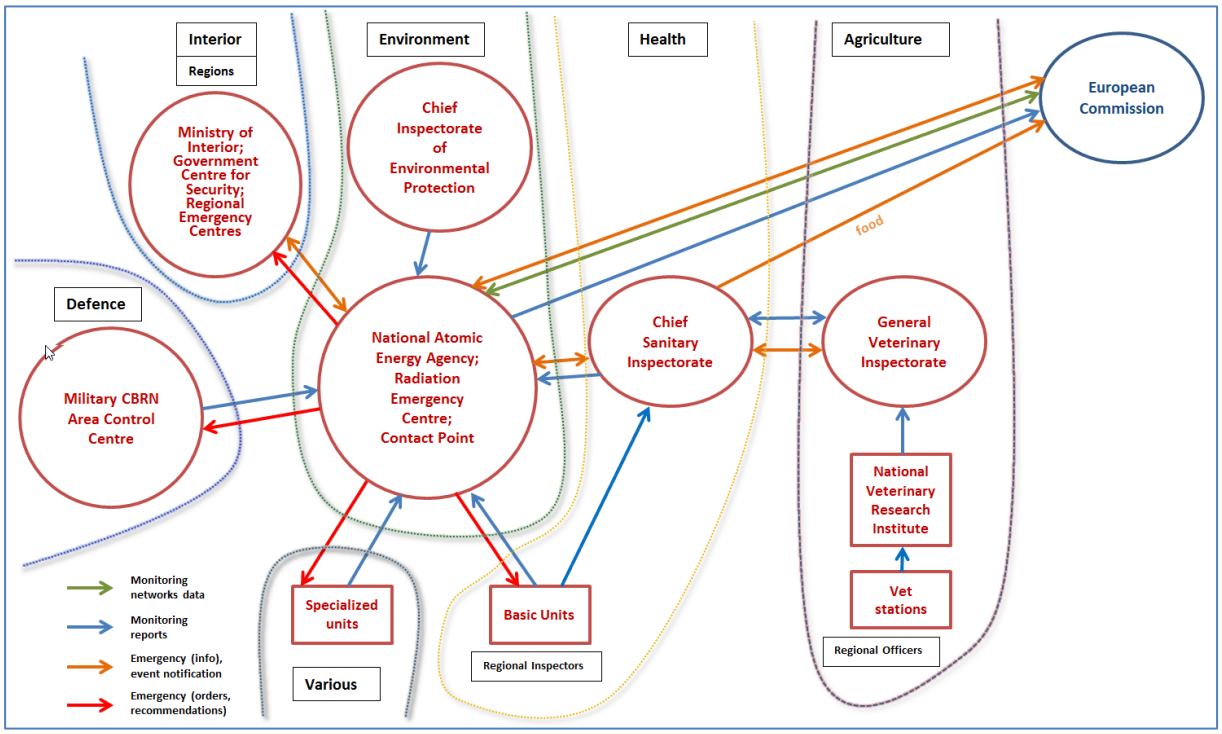

Figure 1: Entities involved in radiological protection

3.2 LABORATORIES AND ASSOCIATED UNITS

The following laboratories and other units are directly involved in the radiological protection activities:

– Environmental radioactivity monitoring;

1. Central Laboratory for Radiological Protection in Warsaw (specialised unit)
2. Laboratory of Radioactivity Analyses, Institute of Nuclear Physics in Kraków (specialised unit)

3. Dosimetric Surveys Laboratory, National Nuclear Research Centre in Świerk (specialised unit)
4. Department of Radiation Protection and Radiobiology, National Institute of Hygiene in Warsaw (specialised unit)
5. Silesian Centre for Environmental Radioactivity, Central Mining Institute in Katowice (specialised unit)
6. Faculty of Physics and Applied Computer Science, AGH University of Science and Technology in Kraków (specialised unit)
7. Institute of Meteorology and Water Management in Warsaw (specialised unit)
8. Military Institute for Chemistry and Radiometry in Warsaw (specialised unit)
9. Military Institute of Hygiene and Epidemiology in Warsaw (specialised unit)
10. Institute for Nuclear Chemistry and Technology in Warsaw (performs ILCs and PTs for the above institutions)

- Radiological surveillance of food stuffs and feeding stuffs;
    1. Sanitary-Epidemiological Stations (30 basic units) – all food products
    2. Veterinary-Hygiene Stations (9 stations + National Veterinary Research Institute in Puławy) – animal products
    3. Central Laboratory for Radiological Protection - mixed diet; ILCs ant PTs for basic units (based upon contract; public procurement)
- Nuclear and radiological emergency preparedness;
    1. Radioactive Waste Management Plant (presently acts as PAA President's Emergency Team; based upon a public procurement contract;) under Ministry of Energy
    2. Regional Emergency Management Centres (16 voivodships) under the Ministry of the Interior
    3. Sanitary-Epidemiological Stations (30 basic units) under the Chief Sanitary Inspectorate
    4. Veterinary Hygiene Stations (9 stations + National Veterinary Research Institute in Puławy) under General Veterinary Inspectorate
    5. Specialised Units (9 laboratories)

3.3 EMERGENCY PREPAREDNESS AND RESPONSE ARRANGEMENTS

In cases of a radiological emergency, intervention measures are taken as necessary separately for incidents occurring within the area of the given organisational unit (on-site emergency incidents) and for those which reach beyond the organisational unit ("regional" and "national" emergency incidents, including those having cross-border effects). The head of the given entity, the provincial governor or the minister competent for the interior are in charge of the elimination of the hazard and of the consequences of the incident, depending on the scale of emergency.

The Radiation Emergency Centre (CEZAR) provides information and consultancy for assessing the doses and contamination as well as other expert opinions and measures which are required on the incident site. Furthermore, they submit information on radiation emergencies to communities which have become exposed as an outcome of the emergency and to international organisations and

neighbouring countries. The same procedure also applies in cases when illegal trade in radioactive substances is revealed (including attempts of illegal shipment across the national border). The PAA CEZAR centre employs a dosimetry team which may perform on-site measurements of radiation dose rate and radioactive contamination, identify the contamination type and the abandoned radioactive substances as well as remove the contamination (on the spot, not applicable in case of wide spread contamination) and transport the radioactive waste from the incident site to the Radioactive Waste Management Plant.

Additionally, on the basis of an agreement between PAA and the Capital City of Warsaw, the Radiation Emergency Centre notifies Warsaw's Security and Crisis Management Bureau about any radiation related threats emerging within the city.

3.4 RADIATION EMERGENCY CENTRE CEZAR

Systematic assessment of the national radiation situation is conducted by the Radiation Emergency Centre CEZAR which is a separate organisational unit of the PAA. Tasks include:

- Collecting, verifying and analysing monitoring data;
- Maintaining databases and operating IT systems important for the assessment of the national radiation situation;
- Verifying and assessing information about radiation events and responding to radiation events (including the activities of National Contact Point and Emergency Service of the PAA President);
- Cooperating with national institutions and emergency centres of other countries and international organisations with regard to radiation monitoring and emergency management;
- Forecasting the development of national radiation situation and hazards to the general public and the environment.

A general schematic overview of the system is shown below:

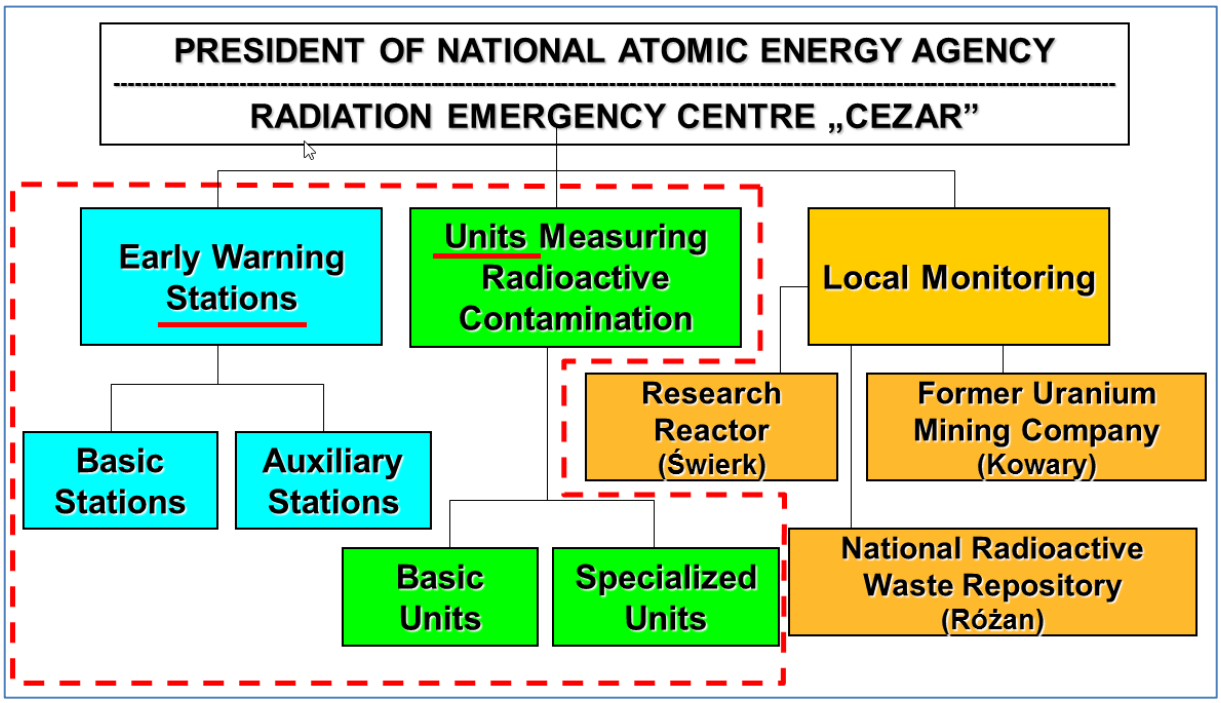

Figure 2: Radiological monitoring system in Poland

4 LEGAL FRAMEWORK FOR ENVIRONMENTAL RADIOACTIVITY MONITORING

4.1 INTRODUCTION

In Poland, all issues connected with radiological protection or the environmental radiation monitoring are, under the binding provisions of law, considered jointly with the issue of nuclear safety, physical protection and nuclear material safeguards. Such a solution assures one common approach to all aspects of radiological protection, nuclear safety, nuclear material safeguards and radioactive sources, and thus all the nuclear regulatory activities are consolidated into one regulatory system.

The nuclear safety and radiological protection system functions according to the Atomic Law Act of 29 November 2000 and the system of lower level regulations, as well as the EU directives and regulations, and also treaties and international conventions to which Poland is a party.

4.2 LEGISLATIVE ACTS REGULATING ENVIRONMENTAL RADIOACTIVITY MONITORING AND RADIOLOGICAL SURVEILLANCE OF FOODSTUFFS

1. Act of Parliament of 29 November 2000 Atomic Law (last amendment 11 February 2016) - (original: Journal of Laws of 2001 No. 3 pos.18, amendments: Journal of Laws of 2014 Item 1512 and of 2015 Item 1505 and 1893, Journal of Laws of 2016 Item 266) Ustawa Prawo Atomowe z dnia 29 listopada 2000 r. (Dz.U. 2001 Nr 3 poz. 18, zmiany: Dz.U. z 2014r. poz. 1512, z 2015 r. poz. 1505 i 1893 oraz z 2016 r. poz.266)
2. Regulation of the Council of Ministers of 17 December 2002 on stations for the early detection of radioactive contamination and units which measure radioactive contamination (Journal of Laws of 2002 No. 239 Item 2030) Rozporządzenie Rady Ministrów z dnia 17 grudnia 2002 r. w sprawie stacji wczesnego wykrywania skażeń promieniotwórczych i placówek prowadzących pomiary skażeń promieniotwórczych (Dz.U. 2002 nr 239 poz. 2030)
3. Regulation of the Council of Ministries of 18 January 2005 on the emergency planning for radiological emergency (Journal of Laws of 2004 No. 98 Item 987 last amendment on 20 February 2007) Rozporządzenie Rady Ministrów z dnia 27 kwietnia 2004 r. w sprawie wartości poziomów interwencyjnych dla poszczególnych rodzajów działań interwencyjnych oraz kryteriów odwołania tych działań (Dz.U. 2004 nr 98 poz. 987 ze zmianami z dnia 20 lutego 2017 r.)
4. Regulation of the Council of Ministers of 27 April 2004 on the determination of entities competent to inspect maximum permitted levels of radioactive contamination of foodstuffs and feeding stuffs following a radiation event (Journal of Laws of 2004 No. 98 Item 988) Rozporządzenie Rady Ministrów z dnia 27 kwietnia 2004 r. w sprawie określenia podmiotów właściwych w sprawach kontroli po zdarzeniu radiacyjnym żywności i środków żywienia zwierząt na zgodność z maksymalnymi dopuszczalnymi poziomami skażeń promieniotwórczych (Dz.U. 2004 nr 98 poz. 988)
5. Regulation of the Minister of Health of 13 November 2015 on the quality of water intended for human consumption (Journal of Laws of 2015 Item 1989) Rozporządzenie Ministra Zdrowia z dnia 13 listopada 2015 r. w sprawie jakości wody przeznaczonej do spożycia przez ludzi (Dz.U. 2015 poz. 1989)
6. Regulation of the Minister of Agriculture and Rural Development of 28 July 2006 on dealing with illicit substances, residues of chemical, biological, medicinal products and radioactive contamination of animals and animal products (Journal of Laws of 2006, no. 147, item 1067) Rozporządzenie Ministra Rolnictwa i Rozwoju Wsi z dnia 28 lipca 2006 r. w sprawie sposobu postępowania z substancjami niedozwolonymi, pozostałościami chemicznymi, biologicznymi, produktami leczniczymi i skażeniami

promieniotwórczymi u zwierząt i w produktach pochodzenia zwierzęcego (Dz. U. z 2006 r. Nr 147, poz. 1067).

4.3 INTERNATIONAL LEGISLATION AND GUIDANCE DOCUMENTS

1. Euratom Treaty establishing the European Atomic Energy Community, together with the annexes and protocols thereto, as it results from the amendments introduced by the Treaty of Lisbon, signed on 13 December 2007 and which entered into force on 1 December 2009

2. Council Directive 2013/59/Euratom of 5 December 2013 laying down basic safety standards for protection against the dangers arising from exposure to ionising radiation, and repealing Directives 89/618/Euratom, 90/641/Euratom, 96/29/Euratom, 97/43/Euratom and 2003/122/Euratom (see 3 and 5 below) – to be transposed by 6 February 2018

3. Council Directive 96/29/Euratom of 13 May 1996 laying down basic safety standards for the health protection of the general public and workers against the dangers of ionising radiation –(repealed by Council Directive 2013/59/Euratom as of 6 February 2018)

4. Council Directive 2013/51/Euratom of 22 October 2013 laying down requirements for the protection of the health of the general public with regard to radioactive substances in water intended for human consumption

5. Commission Recommendation 2001/928/Euratom of 20 December 2001 on the protection of the public against exposure to radon in drinking water supplies

6. Council Regulation (Euratom) 2016/52 of 15 January 2016 laying down maximum permitted levels of radioactive contamination of food and feed following a nuclear accident or any other case of radiological emergency, and repealing Regulation (Euratom) No 3954/87 and Commission Regulations (Euratom) No 944/89 and (Euratom) No 770/90

7. Commission Recommendation 2000/473/Euratom of 8 June 2000 on the application of Article 36 of the Euratom Treaty concerning the monitoring of the levels of radioactivity in the environment for the purpose of assessing the exposure of the population as a whole

8. Commission Recommendation 2004/2/Euratom of 18 December 2003 on standardised information on radioactive airborne and liquid discharges into the environment from nuclear power reactors and reprocessing plants in normal operation

9. Council Regulation No 1048/2009 of 23 October 2009 amending Regulation (EC) No 733/2008 on the conditions covering imports of agricultural products originating in third countries following the accident of the Chernobyl nuclear power station

10. Radiation Protection and Safety of Radiation Sources: International Basic Safety Standards: General Safety Requirements. IAEA Safety Standards Series No. GSR Part 3. International Atomic Energy Agency, Vienna 2014

11. Environmental and Source Monitoring for Purposes of Radiation Protection. IAEA Safety Guide RS-G-1.8. International Atomic Energy Agency, Vienna 2005

12. Measurement of Radionuclides in Food and Environment. IAEA-Technical Report Series 295. International Atomic Energy Agency Vienna, 1989

13. Programmes and Systems for Source and Environmental Radiation Monitoring. IAEA Safety Reports Series No. 64, International Atomic Energy Agency Vienna, 2010

14. International Commission on Radiological Protection (ICRP) The 2007 Recommendations of the International Commission on Radiological Protection, Publication 103, Elsevier (2007)

5 NATIONAL ENVIRONMENTAL RADIOACTIVITY MONITORING PROGRAMME

5.1 INTRODUCTION

The national environmental radioactivity monitoring consists of systematic measurements of the gamma radiation dose rate at specific points within the territory of Poland as well as measurements of radionuclide concentration in main components of the environment, as well as foodstuffs.

National monitoring can be divided into two main types:

- national monitoring for the data necessary to assess the radiological situation of the entire country under normal conditions and in an emergency, as well as to research long-term changes in the radioactivity of the environment components and foodstuffs;
- local monitoring for the data necessary to assess the radiological situation near the facilities potentially rising the radiation exposure to the local population i.e. research reactor in the National Centre for Nuclear Research in Świerk n/Warsaw, the National Radioactive Waste Repository in Różan and the former uranium ore mining facilities in Kowary.

National and local monitoring is performed by means of:

- automatic radiation monitoring stations (PMS, IWMW and ASS-500 – basic stations, MON – auxiliary network) constituting an early warning network for radioactive contamination, and
- units performing measurements of radionuclide concentration in the components of the environment and foodstuffs.

5.2 ENTITIES INVOLVED IN RADIOLOGICAL MONITORING

There are 3 levels involved in routine monitoring:

- Specialised units
- Basic units
- Veterinary hygiene stations

5.2.1 Specialised units

The units listed below are specialised in the measurements of radioactivity; they perform identification of α, β and γ radionuclides (esp. ^{239}Pu, ^{241}Am, ^{137}Cs and ^{90}Sr) in the samples as well as higher sensitivity radiochemical / instrumental analyses. They take part in regular inter laboratory comparisons (ILCs) and proficiency tests (PTs) organised by PAA (coordinated by the Radiation Emergency Centre CEZAR) and international institutions.

- Central Laboratory for Radiological Protection
- Institute of Nuclear Physics
- National Centre for Nuclear Research
- National Institute of Hygiene
- Central Mining Institute
- AGH University of Science and Technology
- Institute of Meteorology and Water Management
- Military Institute for Chemistry and Radiometry
- Military Institute of Hygiene and Epidemiology

The specialised units also perform the measurements within the scope of the National Environmental Monitoring Programme run by the Chief Inspectorate of Environmental Protection, which consists of:

- Performing measurements by means of the IWMW stations for early detection of radioactive contamination;
- Monitoring of ^{137}Cs and ^{90}Sr in the Baltic Sea environment elements: seawater, fish and macrophytobenthic plants carried out in IWMW, Maritime Branch in Gdynia (monitoring is part of the monitoring program of radioactive substances in the Baltic Sea carried out within Helsinki Commission (HELCOM) cooperation).
- Performing systematic control of the concentration of ^{137}Cs and ^{90}Sr in rivers and lakes and ^{137}Cs, ^{238}Pu, ^{239}Pu and ^{240}Pu in sediments;
- Monitoring ^{137}Cs in soil (every 2 years),

5.2.2 Basic units

Sanitary-Epidemiological Stations (see Figure 3 below) collect and prepare samples of drinking and surface water, milk, foodstuffs and feedstuffs. They are equipped with basic equipment capable of measuring ^{137}Cs and ^{90}Sr concentration in the samples, and take part in regular ILCs organised by PAA (coordinated by Radiation Emergency Centre (CEZAR)). The basic units are financed by the Regional Governors. The sampling programme and amendments to the sampling schedule have to be consulted with and accepted by the President of the PAA.

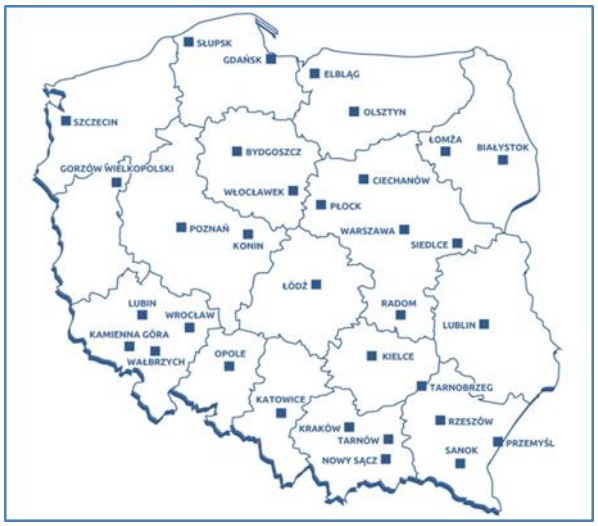

Figure 3: Sanitary-Epidemiological Stations

5.2.3 Veterinary hygiene stations

Nine stations and the main laboratory in Puławy (Figure 4) collect and prepare samples of animal products and feedstuffs. They are equipped with basic equipment capable of measuring ^{137}Cs, and take part in regular ILCs organised by the National Veterinary Research Institute in Puławy. The stations are supervised by the General Veterinary Inspectorate. According to the agreement between the Chief Sanitary Inspector and the Chief Veterinary Officer of 21 September 2007 the data are passed to the Chief Sanitary Inspectorate.

Figure 4: Veterinary hygiene stations

5.3 MONITORING AT NUCLEAR SITES

5.3.1 National Centre for Nuclear Research in Świerk

The Świerk Nuclear Research Centre, near Otwock, around 30 kilometres south-east of Warsaw houses the Maria Research Reactor. The reactor is a pool type reactor with a nominal power of 30 MWth (usually operated at 16 MW, 4000 h/year, weekly cycles). It was built between 1970 and 1974, the first criticality was in December 1974. The reactor is water and beryllium moderated and has a graphite reflector. The fuel elements consist of U-Al alloy and contain fuel with 36% enrichment of ^{235}U. For experiments with neutrons, six horizontal tubes are available. It is the only reactor of this type in the world.

Radiological monitoring on-site and in the surroundings of the Świerk nuclear centre is performed by the Laboratory of Dosimetric Measurements of the National Centre for Nuclear Research and comprises:

- selected natural and artificial isotopes (^{137}Cs, ^{131}I) in atmospheric aerosols,
- beta and gamma isotopes in atmospheric fallout,
- beta and gamma isotopes in well waters,
- beta isotopes in water from the water supply system,
- beta isotopes in waters of the Świder river,
- beta and gamma isotopes (including ^{3}H and ^{90}Sr) and alpha isotopes in drainage fallout waters,
- ^{3}H in underground waters,
- ^{90}Sr and gamma isotopes in sludge from the centre's sewage pumping station,
- gamma and beta isotopes (including the content of ^{90}Sr) in sanitary sewage,
- gamma isotopes in the soil, grass and cereals and in milk collected from a nearby farm.

Additionally, the following independent measurements are carried out by the Central Laboratory for Radiological Protection in Warsaw, at the request of the PAA President (public procurement contract):

- ^{137}Cs and ^{134}Cs and ^{3}H isotopes in waters from the nearby Świder river,
- ^{137}Cs and ^{134}Cs and ^{3}H in waters from sewage treatment plant situated nearby in the city of Otwock,
- ^{137}Cs and ^{134}Cs, ^{3}H and ^{90}Sr isotopes in well waters,
- artificial (mainly ^{137}Cs) and natural radioactive isotopes in the soil and grass,

- gamma dose rate in five selected locations.

5.3.2 National Radioactive Waste Repository in Różan

The National Radioactive Waste Repository (NRWR) at Różan is a near-surface repository dedicated for a disposal of short-lived, low- and intermediate- activity radioactive waste (where half-life period of isotopes is less than 30 years) and sealed radioactive sources. It is also used to store, for the interim period, long-lived, mainly alpha radioactive waste waiting to be placed in a deep repository. The repository has been in operation since 1961 and is the only facility of this type in Poland.

Radiological monitoring within the area and in the surroundings is performed by the Radioactive Waste Management Plant, and in the close surroundings of the repository, by the Central Laboratory for Radiological Protection.

In the area of the NRWR monitoring consists of the following:

- radioactive gamma isotopes in atmospheric aerosols,
- radioactive beta isotopes (including ^{3}H) in waters from the water-supply system and groundwaters (piezometers),
- radioactive beta and gamma isotopes in the soil and grass,
- measurements of gamma radiation in order to determine annual gamma radiation doses for permanent check points with thermoluminiscent dosimeters (TLD).

In the surroundings of the NRWR monitoring consists of the following:

- the content of ^{137}Cs, ^{134}Cs and ^{3}H in spring waters,
- radioactive beta isotopes including ^{3}H in ground waters (piezometers),
- artificial (mainly ^{137}Cs) and natural radioactive isotopes in the soil, grass and cereals,
- artificial (mainly ^{137}Cs) and natural radioactive isotopes in atmospheric aerosols (measurements were carried out twice).

Ambient gamma dose rate is measured at five permanent sites.

5.3.3 Former uranium mining facilities (Kowary)

Mining activities were started in 1948 in the “Wolność” mine in Kowary and in the “Miedzianka” mine in Miedzianka, and completed in 1963 in the last active mine, which was “Radoniów” in Radoniów.

The following measurements are performed by the PAA:

- measurement of total alpha and beta activity in drinking water (public water supply system) in the area of the Association of Karkonoskie Counties, in the city of Jelenia Góra and in surface and underground waters (outflow from underground shafts);
- measurement of radon concentration in water from the public water supply system, in water supplied to housing premises and in surface and underground waters (outflow from underground shafts).

5.4 EXTERNAL GAMMA DOSE RATE MONITORING

Poland has established an ambient gamma dose rate radiation monitoring network, with local monitoring stations of different types. Location of these stations is shown in Fig. 5. The data centre is located at CEZAR. It gathers results measured by the stations. Data from basic stations (PMS and IMGW) are transmitted automatically and are used for the assessment of the current radiation situation in Poland.

There is also a Centre of Contamination Analysis (Ministry of Defence). This is a military centre and has an important role in case of a severe radiological accident in the country.

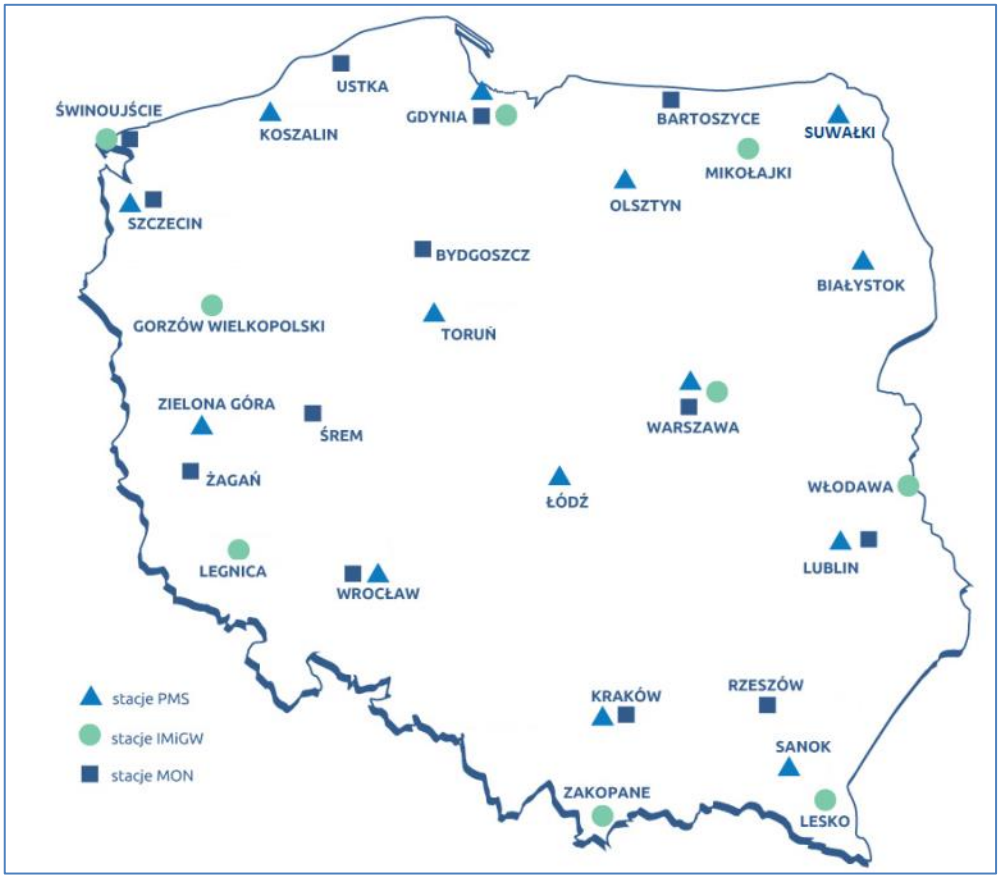

Figure 5: Early warning system networks in Poland (external dose rate)

Main stations

- 14 automatic Permanent Monitoring Stations (PMS) managed by PAA preforming measurements of ambient dose rate equivalent H*(10) by GM-tubes, gamma spectra by 3x3”NaI(Tl) detectors, precipitation, ambient temperature, and in the newest type wind speed and direction, humidity and atmospheric pressure. Data is sent to the CEZAR every 10 minutes. Non-verified hourly dose rate data is provided to EURDEP. A 15th station has been acquired and was planned to be installed/active in Kielce by the end of July 2016.
- 9 IMGW monitoring stations managed by the Institute of Meteorology and Water Management (IMWM) performing continuous measurements of ambient dose rate equivalent H*(10). Aggregated data is sent to CEZAR daily. Data is provided daily to EURDEP.

  Seven IMGW stations (Gorzów, Legnica, Lesko, Mikołajki, Świnoujście, Włodawa, Zakopane) perform total alpha and beta activity measurements of atmospheric aerosols collected on the filters. The stations perform the measurements of total beta activity in 24-hour and monthly samples of cumulative fallout.

Auxiliary stations

- 13 MON automatic monitoring stations operated by the Ministry of National Defence (MON) perform on-line measurements of ambient dose rate equivalent H*(10). Data are sent automatically to the Military CBRN Area Control Centre. Cumulative daily report is sent daily to CEZAR via e-mail. Data is not provided to EURDEP.

There is no passive (TLD) system included in the national radioactivity monitoring programme in Poland.

The table below summarises the three systems.

Parameter	PMS	IMWM (IMGW)	MON
Detectors	2 GM tubes Range: 10 nSv/h – 2 Sv/h Type: TDLG and TDSG-3 512 channel spectrometer with 3x3" NaI(Tl) Producer: TD-Electronics	2 GM tubes Range: 10 nSv/h – 0.3 Sv/h type: TDSG-2; 512 channel spectrometer with 2x2" NaI(Tl) Producer: TD-Electronics	3 GM-tubes Range: 10 nSv/h – 9 Sv/h Type: NEM RAMS PL HSH164; Producer: Envinet
Data storage	Internal station disk Database in CEZAR	Internal station disk Database in IMWM Database in CEZAR (daily aggregate)	Internal station disk Database in Military CBRN Area Control Centre
Data transmission	Ethernet (internet) GPRS	Ethernet (separated IMWM network)	Ethernet (separated military network only)
Transmission frequency	Every 10 minutes to CEZAR and EURDEP	Daily from the stations to the IMWM – manual procedure. Daily from IMWM to CEZAR- manual procedure. Daily to EURDEP (dose rate; total alpha and total beta on filters).	Every 10 minutes to Military CBRN Area Control Centre Daily aggregate to CEZAR (via e-mail) No transmission to EURDEP
Early warning	Frequent station polling	Frequent station polling	On alarm station calls server
Assuring continuous operation	Battery backup: up to 14 days; Data buffer: 120 days; Secondary transmission channel (GPRS).	Battery backup: without battery Data buffer: 4 months (memory card)	Battery backup: up to 7 hours; Data backup: 30 days

PMS network – basic network:

- Data are stored on the station in form of text files.
- Data from the entire PMS network are stored in the MS SQL database server located in CEZAR.
- PMS database is regularly backed up on disk.
- Polling of the stations is preformed either at hourly or 10-minute intervals (PMS Monitor application).
- Non-verified PMS dose rate data are instantly prepared to be pulled to EURDEP.
- Data are verified on-line by the Radiation Emergency Centre's officer on-duty (PMSView, PMSAlarmView and Spectrum software).

IWMW (IMGW) Network – basic network:

- IWMW network is separated from the ordinary internet.
- Data are stored on the station in form of text files.
- Data are aggregated and verified daily at every station and sent to the IWMW centre (Warsaw).
- Data from the entire IWMW network are stored in the database server located in IWMW Warsaw.
- IWMW database is regularly backed up. Database contains all historical data.
- IWMW centre in Warsaw verifies and sends dose rate data to CEZAR daily.
- Data are verified on-line by the Radiation Emergency Centre's officer on-duty.
- IWMW dose rate data (as well as total alpha and total beta data) are prepared to be pulled to EURDEP from CEZAR.

MON network – auxiliary network:

- MON network is separated from the ordinary internet.
- Data are stored on the station in form of text files.
- MON database is regularly backed up.
- Military CBRN Area Control Centre (COAS) in Warsaw verifies, aggregates and sends dose rate data to CEZAR by e-mail - daily.
- Data are verified and archived by the Radiation Emergency Centre's officer on-duty.
- Data are not provided to EURDEP.

5.5 AIR MONITORING PROGRAMME

Monitoring of radioactivity in air consists of a network of high and low volume samplers, completed by dry/wet deposition collectors which are shown the maps below:

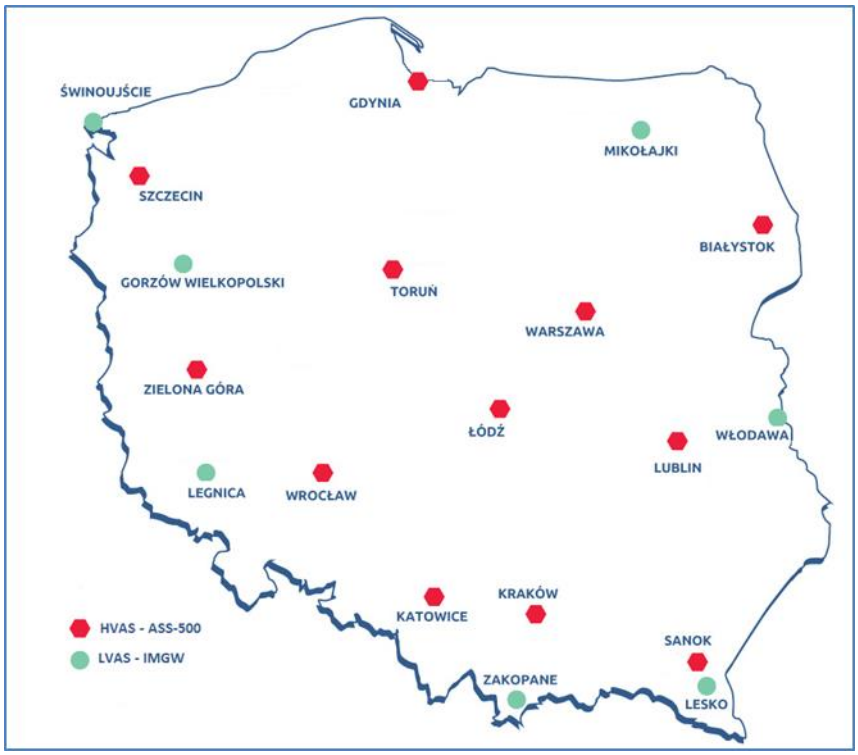

Figure 6: High-volume and low-volume aerosol samplers in Poland (ASS-500 and IMWM networks)

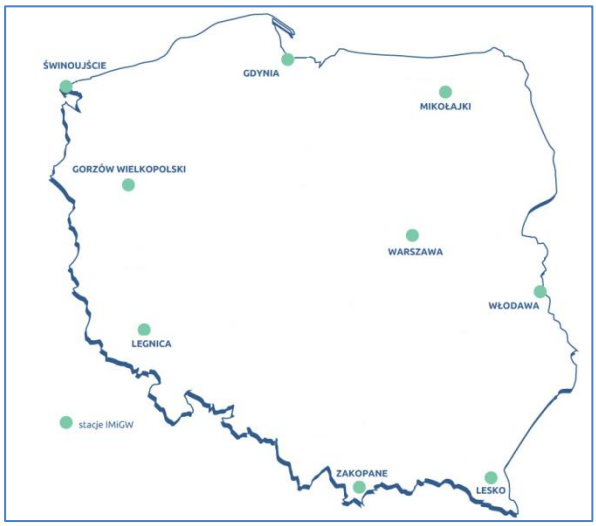

Figure 7: Dry/wet deposition collectors in Poland

5.5.1 High-volume samplers (ASS-500)

Twelve stations designed and manufactured by the Central Laboratory for Radiological Protection (CLOR) (see map above) are operated continuously (365/24/7). Nine stations are located at sites equipped with HPGe spectrometers (except stations in Zielona Góra, Toruń and Szczecin – no HPGe spectrometry available on-site, filters sent to the Central Laboratory for Radiological Protection). The stations in Warsaw and Lublin are of the newer type NASS-500. The nominal airflow is 500 m^3/h (range 200 – 800 m^3/h), the NASS-500 automatically stabilises the airflow during the entire collection period. Petrianov type FPP 15-1.5 PVC filters are used for aerosols with diameters between 0.3 and 1.25 µm. The aerosol collection efficiency is ~99%. For calibration purposes a multi-gamma calibration source is sent to every location in a round-robin manner.

Under normal situations filter exchange is once a week (Monday 12:00 – Monday 12:00). An initial 3-hour measurement of the filter is performed by high performance gamma spectrometry (HPGe

detector). The principal measurement of the filter in the disk geometry (80 000 seconds) has a detection limit of <1 μBq/m^3.

In an emergency situation sampling is as frequently as needed (decision by the President of the PAA).

The ASS-500 stations are equipped with NaI(Tl) (2x2") probes placed above the filter. The gamma spectrum (2048 channels) is measured hourly (10 mins. interval in an emergency). The spectrum is divided into 7 energy windows (esp. ^{131}I, ^{137}Cs). The number of total counts in windows and the ratios between counts in windows are recorded. The theoretical LLD (1 hour measurement, clean filter) is 1 Bq/m^3 for ^{137}Cs, and 2 Bq/m^3 for ^{131}I. The energy calibration is performed using a ^{137}Cs source + natural peaks (^{40}K, ^{208}Tl). No efficiency calibration is carried out. The data are qualitative – only spectra and number of counts. The transmission of data is maintained by the CLOR via modem and/or internet. The database is in CLOR, but the Radiation Emergency Centre has access to it.

The principal nuclides reported automatically from the ASS-500 stations network are:

Natural: ^{226}Ra, ^{228}Ac; ^{210}Pb; ^{40}K; ^{7}Be; ^{22}Na;

Artificial: ^{137}Cs, ^{131}I (other artificial radionuclides are detected by high resolution gamma spectrometry).

The data are collected and assessed by the Central Laboratory for Radiological Protection. CLOR maintains the database of results from the ASS-500 network. PAA has "on-line" access to the database. CLOR prepares monthly reports from the ASS-500 stations. In case of unusual detections CLOR immediately informs CEZAR and the decision is made on the filter exchange frequency.

Annual average concentration data are transmitted once a year to the EU REM database.

5.5.2 Low-volume samplers (IMWM)

Seven stations of the type Berthold LB 9128 (moving paper filter) (see Figure 6) are operated continuously (365/24/7). The older Thermo Fischer FHT 59 SI system is still used as back-up. Nominal airflow is 25 m^3/h. A glass fibre particulate filter band for aerosols with diameters between 0.1 and 10 μm is used with continuous automatic filter exchange. Total alpha and total beta in aerosols (in Bq/m^3) together with artificial beta in aerosols (in Bq/m^3) are assessed. Both artificial α aerosols and artificial β aerosols are measured with 30 min sampling time and 30 min measuring time (flow ~25 m^3/h) using a Si-diode CAM-PIPS 1700 mm^2 for simultaneous alpha-beta measurement. The station has a data buffer for 4 months storage and a diesel engine for power backup. Early warning is set at 1 Bq/m^3. Data are collected in a continuous manner and aggregated into hourly and daily averages by the station software.

Data transmission:

- Separated IMGW network.
- Daily total alpha and total beta averages are transmitted daily from the stations to the IMWM – manual procedure (FTP).
- Daily transmission from IMWM to CEZAR - manual procedure (FTP).
- Daily transmission of total alpha and total beta averages of to EURDEP (dose rate; total alpha and total beta on filters).

The IMWM database contains all historical data.

5.5.3 Dry/wet deposition collectors

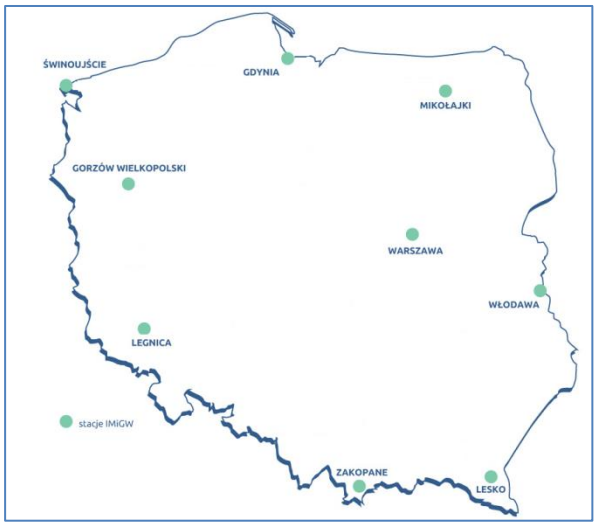

Figure 7: Fallout collectors

There are altogether nine dry/wet deposition collectors in Poland (Figure 7). The fallout collector includes two cuvettes:

- Daily total (wet and dry) fallout;
- Monthly total fallout.

Daily fallout is collected in a 1500 cm^2 cuvette. The cuvette is pre-filled with 1 cm of water and exposed for 24 hours (6 – 6 UTC).

Monthly fallout is collected into three cuvettes having a total surface of 4500 cm^2. The cuvettes are exchanged every first day of month.

After exposition, for both daily and monthly measurements the collected fallout is placed in the evaporator filled with filter paper. The fallout stays on filter paper after evaporation. The filter paper is ashed in the oven at 450°C. The ash is transferred to an aluminium measuring bowl (inner diameter – 25 mm, depth – 4 mm) in a manner to neglect self-absorption (surface density below 50 mg/cm^2).

Daily fallout is measured for total beta activity using a TDSPI spectrometer with a TD-SSU-BETA scintillation detector.

Monthly fallout undergoes the following sequence:

- All 9 station samples are cumulated;
- Total beta activity cumulative measurement performed by the IMWM Warsaw;
- High resolution gamma spectrometry (mainly ^{137}Cs determination) of cumulative sample in total fallout performed by the IMWM Gdynia (Marine Section);
- ^{90}Sr determination in cumulative sample of total fallout by radiochemical method and further gas-flow counter (FHT 770T) measurement performed by the IMWM Gdynia (Marine Section).

Fallout data are provided to the Radiation Emergency Centre (CEZAR) once a year. Fallout data are not provided to the REMdb system.

5.6 WATER MONITORING PROGRAMME

5.6.1 Surface water (regional monitoring)

According to the Regulation of the Council of Ministers of 17 December 2002 on stations for the early detection of radioactive contamination and units which measure radioactive contamination, the surface water sampling programme is executed by the basic units (Sanitary-Epidemiological Stations) from the Vistula (Wisła), Bug, Narew, Odra and Warta rivers. The samples are collected twice a year. The samples of surface water collected by the Sanitary-Epidemiological Stations are measured by selected basic units of the Sanitary Inspection (WSSE). The samples are analysed for ^{137}Cs and ^{90}Sr activity with radiochemical or spectrometric methods. Preparation and measurement of samples is carried out in accordance with the procedure approved by the PAA President: Method for Radiochemical Determination of ^{90}Sr in foodstuff and water (Metodyka radiochemicznego oznaczania ^{90}Sr w próbkach produktów żywnościowych i wodzie) and Method for Radiochemical Determination of ^{137}Cs in foodstuff and water (Metodyka radiochemicznego oznaczania ^{137}Cs w próbkach produktów żywnościowych i wodzie).

Radiochemical preparation of samples (^{137}Cs)

Water samples of 10 litres (the minimum volume) are collected from the main streams of the rivers. Water is poured into polyethylene containers, then samples are acidified with concentrated nitric acid. After transportation to the laboratory, the water samples are precisely dispensed and evaporated after adding concentrated HNO_3 (1ml of HNO_3 for 1 litre of water) and filtering through a paper filter. The water is evaporated to a small volume. The filter with any residue is dried and reduced to ashes in the muffle furnace (temp. not above 450°C). The ash is dissolved in 10 ml of concentrated HNO_3.

This solution is combined with the previously evaporated water. Final preparation of the sample is to add 20 ml of concentrated nitric acid and to adjust the final volume to 150 ml with distilled water. The solution should be clear.

Radiochemical preparation of samples (^{90}Sr)

Water samples of 20 litres (the minimum volume) are collected from the main streams of the rivers or from platforms on the lakes. Water is poured into polyethylene containers, the water samples are precisely dispensed and evaporated after adding concentrated HNO_3 (1ml of HNO_3 for 1 litre of water). ^{90}Sr analysis is carried out according to the method developed by Volchok (via its progeny ^{90}Y).

Spectrometric preparations of samples

Water samples of 20-30 litres are collected from the main streams of the rivers or from platforms on the lakes. Water is poured into polyethylene containers. The water samples are precisely dispensed and evaporated after adding concentrated HNO_3 (1ml of HNO_3 for 1 litre of water). The large volume of water samples is evaporated to the required volume.

The table below summarises surface water samples analysed by the Sanitary-Epidemiological Stations in 2015:

Surface water – 2015 (29 sites)		
No. of samples	^{137}Cs	^{90}Sr
57	52 (Radiochemistry - 28, ɣ-Spectrometry - 24)	5

The reports containing results of the analyses are sent quarterly to the Chief Sanitary Inspectorate (Environment Hygiene Department), and simultaneously to the Radiation Emergency Centre CEZAR at PAA.

5.6.2 Surface water (national monitoring)

In addition to the regional monitoring, samples of surface water are collected twice a year (spring, autumn) from the Vistula (Wisła) river and its two tributaries (Bug and Narew rivers), from the Odra river and its tributary the Warta river and from six lakes located in various regions of Poland within the framework of the National Environmental Monitoring run by the GIOŚ (Chief Inspectorate of Environmental Protection) – see map below.

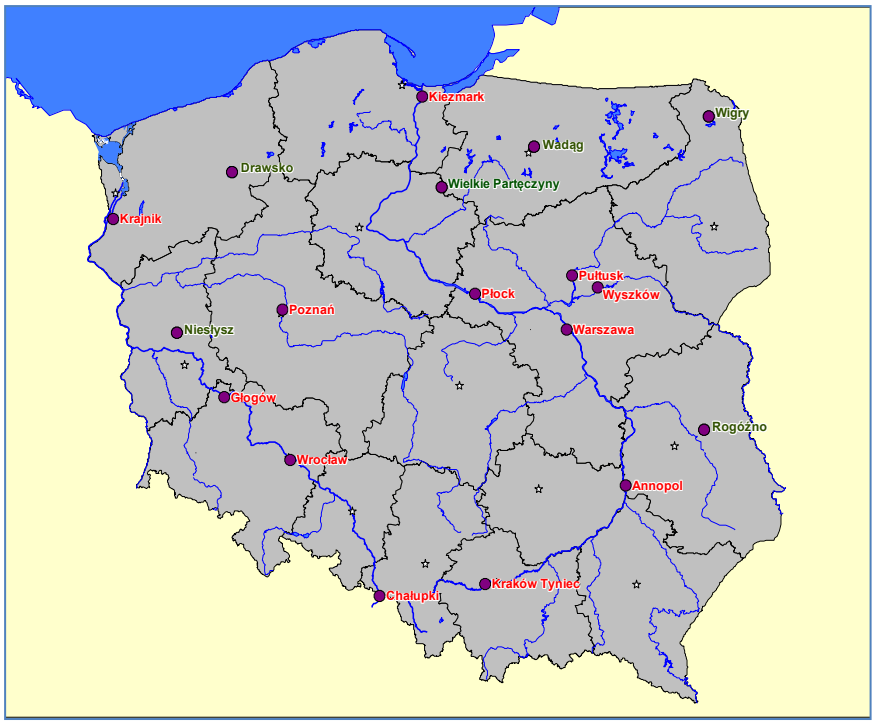

Figure 8: Surface water sampling locations (lakes – black, rivers – red)

Water samples of 20 litres are collected from the main streams of the rivers or from platforms on the lakes. Water is poured into polyethylene containers, then samples are acidified with concentrated nitric acid. After transportation to the laboratory, the water samples are precisely dispensed and evaporated after adding concentrated HNO_3.

The analysis of samples is performed by the Central Laboratory for Radiological Protection (CLOR), financed and supervised by the Chief Inspectorate of Environmental Protection (GIOŚ).

The content of ^{137}Cs and ^{90}Sr isotopes in surface water samples is determined by means of radiochemistry. The determination of ^{137}Cs involves selective absorption of caesium on a thin ammonium molybdophosphate layer and the measurement of beta activity. The determination of ^{90}Sr is carried out with the method developed by Volchok (via its progeny ^{90}Y). Activities of ^{137}Cs and ^{90}Y are measured with a low-level beta GM multicounter system Model Risø GM-25-5 having a background of about 0.2 counts per minute and efficiency of about 40%.

5.6.3 Drinking water

According to the Regulation of the Council of Ministers of 17 December 2002 on stations for the early detection of radioactive contamination and units which measure radioactive contamination the drinking water sampling programme is executed by the basic units (Sanitary-Epidemiological Stations). The samples are taken directly from taps - 10 litres (the minimum volume) for the radiochemical analyses and 20-30 litres for the spectrometric analyses. Water is poured into polyethylene containers, then samples are acidified with concentrated nitric acid. The samples of drinking water are taken once per quarter and analysed for ^{137}Cs specific activity with radiochemical or spectrometric methods.

Preparation and measurement of samples is carried out in accordance with the procedure approved by the PAA President: Method for Radiochemical Determination of ^{137}Cs in foodstuff and water (Metodyka radiochemicznego oznaczania ^{137}Cs w próbkach produktów żywnościowych i wodzie).

Radiochemical preparation of samples

Sampled water (10 litres) is poured into polyethylene containers, then samples are acidified with concentrated nitric acid. After transportation to the laboratory, the water samples are precisely dispensed and evaporated after adding concentrated HNO_3 (1ml of HNO_3 for 1 litre of water) through a paper filter. The filter and any deposited matter is dried and reduced to ashes in the muffle furnace (temp. not above 450°C). The ash is dissolved in 10 ml of concentrated HNO_3.This solution is combined with the previously evaporated water. Final preparation of the sample is to add 20 ml of concentrated nitric acid and to adjust the final volume to 150 ml with distilled water. The solution should be clear.

Spectrometric preparations of samples

Sampled water is poured into polyethylene containers. The water samples are precisely dispensed and evaporated after adding concentrated HNO_3 (1ml of HNO_3 for 1 litre of water). The large volume of water samples is reduced to the required volume by evaporation.

The below table summarises drinking water samples analysed by the Sanitary-Epidemiological Stations in 2015:

Drinking water - 2015	
No. of samples	^{137}Cs
96	96 (Radiochemistry - 49, ɣ-Spectrometry - 47)

The reports containing results of the analyses are sent quarterly to the Chief Sanitary Inspectorate (Environment Hygiene Department), and simultaneously to the Radiation Emergency Centre CEZAR at PAA.

Measurements contracted by the PAA

In addition to the measurements carried out by the basic units, since 2007 drinking water monitoring has been performed by the Central Laboratory for Radiological Protection (CLOR), financed and supervised by the National Atomic Energy Agency.

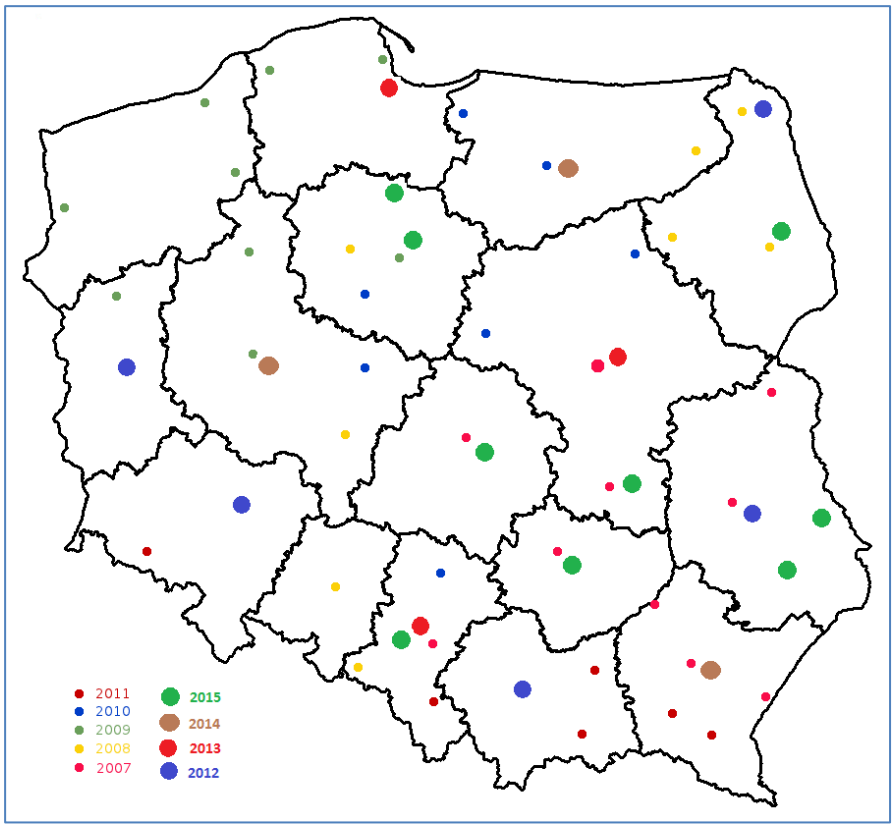

Figure 9: Radioactivity in drinking water sampling locations (contracted by the PAA)

The scope of these analyses is defined each year by the PAA's President and it takes into account the main water supplies in selected cities. In Warsaw, the drinking water was analysed in 2007 and 2013. The samples are taken once a year. A quantity of 20 litres of drinking water is taken in each sampling point. ^{137}Cs and ^{90}Sr are determined in a 15 litre sample. In the remaining 5-litre sample, the tritium activity and total alpha and beta radioactivity are determined.

In order to determine the size and nature of the likely exposure to radioactive substances in water intended for human consumption The Regulation of the Minister of Health of 13 November 2015 on the quality of water intended for human consumption (which fully implements The Council Directive 2013/51/EURATOM of 22 October 2013 laying down requirements for the protection of the health of the general public with regard to radioactive substances in water intended for human consumption) provides for the preliminary monitoring of radioactive substances, in which all existing water intakes and water intakes being created are tested for the presence of radioactive substances (radon, radium isotopes: ^{226}Ra and ^{228}Ra and tritium). Depending on the observed activity values of the those parameters, further tests are performed:

- when preliminary monitoring of radioactive substances shows that the concentrations of tritium and radium radioactive isotopes ^{226}Ra and ^{228}Ra do not exceed detection limits (tritium – 10 Bq/l, radium: ^{226}Ra – 0,04 Bq/kg and ^{228}Ra – 0,02 Bq/l), measurement of the concentrations of those substances is performed every 5 years,
- when preliminary monitoring of radioactive substances show that the concentrations of tritium and radium radioactive isotopes exceed the detection limits but at the same time do not exceed parametric values for tritium – 100 Bq/l, for radium isotopes: ^{226}Ra – 0,5 Bq/kg and ^{228}Ra – 0,2 Bq/kg, measurement of the concentrations of those substances is performed every 2 years,
- frequency of radon testing depends on the level of activity concentrations of radon (≤ 10 Bq/l – second test after 10 years; > 10 Bq/l – second test after 6 months; subsequent tests after 6 months or once a year, once every 2 years or once every 5 years),

- measurements of the concentrations of radioactive isotopes of lead ^{210}Pb, polonium ^{210}Po and uranium ^{238}U and ^{234}U take place when preliminary monitoring of radioactive substances show that the concentrations of radium radioactive isotopes: ^{226}Ra and ^{228}Ra have exceeded their parametric values (^{226}Ra – 0,5 Bq/kg, ^{228}Ra – 0,2 Bq/kg); additional measurements of the concentrations of radioactive isotopes are proceeded when the concentration of radioactive isotopes of lead ^{210}Pb, polonium ^{210}Po and uranium ^{238}U and ^{234}U have exceeded their parametric values (^{210}Pb – 0,2 Bq/kg, ^{210}Po 0 – 0,1 Bq/kg, ^{238}U – 3,0 Bq/kg, ^{234}U - 2,8 Bq/kg),
- if the preliminary monitoring of radioactive substances show that the concentration of tritium has exceeded its parametric value (100 Bq/l), additional measurement of the concentration of artificial radioactive nuclides is performed,
- if the concentrations of artificial radioactive nuclides have exceeded their parametric values, additional measurements of the concentration of radioactive isotopes are performed.

Preliminary and check monitoring of radioactive substances[4] are performed by water companies and entities that provide water from individual water supply points as part of commercial activity or activity carried out in public buildings.

5.6.4 Ground water

Sampling and analyses of ground water are performed only within the local monitoring of the National Radioactive Waste Repository in Różan and local monitoring of the National Centre for Nuclear Research in Świerk.

[4] Check monitoring of radioactive substances is another measurement of radioactive substance concentration in the treated water and is aimed at the reduction of radioactive substance parameters.

Local monitoring in the vicinity of the National Radioactive Waste Repository in Różan

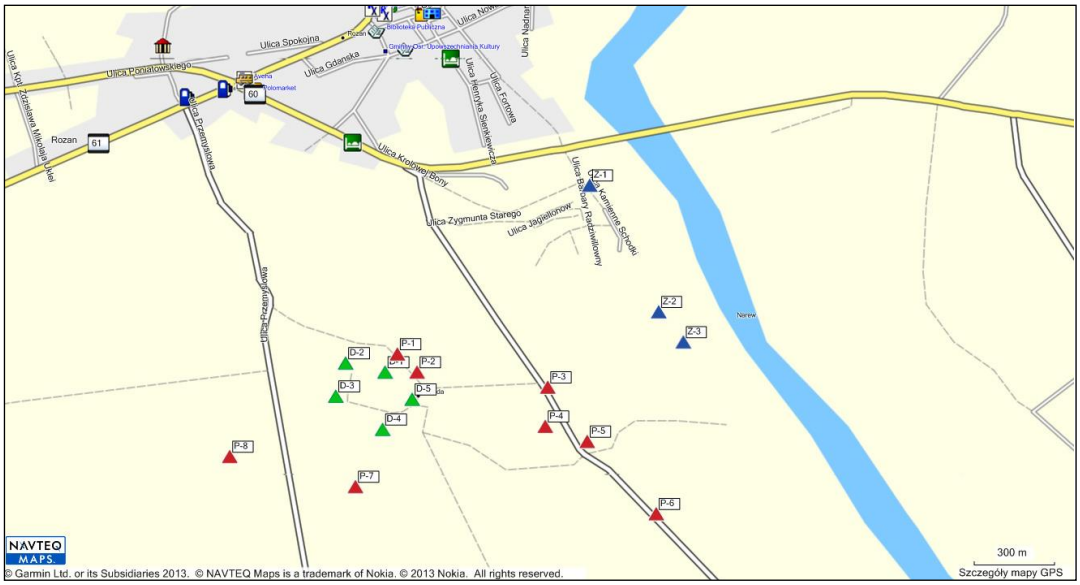

Figure 10: National Radioactive Waste Repository in Różan sampling locations (piezometers – red triangles)

Groundwater samples (5-litre) are taken from eight piezometers in the vicinity of the facility. The samples are taken twice a year (summer, autumn) – altogether 16 samples. The samples are measured for total beta activity and tritium content. The 2-litre sample of water is evaporated to 5 ml, H_2SO_4 is added and then evaporated entirely. The evaporator is placed in the oven and left at a temperature of 350^{o}C for 30 minutes. After cooling the dry matter is ground and 250 mg is transferred on the measuring plate.

A Geiger-Muller based flow proportional counter (Riso GM-25-5) is used for the total beta activity measurements. The measurement time is 180 mins (LLD for total beta is 0.014 Bq/l).

Tritium content is determined by electrolytic enrichment and beta activity measurement using LSC in 3-litre samples. At the same time a blank sample and a sample containing a known amount of tritium is electrolysed. Due to the difference in the ion mobility the decay of the water particles which does not contain tritium is faster. The detection limit for this method reaches 0.5 Bq/l.

Local monitoring in the area of Świerk Nuclear Centre.

Sampling and analysis of ground water is performed within the local monitoring of the National Centre for Nuclear Research in Świerk.

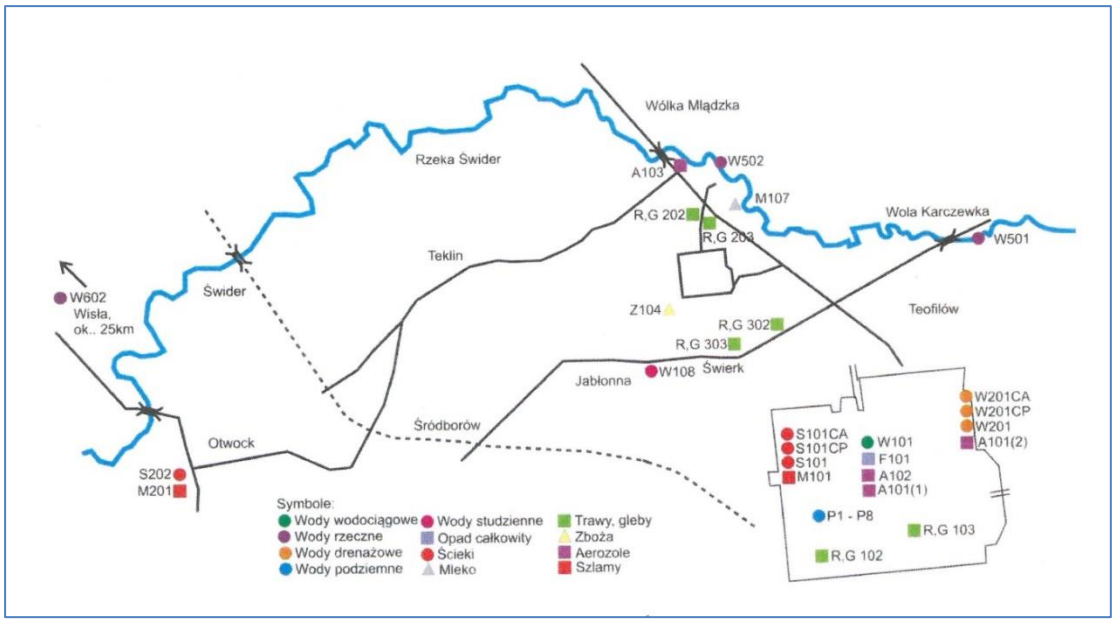

Figure 11: Sampling locations in the area of Świerk Nuclear Centre and its vicinity

Groundwater samples are taken from eight piezometers (8 samples) in the vicinity of the spent fuel storage facility No 19A. The samples are taken once in a year (spring).

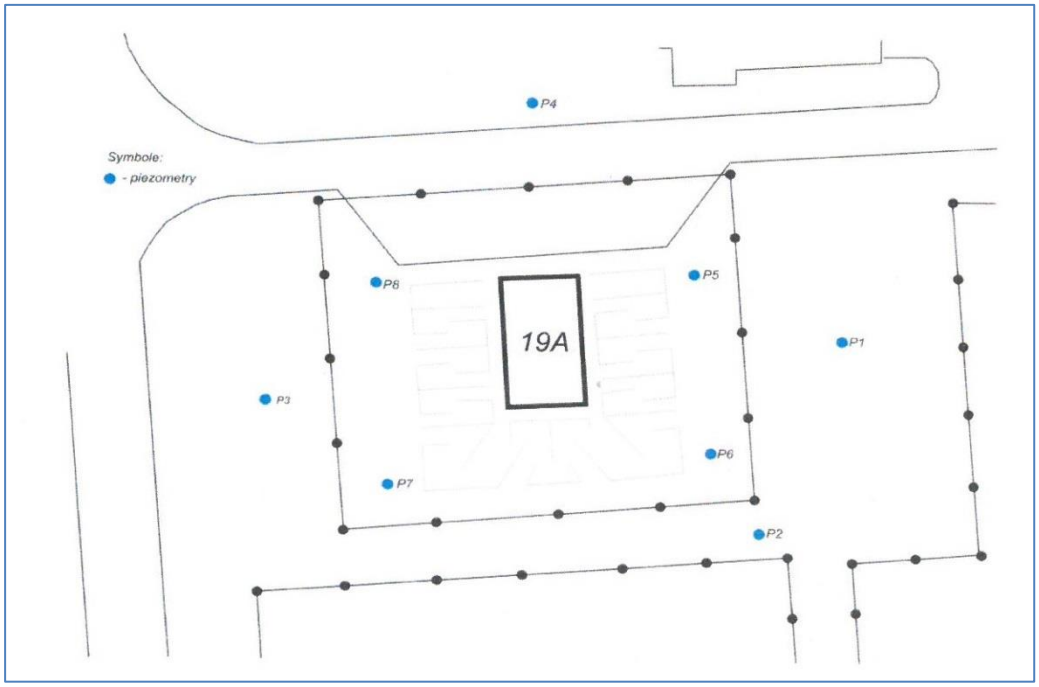

Figure 12: Groundwater sampling points in the vicinity of the spent fuel storage facility No 19A

Additionally, 8 groundwater samples are taken from eight piezometers (Figure 13) in the vicinity of the sump No R1 I and R1 II. The samples are taken twice during winter.

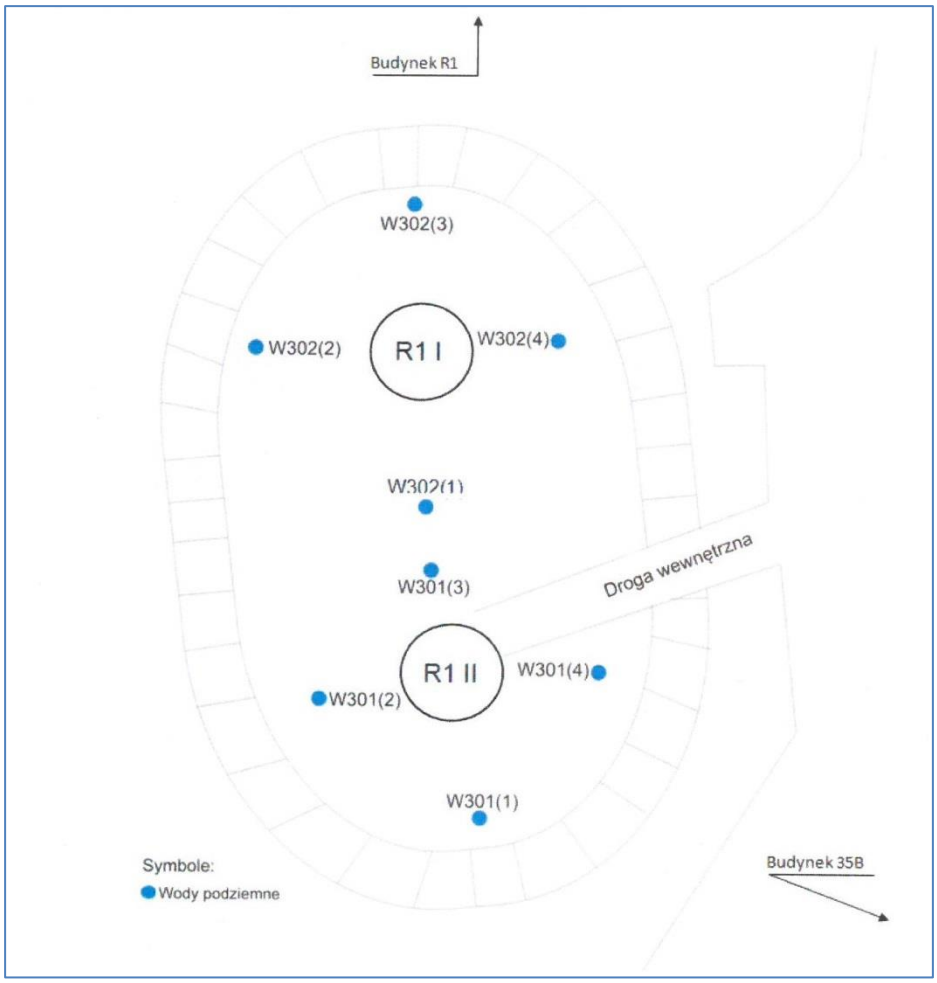

Figure 13: Sampling points in the vicinity of the sump No. R1 I and R1 II

The samples are analysed for tritium content. Tritium content is determined by electrolytic enrichment. The detection limit for this method reaches 4 Bq/l.

5.6.5 Sea water

The measurements of sea water radioactivity are contracted by the PAA. Currently the task is performed by the Central Laboratory for Radiological Protection. The programme contains also the sampling and measurement of the sea sediments (Figure 14).

Monitoring of ^{137}Cs and ^{90}Sr in seawater samples taken yearly at 17 sampling stations in the Polish Economic Zone of the Baltic Sea is also carried out by IWMW, Maritime Branch in Gdynia. Monitoring is a part of State Environmental Monitoring coordinated by Chief Inspectorate of Environmental Protection.

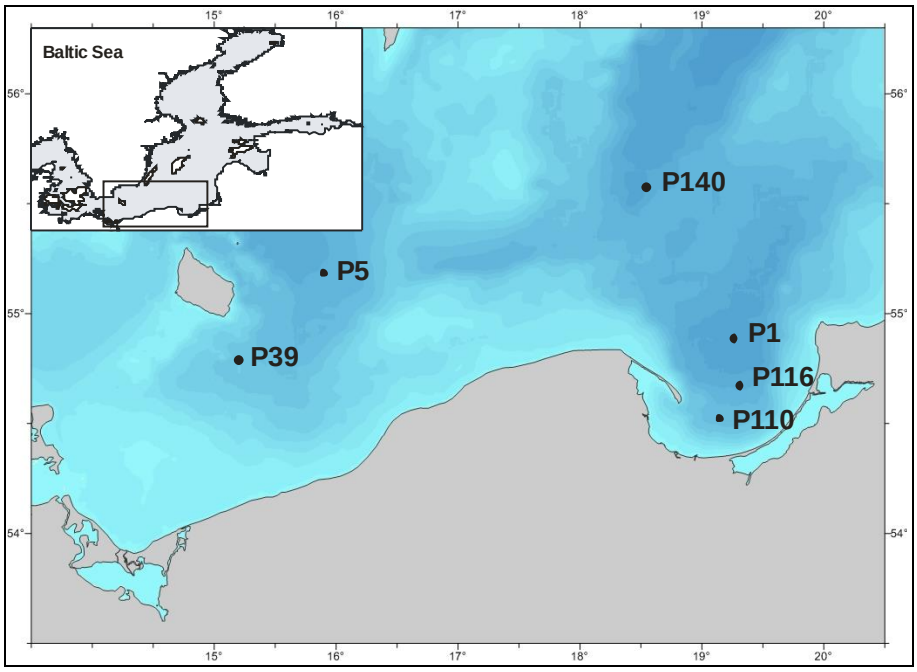

Figure 14: Baltic Sea surface water sampling locations

Every year water samples are taken from the surface layer at 6 locations using bathometers. Water is poured into polyethylene containers with a capacity of 5 litres, then samples are acidified with concentrated nitric acid (0.5 ml per litre). After transportation to the laboratory, the water samples are precisely dispensed and evaporated to a volume of 450 ml, after adding 2.5 ml of concentrated HNO_3, and subsequently transferred to Marinelli beakers.

Radioactivity of surface waters in the southern Baltic Sea is measured for ^{137}Cs and ^{40}K by means of gamma spectrometric measurement and ^{226}Ra with liquid scintillation counting (LSC).

5.7 MONITORING OF SOIL AND SEDIMENTS

5.7.1 Soil

The programme is contracted by the Chief Inspectorate for Environmental Protection (GIOŚ) (public contract) within the National Environmental Monitoring. Currently, the task is performed by the Central Laboratory for Radiological Protection.

The concentrations of natural and artificial radionuclides in soil are determined based upon cyclic spectrometric measurements performed every second year on samples of non-cultivated soil collected from 10 and 25 cm thick layers. Every sample is composed of seven portions of soil taken from 6 points placed on circle of 2m radius and one portion from the centre of this circle. Each portion is sampled using a special steel blanking knife in the shape of a cylinder 6.9 cm in diameter. The last measurement cycle was performed in the years 2014-2015. In 2014, 264 samples of soil were taken at 254 fixed check points spread across the country (Figure 15) (10 samples are taken from the 10-25 cm layer).

The soil samples are measured by high resolution gamma spectrometry to determine the concentration of artificial (especially ^{137}Cs, ^{134}Cs) and natural (^{40}K, ^{226}Ra, ^{228}Ac, ^{210}Pb) radioisotopes and other gamma-emitting radionuclides.

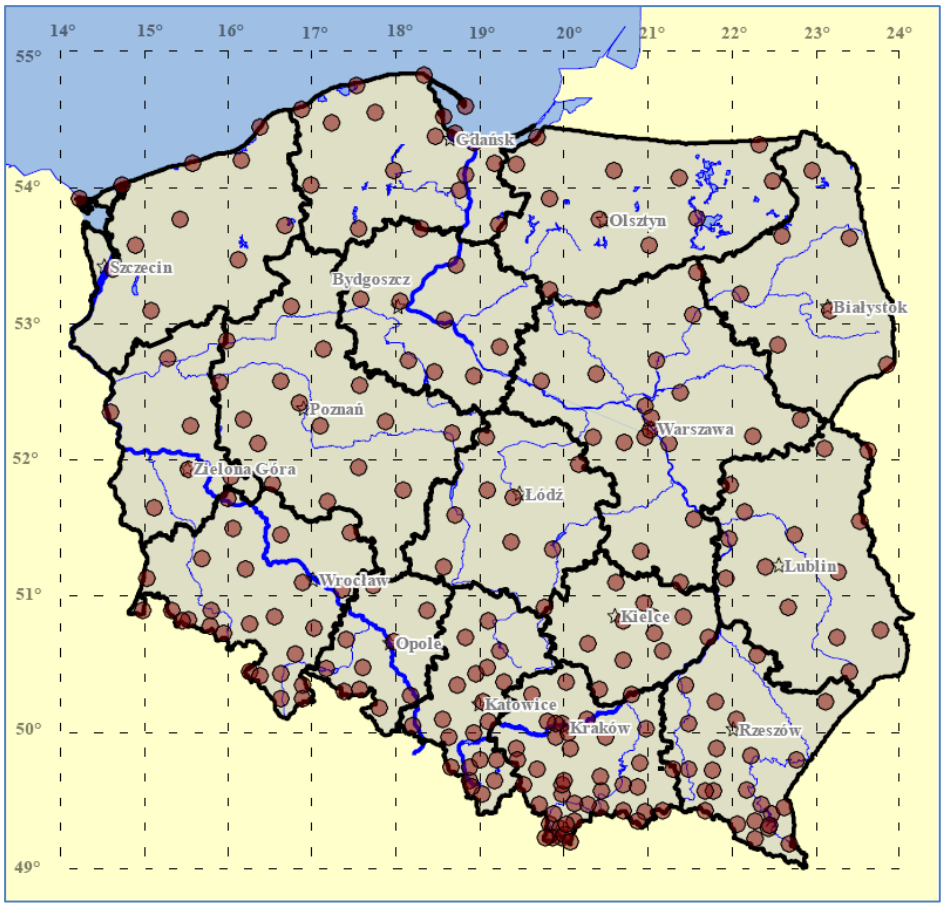

Figure 15: Soil sampling locations

5.7.2 Sea sediments

The Baltic Sea sediments are sampled and analysed within the programmes dedicated to waters. The programme is contracted by the PAA (public procurement).

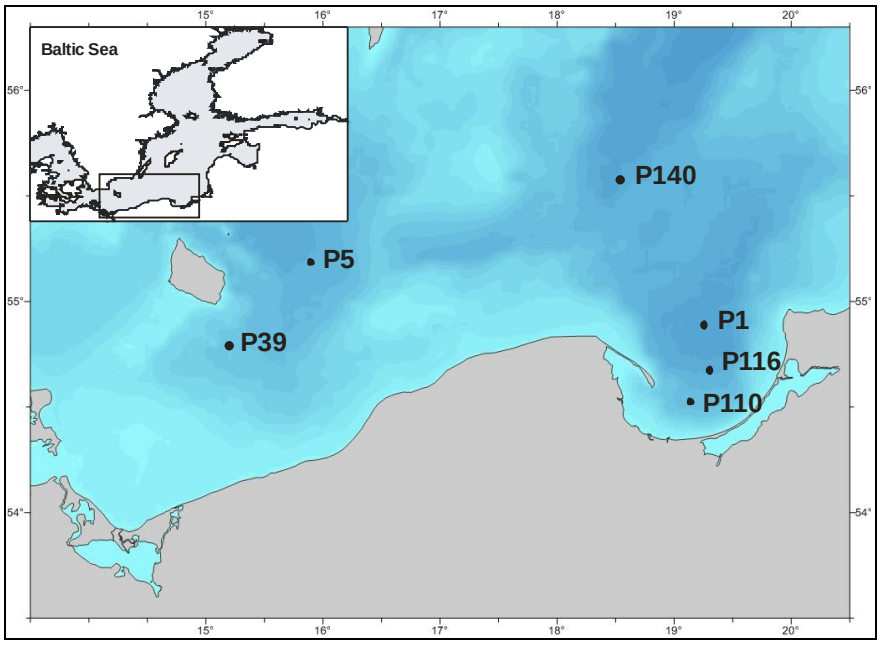

Figure 16: Baltic Sea sediment sampling locations

Every year, 6 sediment samples from the southern Baltic Sea are collected and measured (Figure 16). A 50 mm inner diameter gravity-based Niemistö probe is used to collect the sediment samples. Six cores of sediment are collected in each of the sampling locations. Cores are divided into 5 parts of 1 cm thickness of sediment up to 5 cm depth, and 7 parts of 2 cm thickness up to a depth of 19 cm. The same layers of sediment cores from each point are combined into one sample, frozen at -15°C and transported to the laboratory. In the laboratory, the samples are subsequently thawed, dried at room temperature and then put in an oven at 105°C. Dried samples are sieved through a sieve having a mesh diameter of 0.25 mm.

The concentration of artificial ^{137}Cs and natural ^{40}K in the Baltic Sea sediments is determined by means of high-resolution gamma spectrometry. The concentration of plutonium (^{238}Pu and ^{239,240}Pu), as well as ^{90}Sr is determined using radiochemical methods.

5.7.3 River and lake sediments

River and lake sediments are sampled and analysed within the programme dedicated to surface waters. The programme is contracted by the Chief Inspectorate for Environmental Protection (GIOŚ) (public contract) within the National Environmental Monitoring. Currently, the task is performed by the Central Laboratory for Radiological Protection.

Every 2-3 years, samples of river and lake sediments are collected in 18 points in the Wisła basin (7 points), in the Odra basin (5 points) and six lakes (Figure 17). Bottom sediments are collected using scoops in three sites spaced approx. 50 m apart and combined into an aggregate sample of approx. 1 kg. After removal of stones and plant parts the sediment samples are dried at 105°C to constant weight and sieved through a sieve having a mesh diameter of 2 mm.

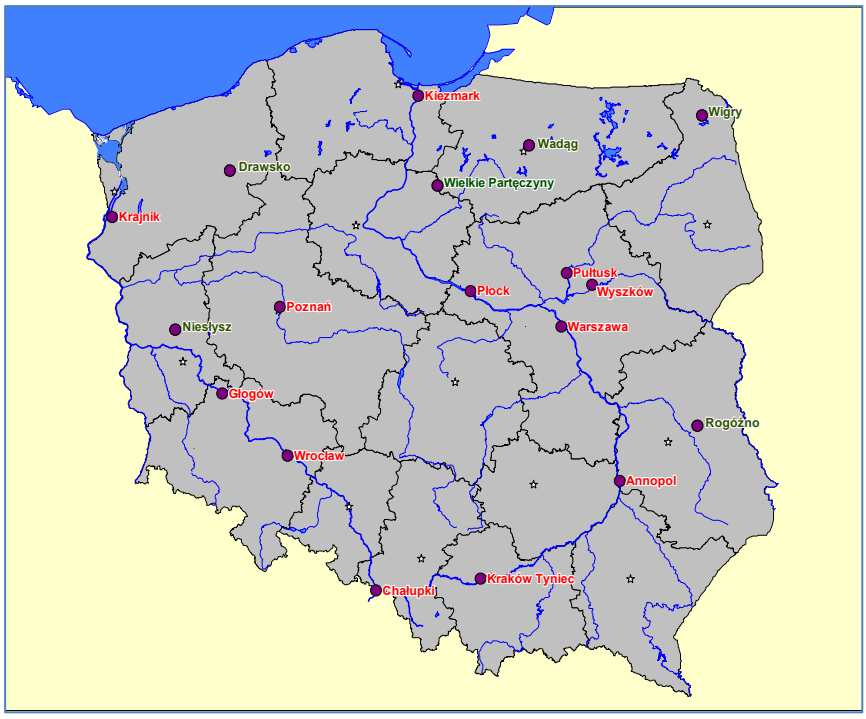

Figure 17: River and lake sediment sampling locations.

5.8 MONITORING OF TERRESTRIAL AND AQUATIC BIOTA

5.8.1 Terrestrial biota

The only samples of terrestrial biota are mushrooms (edible). The measurements are carried out by selected basic units of the Sanitary-Epidemiological Inspection (WSSE). The samples are taken a few times a year (1-4) depending on the region. The samples are analysed for ^{137}Cs and ^{90}Sr specific activity with radiochemical and/or spectrometric methods.

Preparation and measurement of samples is carried out in accordance with the procedure approved by the President of the PAA: Method for Radiochemical Determination of ^{90}Sr in foodstuff and in water (Metodyka radiochemicznego oznaczania ^{90}Sr w próbkach produktów żywnościowych i wodzie). In case of the spectrometric analyses the laboratories use their own procedures.

Before measurement the samples are crumbed, ashed, digested with acid (1:1) and diluted with distilled water to the desired measurement geometry.

The table below summarises mushroom samples analysed by the Sanitary-Epidemiological Stations in 2015.

Mushrooms - 2015		
No. of samples	^{137}Cs	^{90}Sr
27	24 (Radiochemistry - 0, ɣ-Spectrometry - 24)	3

The reports containing results of the analyses are sent quarterly to the Chief Sanitary Inspectorate (Environment Hygiene Department), and simultaneously to the Radiation Emergency Centre CEZAR at PAA.

5.8.2 Aquatic biota

The PAA orders (public procurement) measurements of the specific radionuclide activity in fish. The monitoring is performed within the Baltic Sea water and sediments monitoring programme. Currently the monitoring programme is performed by the Central Laboratory for Radiological Protection.

Fish samples (at least four common species present in the Baltic sea, e.g. Atlantic herring, Atlantic cod, flounder, sprat) are collected (or should originate from) the following locations:

PL-1 (54°35,00'N, 19°00,00'E) – Gdańsk Basin,

PL-2 (54°55,00'N, 18°10,00'E) - Gdańsk Basin, and

PL-4 (54°20,00'N, 15°20,00'E) - Bornholm.

The following methods are used:

- ^{137}Cs – high-resolution gamma spectrometry with MDA less than 0.1 Bq/kg;

- ^{40}K – high-resolution gamma spectrometry with MDA less than 5 Bq/kg;
- ^{226}Ra – emanation method (i.e. separation of radium by coprecipitation with barium, dissolution of the precipitate and radon de-emanation) and measurement of alpha activity by means of a scintillation detector. This method allows results with an MDA less than 0.01 Bq/kg to be obtained.

5.9 MONITORING OF FOODSTUFFS AND FEEDING STUFF

In general, the sampling programme for foodstuffs and feeding stuff is run by the basic units of the Sanitary-Epidemiological Stations (see map below) - the exception is mixed diet monitoring which is procured by the PAA. The schedule (locations and times) of sampling is consulted by Regional Sanitary-Epidemiological Inspectors with the Radiation Emergency Centre and further approved by the President of the PAA.

Figure 18: Sanitary-Epidemiological Stations

Additionally, the National Veterinary Research Institute (PIWet) collects the results from the monitoring of the ^{137}Cs content performed by the Veterinary-Hygiene Stations and sends them to the General Veterinary Inspectorate. According to the Report of 2014 the Veterinary-Hygiene Stations performed analyses of 1244 samples originating from 16 regions (voivodships): 198 beef muscles, 48 sheep muscles, 177 pork muscles, 185 poultry muscles, 116 wild (hunted) animal muscles, 181 fish samples, 169 egg samples, 170 cow milk samples. Moreover, they performed analyses of 86 samples of various feedstuffs.

The summary below does not take into account the measurements performed by the Veterinary-Hygiene Stations.

5.9.1 Milk

Milk samples are collected from the local producers or from local shops (local producers preferred when available). Routinely (normal situation) milk is sampled quarterly. The primary raw milk samples are taken randomly. The monthly composite sample is taken for the routine control. The milk subsamples of 500ml can be taken once in a week. The sample is stored in a refrigerator, conserving it with hydrogen peroxide.

The samples are analysed for ^{137}Cs activity with radiochemical or spectrometric methods. Selected basic units also determine ^{90}Sr activity. Additionally ^{40}K results are available for some samples.

Preparation and measurement of samples is carried out in accordance with the procedure approved by the PAA President: Method for Radiochemical Determination of ^{90}Sr in foodstuff and in water (Metodyka radiochemicznego oznaczania ^{90}Sr w próbkach produktów żywnościowych i wodzie). The laboratories use their own procedures when carrying out the spectrometric analyses.

Radiochemical preparation of samples (^{137}Cs and ^{90}Sr)

Milk samples of 1.5 litres are taken from the primary sample which is transferred to a porcelain dish and evaporated to dryness after adding 2ml of trichloroacetic acid. The sample is dried and ashed in the muffle furnace (temp. not above 450°C).

The table below summarises milk samples analysed by the Sanitary-Epidemiological Stations in 2015.

Milk - 2015		
No. of samples	^{137}Cs	^{90}Sr
130	120 (Radiochemistry - 39, ɣ-Spectrometry - 81)	10

The reports containing results of the analyses are sent quarterly to the Chief Sanitary Inspectorate (Environment Hygiene Department), and simultaneously to the Radiation Emergency Centre CEZAR at PAA. The Radiation Emergency Centre CEZAR prepares the quarterly notifications of the PAA President published in the Monitor Polski (Official Gazette of the Republic of Poland) containing data on ^{137}Cs content in milk.

5.9.2 Mixed diet

The investigation of mixed diet is ordered (public procurement contract) by the PAA every year. The programme includes the collection of mixed diet samples in two/three cities having the population over 100 thousand inhabitants once or twice per year (2015 programme involved Białystok and Szczecin cities, 2014 programme – Poznań and Rzeszów, 2013 programme included Warsaw, Gdańsk and Sosnowiec).

Mixed diet samples are collected in canteens preparing all the day's meals which are combined into one sample. Whole day samples are collected during 5 consecutive days. ^{137}Cs and ^{90}Sr activity concentration is determined in all of the above mentioned samples by the Central Laboratory for Radiological Protection CLOR (contract). The determination of ^{137}Cs activity in meals and food products involves radiochemical and spectrometric methods. Spectrometric method uses high-resolution gamma spectrometer (HPGe). The measurements are performed using a flat cylinder geometry placed on the detector following the homogenisation and ashing of the products. The radiochemical analyses consist in dissolving the sample, filtering through a radiochemical funnel with ammonium molybdeno-phosphate (AMP) bed, which is selective for caesium. The activity of caesium in the AMP bed is measured by means of Low Level GM Multicounter system (production Riso, Denmark). Strontium 90 is determined from beta radiation of ^{90}Y, after equilibrium ^{90}Sr – ^{90}Y is reached.

5.9.3 Other foodstuffs

According to the recommendations of the PAA's President foodstuffs are collected first from local manufacturers and then, if not available, from hypermarkets and local shops. They are measured by the basic units of the Sanitary Inspection (WSSE).

In general, the samples are taken a few times a year:

- fish, eggs, cereals – once per year,
- fruit, vegetables – once per year during harvest,
- meat (different kinds) – once per quarter.

Vegetables, fruit, freshwater and sea water fish as well as feeding stuffs are measured by basic units of the Sanitary Epidemiological Inspection (WSSE).

The samples are analysed for ^{137}Cs activity above 0.5 Bq/l with radiochemical and spectrometric methods. Some basic units also perform analyses for ^{90}Sr activity in the samples.

Preparation and measurement of samples is carried out in accordance with the procedure approved by the PAA President: Method for Radiochemical Determination of ^{90}Sr in foodstuff and in water (Metodyka radiochemicznego oznaczania ^{90}Sr w próbkach produktów żywnościowych i wodzie). The laboratories use their own procedures when carrying out the spectrometric analyses.

Radiochemical preparation of samples (^{137}Cs and ^{90}Sr)

Flaked samples are transferred to a porcelain dish, crumbed and evaporated to dryness. Sample is dried and reduced to ashes in the muffle furnace (temp. not above 450°C).

Before the measurement samples are crumbed, ashed, digested with acid (1:1) and diluted with distilled water to the desired measurement geometry.

The below table summarises food samples analysed by the Sanitary-Epidemiological Stations in 2015:

2015			
Foodstuff	No. of samples	^{137}Cs	^{90}Sr
Poultry	78	78 (Radiochemistry - 48, ɣ-Spectrometry - 30)	-
Eggs	75	75 (Radiochemistry - 28, ɣ-Spectrometry - 47)	-
Meat	113	108 (Radiochemistry - 39, ɣ-Spectrometry - 69)	5
Dairy products (excl. milk)	13	8 (all ɣ-Spectrometry)	5
Fruits	34	34 (Radiochemistry - 14, ɣ-Spectrometry - 20)	-

2015			
Foodstuff	No. of samples	^{137}Cs	^{90}Sr
Fruits (blackberries)	2	1 (ɣ-Spectrometry)	1
Fish	80	80 (Radiochemistry - 35, ɣ-Spectrometry - 45)	-
Vegetables	46	41 (Radiochemistry - 15, ɣ-Spectrometry - 26)	5
Cereals	30	26 (Radiochemistry - 13, ɣ-Spectrometry - 13)	4
Potatoes	31	30 (Radiochemistry - 13, ɣ-Spectrometry - 17)	1

The reports containing results of the analyses are sent quarterly to the Chief Sanitary Inspectorate (Environment Hygiene Department), and simultaneously to the Radiation Emergency Centre CEZAR at the PAA.

5.9.4 Feeding stuffs

The feeding stuff samples are collected once per year from local feeding stuff vendors and measured by the basic units of the Sanitary Inspection (WSSE).

Preparation and measurement of samples is carried out in accordance with the procedure approved by the PAA President: Method for Radiochemical Determination of ^{90}Sr in foodstuff and in water (Metodyka radiochemicznego oznaczania ^{90}Sr w próbkach produktów żywnościowych i wodzie). The laboratories use their own procedures for the spectrometric analyses.

Radiochemical preparation of samples (^{137}Cs and ^{90}Sr)

Flaked samples are transferred to a porcelain dish, crumbed, and evaporated to dryness. Sample is dried and reduced to ashes in the muffle furnace (temp. not above 450°C).

Preparation of samples for spectrometric analysis

Before the measurement samples are crumbed, ashed, digested with acid (1:1) and diluted with distilled water to the desired measurement geometry.

The below table summarises feeding stuff samples analysed by the Sanitary-Epidemiological Stations in 2015:

Feeding stuffs - 2015		
No. of samples	^{137}Cs	^{90}Sr
26	25 (Radiochemistry - 10, ɣ-Spectrometry - 15)	10

In 2015, the following types of fodder were analysed:

- Wheat bran;
- Rye bran;
- Alfalfa - fresh;
- Maize - fresh;
- Granulates;
- Fodder mixtures;
- Grass.

The reports containing results of the analyses are sent quarterly to the Chief Sanitary Inspectorate (Environment Hygiene Department), and simultaneously to the Radiation Emergency Centre CEZAR at the PAA.

5.10 THEMATIC INVESTIGATIONS

In 2015, the measurements of releases of radioactive substances into the air were performed by CLOR in the vicinity of the National Centre for Nuclear Research in Świerk (ordered by PAA).

The scope of the investigation included the collection and analysis of:

- the concentration of gaseous iodines;
- the concentration of noble gases;
- the concentrations of artificial and natural radioactive isotopes in ground-level atmospheric aerosols.

Sampling was performed by means of the mobile stations described in Section 5.13.

5.11 INFORMATION FOR THE GENERAL PUBLIC

Quarterly notifications of the PAA President are published in the Monitor Polski Official Gazette of the Republic of Poland concerning the national radiation situation and containing data on the gamma radiation level, radioactive contamination of air and ^{137}Cs content in milk (also available online). Annual “Reports on the activities of the President of the National Atomic Energy Agency and assessment of nuclear safety and radiological protection in Poland” are published and are available on the National Atomic Energy Agency website.

Based on the data obtained from early warning stations for radioactive contamination conducting continuous measurements, the PAA website http://paa.gov.pl/ displays a map illustrating the 24 hour distribution of gamma radiation dose rate within the territory of the whole country, updated on a daily basis (data from early warning stations for radioactive contamination is also available on the EURDEP site updated every 10 minutes).

5.12 PLANNED EXPANSION OF THE MONITORING NETWORK

The National Atomic Energy Agency within the framework of the Polish Nuclear Programme plans to increase the number of the stations belonging to the PMS network. The primary aim is to include the largest cities (regional capitals) in the on-line radiological monitoring: Poznań, Katowice, Opole, and Kielce.

5.13 MOBILE MEASUREMENT SYSTEMS

5.13.1 Mobile Spectrometric Laboratory

The PAA uses the Mobile Spectrometric Laboratory based on a Toyota Landcruiser GX90 vehicle. The laboratory is used to perform radioactivity scanning/mapping of the broader area or on the pre-described route, as well as searching for lost/orphan sources. The laboratory is equipped with an Exploranium GR-660 system consisting of:

- Gamma spectrometer GR-320 (512 channel, natural thorium or ^{137}Cs peak stabilisation, measurement every 2 seconds);
- Portable NaI(Tl) GPX-21A scintillation detector (0.35 litre);
- 4-litre NaI(Tl) GPX-256 scintillation detector placed on the roof of the car;
- GPS system;
- On-board touch-screen computer for data collection, on-line visualisation and storage. The computer is mounted inside the G-shock resistant case.
- GPRS data communication system.

The Mobile Spectrometric Laboratory is not foreseen to transport sources and/or samples (Figure 19).

Data are further analysed and the radiological maps are prepared at the Radiation Emergency Centre (CEZAR) using GIS software (MapInfo and/or QGIS).

At present the computer and software used by the Mobile Spectrometric Laboratory are being modernised.

Figure 19: Mobile Spectrometric Laboratory

5.13.2 Mobile air sampling

The PAA makes use of the stations (Figure 20) available from the Central Laboratory for Radiological Protection in Warsaw, which has designed and produced the mobile stations for monitoring during emergency or ad-hoc sampling/monitoring:

- Mobile aerosol sampling station MASS 1000,
- Mobile gaseous iodine sampling station,

Figure 20: Mobile aerosol sampling station (MASS-1000)

Station parameters:

- Controlled sampling of the aerosols on the filter (up to 1000 m^3/h);
- On-line measurement of γ-radioactive isotopes contained in the ground-level atmosphere ($LaBr_3$ detector);
- Remote control of the station and measurement results (Wi-Fi connection);
- Power supply form the public electrical network (230 V/60 Hz) or portable power generator;
- Filter dimensions 50 x 50 cm – cylindrical positioning;
- Collection of the meteorological parameters (e.g. wind speed and direction, temperature, humidity) during aerosol sampling – results in graphical form;
- Precise offline filter measurement in the laboratory using HPGe detectors;
- Station preparation time takes approximately 10 minutes.

Mobile gaseous iodine sampling station

Station parameters:

- Two-stage filtering:
- Preliminary aerosol filter (Petrianov type);
- Activated carbon cartridge (TEDA) – volume 450 ml.;
- Flow rate: ~10 m^3 (typical);
- Precise automatic regulation of the TEDA cartridge temperature and its thickness ensures the full adsorption of the iodine gas (gas stays in the active carbon for at least 0.2 seconds);
- Power supply form the public electrical network (230 V/60 Hz) or portable power generator;
- Offline measurement of preliminary aerosol filter and TEDA cartridge in the laboratory by means of HPGe spectrometry.

All mobile stations have already been used at the request of the PAA for the local monitoring programmes at the MARIA research nuclear reactor situated in Świerk (aerosol sampling station, gaseous iodine sampling station and noble gas sampling station) and at the Radioactive Waste Repository in Różan (mobile aerosol sampling station). The stations are suitable to be used for air collection in various circumstances (including urban environment and the interior of buildings).

6 REPORTS OF OFF-LINE ENVIRONMENTAL RADIOACTIVITY MONITORING RESULTS TO THE EUROPEAN COMMISSION

6.1 INTRODUCTION

In accordance with the Commission Recommendation 2000/473/Euratom of 8 June 2000 on the application of Article 36 of the Euratom Treaty concerning the monitoring of the levels of radioactivity in the environment for the purposes of assessing the exposure of the population as a whole Poland forwards its results of monitoring of the levels of radioactivity in the environment to the Commission REM database, as listed in Annex 1 therein.
(Source: http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:2000:191:0037:0046:EN:PDF)

6.2 DENSE MONITORING NETWORK

Airborne particulates: ^{137}Cs, gross beta

ASS-500 network - ^{137}Cs (additionally ^{7}Be and ^{40}K)		
Name	**Latitude**	**Longitude**
BIALYSTOK	53.166667	23.166667
GDYNIA	54.516667	18.55
KATOWICE	50.233333	19.033333
KRAKOW	50.066667	19.966667
LODZ	51.766667	19.433333
LUBLIN	51.233333	22.516667
SANOK	49.566667	22.2
SZCZECIN	53.4	14.666667
TORUN	53.016667	18.6
WARSAW	52.3	20.983333
WROCLAW	51.166667	17.016667
ZIELONA GORA	51.933333	15.5

IWMW network - Gross beta		
Name	**Latitude**	**Longitude**
GORZOW WLKP IMWM	52.740950	15.277258
LEGNICA IMWM	51.192642	16.207675
LESKO IMWM	49.466417	22.341970
MIKOLAJKI IMWM	53.789100	21.589469
SWINOUJSCIE IMWM	53.921575	14.240014
WLODAWA IMWM	51.553667	23.529944
ZAKOPANE IMWM	49.293772	19.960469

Ambient gamma dose rate
On-line data is provided to EURDEP. Data provided to REM database are annual averages.

Name	Latitude	Longitude
PMS stations (13)		
BIALYSTOK	53.166667	23.166667
GDYNIA	54.516667	18.55
KOSZALIN	54.183333	16.2
KRAKOW	50.066667	19.966667

Name	Latitude	Longitude
LODZ	51.766667	19.433333
LUBLIN	51.233333	22.516667
OLSZTYN	53.8	20.5333
SANOK	49.566667	22.2
SZCZECIN	53.4	14.666667
TORUN	53.016667	18.6
WARSAW	52.3	20.983333
WROCLAW	51.166667	17.016667
ZIELONA GORA	51.933333	15.5
IMWM stations (9)		
GDYNIA IMWM	54.520642	18.546433
GORZOW WLKP IMWM	52.740950	15.277258
LEGNICA IMWM	51.192642	16.207675
LESKO IMWM	49.466417	22.341970
MIKOLAJKI IMWM	53.789100	21.589469
SWINOUJSCIE IMWM	53.921575	14.240014
WARSAW IMWM	52.281436	20.963261
WLODAWA IMWM	51.553667	23.529944
ZAKOPANE IMWM	49.293772	19.960469

Surface water: ^{137}Cs, (additionally ^{90}Sr)

Name	Catchment	Latitude	Longitude
ANNOPOL WISLA	WISLA	50.886111	21.859167
CHALUPKI ODRA	ODRA	49.922778	18.319444
GLOGOW ODRA	ODRA	51.653056	16.081944
KIEZMARK WISLA	WISLA	54.253889	18.930833
KRAJNIK ODRA	ODRA	53.195556	14.480556
KRAKOW TYNIEC	WISLA	50.713889	20.18
MORZE BALTYCKIE P-110	BALTIC SEA	54.5	19.102222
MORZE BALTYCKIE P-116	BALTIC SEA	54.652778	19.285
MORZE BALTYCKIE P-140	BALTIC SEA	55.558333	18.383333
MORZE BALTYCKIE P-39	BALTIC SEA	54.733333	15.133333
MORZE BALTYCKIE P-5	BALTIC SEA	55.233333	15.910033
PLOCK WISLA	WISLA	52.547222	19.697778
POZNAN WARTA	WARTA	52.408333	16.9225
PULTUSK NAREW	NAREW	52.705	21.085556
WARSAW WISLA	WISLA	52.235278	21.016389
WROCLAW ODRA	ODRA	51.109444	17.036667
WYSZKOW BUG	BUG	52.602778	21.456111

Drinking water: ^{3}H, ^{90}Sr, ^{137}Cs

Name	Latitude	Longitude	Comment
OLSZTYN	53.8	20.333	2014: ^{3}H, ^{90}Sr, ^{137}Cs
POZNAN	52.4167	16.85	2014: ^{3}H, ^{90}Sr, ^{137}Cs
RZESZOW	50.0333	22.0	2014: ^{3}H, ^{90}Sr, ^{137}Cs
GDANSK	54.36	18.639	2013: ^{3}H, ^{90}Sr, ^{137}Cs

Name	Latitude	Longitude	Comment
SOSNOWIEC	50.279	19.12	2013: ^{3}H, ^{90}Sr, ^{137}Cs
WARSAW	52.3	20.98333	2013: ^{3}H, ^{90}Sr, ^{137}Cs
KRAKOW	50.713889	20.18	2012: ^{3}H, ^{90}Sr, ^{137}Cs
LUBLIN	51.233333	22.516667	2012: ^{3}H, ^{90}Sr, ^{137}Cs
ZIELONA GORA	51.933333	15.5	2012: ^{3}H, ^{90}Sr, ^{137}Cs
WROCLAW	51.166667	17.016667	2012: ^{3}H, ^{90}Sr, ^{137}Cs
ANNOPOL WISLA	50.886111	21.859167	2012: ^{3}H, ^{90}Sr, ^{137}Cs
BIALYSTOK SES	53.1167	23.1667	^{137}Cs
BYDGOSZCZ SES	53.1667	18.05	^{137}Cs
WLOCLAWEK SES	52.65	19.0667	^{137}Cs
KATOWICE SES	50.4833	19.0833	^{137}Cs
POZNAN SES	52.4167	16.85	^{137}Cs

Milk: ^{137}Cs, ^{90}Sr

Name	Latitude	Longitude	Comment
BIALYSTOK SES	53.116667	23.166667	^{137}Cs
BYDGOSZCZ SES	53.166667	18.05	^{137}Cs
BYDGOSZCZ SES	53.166667	18.05	^{137}Cs
CIECHANOW SES	52.883333	20.6	^{137}Cs
KATOWICE SES	50.483333	19.083333	^{137}Cs
KONIN SES	52.8	18.266667	^{137}Cs
LOMZA SES	53.166667	22.066667	^{137}Cs
PLOCK SES	52.583333	19.733333	^{137}Cs
POZNAN SES	52.416667	16.85	^{137}Cs
PRZEMYSL SES	49.8	22.766667	^{137}Cs
WARSAW SES	52.25	20.95	^{137}Cs
WLOCLAWEK SES	52.65	19.066667	^{137}Cs
KATOWICE SES	50.483333	19.083333	^{137}Cs
POZNAN SES	52.416667	16.85	^{137}Cs
PRZEMYSL SES	49.8	22.766667	^{137}Cs

Mixed diet: ^{137}Cs, ^{90}Sr

Name	Latitude	Longitude	Comment
POZNAN	52.416667	16.85	2014
RZESZOW	50.033333	22.00	2014
WARSAW	52.3	20.983333	2013
GDANSK	54.36	18.639	2013
SOSNOWIEC	50.279	19.12	2013

6.3 SPARSE MONITORING NETWORK

Airborne particulates: ^{137}Cs, ^{7}Be, (additionally ^{40}K)

Name	Latitude	Longitude
KRAKOW	50.066667	19.966667
WARSAW	52.3	20.983333

Air: Ambient gamma dose rate

On-line data is provided to EURDEP. Data provided to REMdb are annual averages (see dense monitoring network).

Surface water: ^{137}Cs, (additionally ^{90}Sr)

Name	Catchment	Latitude	Longitude
WARSAW WISLA	WISLA	52.235278	21.016389
WROCLAW ODRA	ODRA	51.109444	17.036667

Drinking water: ^{137}Cs (according to the Draft Report for 2014)

Name	Latitude	Longitude	Comment
BIALYSTOK SES	53.1167	23.1667	^{137}Cs
BYDGOSZCZ SES	53.1667	18.05	^{137}Cs
WROCLAW SES	51.166667	17.016667	^{137}Cs

Milk: ^{137}Cs, ^{90}Sr, ^{40}K

Name	Latitude	Longitude	Comment
BIALYSTOK SES	53.116667	23.166667	^{137}Cs
KATOWICE SES	50.483333	19.083333	^{137}Cs

Mixed diet: ^{137}Cs, ^{90}Sr, C-14

No fixed-location mixed diet sampling is performed in the sparse network.

7 LABORATORIES PARTICIPATING IN THE NATIONAL ENVIRONMENTAL RADIOACTIVITY MONITORING PROGRAMME

7.1 CENTRAL LABORATORY FOR RADIOLOGICAL PROTECTION (CLOR)

CLOR fulfils its tasks by routine practical activities, preventive and operational tasks, by scientific studies, and by providing advice to private and governmental organisations. According to its statutory responsibility, CLOR duties comprise:

1. Radiological emergency service assistance, conducted by the Prevention and Dose Assessment Service
2. Research on matters dealing with radiation, radiation protection, radiobiology and radioecology
3. Monitoring of radioactive contamination in environmental components, foodstuffs and in human bodies
4. Support the countermeasures against illegal trafficking in nuclear and radioactive materials
5. Monitoring of personal radiation doses
6. Calibration and attestation of radiation measurement instruments
7. Professional training in radiation protection

CLOR offers services which are based on its many years' experience in radiological protection and which are backed up by research and development. CLOR customers include corporations, industrial organisations, hospitals, universities and local authorities. CLOR staff has a wide range of practical experiences in the measurements of radiation both in the workplace and environment.

According to the Regulation of the Council of Ministers of 17 December 2002 on stations for the early detection of radioactive contamination and units which measure radioactive contamination CLOR is one of the specialised units.

7.1.1 Soil monitoring

Measurements of the concentration of natural (^{40}K, ^{226}Ra and ^{228}Ac) and artificial radionuclides (^{137}Cs/^{134}Cs) in soil samples (the surface layer of soil: 0 – 10 cm depth), which are taken at 254 points covering the whole territory of Poland are carried out by CLOR in the framework of the State Monitoring of the Environment.

Measurements are performed by gamma spectrometry with semi-conductor HPGe detectors (efficiency 45 and 50 %) with the following LLDs (MDAs):

- 0.15 Bq/kg (0.02 kBq/m^2) for ^{137}Cs
- 2.5 Bq/kg for ^{40}K
- 2.0 Bq/kg for ^{226}Ra
- 0.5 Bq/kg for ^{228}Ac

Measurement time is 80 000 sec.

7.1.2 Air monitoring

CLOR carries out measurements of concentrations of gamma radionuclides (natural and artificial) in ground-level air using Aerosol Sampling Stations type ASS-500 (12 localisations in Poland). Measurements are performed by gamma spectrometry with semi-conductor HPGe detectors (efficiency 45 and 50 %). LLDs (MDAs) range from tenths to a few microbecquerels per cubic meter of air for different radionuclides (for one week collection and 80 000 seconds measurement).

7.1.3 Raw and building materials monitoring

CLOR carries out measurements of concentrations of natural radioactivity (^{40}K, ^{226}Ra and ^{228}Th) in samples of raw and building materials and calculations of qualification coefficients for exposure to whole body gamma radiation. Measurements are performed using a three-channel analyser with a NaI(Tl) scintillation detector.

The following LLD (MDA) minimal values for the accreditation range are used:

- 50 Bq/kg for ^{40}K,
- 15 Bq/kg for ^{226}Ra and
- 10 Bq/kg for ^{228}Th.

7.1.4 Monitoring in Różan and around the Institute in Świerk

Measurements of radionuclide concentrations (gamma- and beta-spectrometry with radiochemistry preparations) are carried out in different environmental samples (spring water, groundwater, river and well water, low-level air, soil, grass), measurements of exposition dose rate.

Measurements are performed by gamma spectrometry with semi-conductor HPGe detectors (efficiency 45 and 50 %).

Tritium content is determined by electrolytic enrichment and beta activity measurement using LSC in 3-litre samples. At the same time the blank sample and the sample containing a known amount of tritium is electrolysed. Due to the difference in the ion mobility the decay of the water particles which does not contain tritium is faster, thus in the process of the electrolysis the remaining part contains more HTO. The detection limit for this method reaches 0.5 Bq/l.

The content of ^{137}Cs and ^{90}Sr isotopes in surface water samples is determined also by means of radiochemistry. The determination of ^{137}Cs involves selective absorption of caesium on a thin ammonium molybdophosphate layer and the measurement of beta activity. The determination of ^{90}Sr is carried out with the method developed by Volchok (via its progeny ^{90}Y). Activities of ^{137}Cs and of ^{90}Y are measured with the low-level beta GM multicounter system Model Risø GM-25-5 having a background of about 0.2 counts per minute and efficiency of about 40%.

LLDs (MDAs) range from a few of millibecquerel to 5 Becquerel per kg for environmental samples (gamma-spectrometry measurement time: 80 000 sec), up to 0.2 mBq/m^3 for aerosols in air (gamma spectrometry, collection time 5 hours, measurement time: 80 000 sec). For tritium the detection limit reaches 0.5 Bq/l.

7.1.5 Monitoring of radioactive contamination in foodstuffs and water

Gamma spectrometric methods

Measurements are performed using multi-channel gamma spectrometry with the semi-conductor HPGe detectors, with energy resolution 1.8 keV FWHM for ^{60}Co (1332 keV) and relative efficiency of 30-35%, connected to the multi-channel analyser Canberra MULTIPORT II MCA with GENIE-2000.

Food samples

Isotopes: ^{134}Cs, ^{137}Cs and each additional gamma isotope

Sample mass: 0.6 kg

LLD(MDA): 0.5 Bq/kg or Bq/l

Water samples

Radionuclides	Volume	LLD (MDA)
^{228}Ra	5 dm^3	0.02 Bq/dm^3
^{210}Pb	30 dm^3	0.02 Bq/dm^3
^{137}Cs, ^{134}Cs	10-20 dm^3	0.5 Bq/dm^3
^{241}Am	10 dm^3	0.4 Bq/dm^3
^{60}Co	10 dm^3	0.5 Bq/dm^3
^{131}I	10 dm^3	0.5 Bq/dm^3

Radiochemical method

Determination of activity concentration of ^{90}Sr, $^{238,\ 234\ \text{and}\ 235}$U, ^{239,240,238}Pu, ^{210}Po, ^{226}Ra, $^{228,230\ \text{and}\ 232}$Th and total (gross) beta activity in is performed using the following equipment:

- Alpha spectrometry: PIPS detector with an efficiency of 32% placed in a vacuum chamber, connected to the multichannel analyser Canberra MULTIPORT II MCA with GENIE-2000,
- Beta-counter – low-level gas-flow beta multicounter system (Riso GM-25-5),
- iSolo – Alpha/Beta Counting System,
- Liquid scintillation counter Wallac 1410.

Food samples

Measurements	Weight	LLD (MDA)
^{90}Sr	from 0.3 to 1.5 kg or 2 litres depending on kind of food	0.01 Bq/kg or Bq/l
^{234}U, ^{235}U, ^{238}U	0.5 – 1 kg; only milk and milk products	0.5 mBq/kg
^{239,240}Pu, ^{238}Pu	0.5 – 1 kg; only milk and milk products	0.002 Bq/kg
^{210}Po	0.5 – 1 kg; only milk powder	0.003 Bq/kg
^{226}Ra	0.5 – 1 kg; mass depends on kind of products	0.73 mBq per sample
^{228}Th, ^{230}Th, ^{232}Th	0.5 – 1 kg; only milk and milk products	0.004 Bq/kg
Total (gross) beta activity	0.3 – 1 kg; mass depends on kind of products	0.5 Bq/kg

Water samples

Measurements	Volume	LLD (MDA)
Total (gross) alpha activity	5 dm^3	0.015 Bq/dm^3
Total (gross) beta activity	5 dm^3	0.014 Bq/dm^3
^{3}H	1 dm^3	10 Bq/dm^3
^{226}Ra	1 dm^3	0.73 mBq per sample
^{90}Sr	10-20 dm^3	8.0 mBq per sample
^{234}U, ^{235}U, ^{238}U	5 dm^3	0.5 Bq/dm^3
$^{239,240}Pu$, ^{238}Pu	5 dm^3	0.002 Bq/dm^3
^{210}Po	5 dm^3	0.3 mBq per sample

7.2 SANITARY-EPIDEMIOLOGICAL STATION IN WARSAW (WSSE)

The Radiation Hygiene Section (Oddział Higieny Radiacyjnej) of the basic unit no. 20 Voivodship Sanitary-Epidemiological Station in Warsaw (Wojewódzka Stacja Sanitarno-Epidemiologiczna w Warszawie) carries out measurements within the framework of monitoring of contamination of foodstuffs and the environment performed according to the schedule of the Radiation Emergency Centre CEZAR PAA for assessment of the radiological situation of the country.

The main measurement method is radiochemical analysis, (spectrometric analyses are sporadic; mainly samples taken within the framework of official food control). Radiochemistry methods are not accredited but are in accordance with the method prepared by the Central Laboratory for Radiological Protection (CLOR), whilst the spectrometry procedure was developed in-house, and is accredited.

A Sapos-90, detector type SSU-70-2, NaI(Tl), with a DOP-80 shielding house is used for radiochemical analyses.

For spectrometric analyses a modernised SSU-70 with a DOP-80 shielding house (scintillator diam. 5 cm) with STANDARD-70 system (detector and system modernised in 2008) is used. The analyser is a Tukan 8k-USB, detector NaI(Tl). A Marinelli 1000 ml geometry is used.

Calibration / reference sources consist of a reference prepared in-house based upon the reference solution of ^{137}Cs + ^{137}Ba with specific activity of 57 Bq/g (22 June 2005) purchased from OBRI POLATOM Świerk and 4 references of ^{137}Cs purchased from OBRI POLATOM Świerk with activities 5.99Bq, 42.4 Bq, 335 Bq and 1043.8 Bq (22 September 2004).

The results from the SAPOS-90 are printed after the measurement, and the results are put into the sample analysis sheet with all the information used for determination of the specific activity in the sample, as well as for the sample identification. Sample analysis sheets are archived for 5 years. The results are transferred to the PAA quarterly. The results of the spectrometric analyses are stored in the computer memory.

The laboratory participates in the interlaboratory exercises organised by the PAA (both methods) and internal or Polish Certification Authority audits for spectrometric methods.

7.3 INSTITUTE OF METEOROLOGY AND WATER MANAGEMENT (IWMW - IMGW)

7.3.1 Introduction

The facility in Warsaw deals with the substantive and administrative coordination of the network of the 9 IWMW measurement stations.

The measurement range and scope of the data comprising the IMGW-PIB network of stations performing radioactive contamination measurements for the PAA is defined in the Regulation of the Council of Ministers of 17 December 2002 on stations for the early detection of radioactive contamination and units which measure radioactive contamination (Journal of Laws of 2002 No. 239 Item 2030).

The average monitoring results for the previous day are transferred daily to the Radiation Emergency Centre at the National Atomic Energy Agency (CEZAR PAA) within the early detection of radioactive contamination system. The details of gamma dose rate in the form of graphs are available on the http://paa.gov.pl/monitoring.html and on the website of the European Radiological Data Exchange Platform (EURDEP) https://remap.jrc.ec.europa.eu/GammaDoseRates.aspx .

The IMGW-PIB (IWMW) network and the measurements of the contamination are financed externally, i.e. from the periodic agreements with the Chief Inspectorate for Environmental Protection (GIOŚ - CIEP) and the National Fund for Environmental Protection and Water Management (the National Fund). The current two-year agreement is entitled "Monitoring of ionising radiation carried out in the framework of the State Environmental Monitoring Task 1: Measuring network for early detection of radioactive contamination". The agreement is currently signed for the period starting from 01 October 2015 up to 30 September 2018 (no 36/2015/F). The measuring programme of the IWMW stations is included in the above agreement and the State Environmental Monitoring Programme for the years 2016-2020. Reports from the analysis of measurement results for the previous years are available free of charge at the Chief Inspectorate for Environmental Protection (GIOŚ - CIEP), who is a trustee of the results http://www.gios.gov.pl/pl/stan-srodowiska/monitoring-promieniowania-jonizujacego

The scope of measurement tasks of the IWMW network includes:

A) Continuous measurement of gamma dose rate in the air at the height of 1m above the ground with the registration of the hourly averages and daily averages of 9 measuring stations of the network for early detection of radioactive contamination (Warsaw, Gdynia, Wlodawa, Swinoujscie, Gorzow Wielkopolski., Lesko, Zakopane, Legnica and Mikolajki).

B) Continuous measurement of the radioactivity of aerosols samples at 7 stations in the network (Wlodawa, Swinoujscie, Gorzow Wielkopolski., Lesko, Zakopane, Legnica and Mikolajki) the registration of hourly averages, and the average daily value of alpha and beta radioactivity emitters and the total activity of artificial beta-radioactive emitters.

C) Measurement of the global beta activity of daily precipitation samples and monthly total precipitation samples at 9 measuring stations (Warsaw, Gdynia, Wlodawa, Swinoujscie, Poznan, Lesko, Zakopane, Legnica and Mikolajki).

D) Spectrometric ^{137}Cs activity measurements and selected natural gamma-radioactive isotopes in bulk samples of the monthly total precipitation.

E) The radiochemical determination of ^{90}Sr in collected monthly total precipitation samples.

7.3.2 Measurements

The following measurements are performed in Warsaw:

- Measurement of the dose rate
- Measurement of global beta activity of total precipitation samples: daily, monthly
- Preliminary spectrometric measurement of the activity of ^{137}Cs and selected natural gamma isotopes radioactive; collective monthly total precipitation samples

The facility in Gdynia performs the following measurements:

- Measurement of the dose rate
- Measurement of global beta activity of samples daily total precipitation, monthly
- Accurate measurement of spectrometric ^{137}Cs activity and selected natural gamma isotopes in monthly total precipitation samples
- Radiochemical measurement of ^{90}Sr in monthly total precipitation samples

Sampling and analytical assessments are not outsourced to third parties. Service of the equipment and repairs are outsourced.

7.3.3 Sample reception, sample identification and registration procedures

Fallout samples are collected in open plastic boxes measuring 30x40 cm, placed outdoors. The containers are filled with distilled water to a height of 1 cm.

The daily fallout sample is collected for 24 hours. The monthly fallout sample is collected for one month.

The wet and dry atmospheric deposition gathered in the daily or monthly regime is registered with the date of sampling.

7.3.4 Sample preparation

The fallout collected in the water is evaporated under 250W infrared lamps in porcelain containers lined with a layer of tissue paper which is subsequently ashed in an oven at 450 degrees for 10 hours.

7.3.5 Sample measurements

The resulting ash is placed in a container, chosen depending on the measurement (beta or gamma). After the last non-destructive analysis the sample is measured radiochemically. The samples collected over 24 hours are measured after 5 days for beta activity. The monthly samples are measured on the 10th day of the following month for beta activity. The collective monthly samples from all stations are measured spectrometrically and then processed radiochemically.

7.3.6 Measurement devices available in the laboratory

The measurement of beta activity (daily and monthly fallout samples) is carried out using a Riso GM-25-5, five sample low-level beta detector. The calibration source consists of ^{40}K. Calculation of the results is built-in.

For spectrometric measurements (pooled fallout samples) a HPGe detector cooled with liquid nitrogen with a DSA-1000 digital spectrum analyser is used together with Genie-2000. Calculation of the results is built-in.

7.3.7 Measurement results

The measurement results are saved in spreadsheets and the database. Spectroscopy results below the detection limit are recorded as well.

7.3.8 Statutory accounting and reporting obligations

The results are submitted to the Chief Inspectorate of Environmental Protection and the National Atomic Energy Agency at semi-annual intervals as well as published on the website.

7.3.9 Sample storage

Collective monthly samples are destroyed during the radiochemical measurement. Collective daily samples are not archived.

7.3.10 Quality assurance and control procedures

Quality assurance procedures are regulated by internal instructions. The spectrometric measurement in the laboratory in Gdynia is preceded by a preliminary measurement in the laboratory in Warsaw as the basic verification. In case of dubious results, the measurements are repeated. The background is measured spectrometrically using an empty container to diminish the effects of possible contaminants within the container.

Internal control is based upon the calibrations performed at prescribed time intervals, background measurement before sample measurement and the use of reference solutions.

7.3.11 Laboratory accreditation

The laboratories in Warsaw and Gdynia take part every second year in the intercalibration measurements organised by the National Atomic Energy Agency and the Institute of Nuclear Chemistry and Technology. The Laboratory in Gdynia also participates in comparative measurements organised by other institutions.

7.4 VETERINARY INSPECTION

The veterinary Inspection implements tasks concerning animal health protection and safety of products of animal origin in order to ensure protection of public health through the following:

- monitoring of prohibited substances, chemical and biological residues, medical products, radioactive contamination of animals, waste and secretion, in animal tissues or organs, in products of animal origin, in water for animals and in animal feedstuffs.

This is achieved through:

- official laboratories within the meaning of Art. 12 of Regulation No 882/2004, including veterinary hygiene facilities, national laboratories and research institutes.
- The National Reference Laboratories within the meaning of Art. 33 of Regulation No 882/2004.

7.4.1 Sample reception

Each sample is provided to the laboratory with a sampling protocol prepared for monitoring. Thus, samples are easily identified as monitoring ones. They are registered and processed according to the quality system procedures.

7.4.2 Sample preparation

Solid samples (meat and fish) are ground before being placed in measurement vessels, whereas liquid ones (eggs and milk) are poured directly into 450cc Marinelli beakers. The mass of each sample is noted before measurement.

7.4.3 Sample measurements

Individual (meat, fish, milk) or bulked (10 eggs per sample) samples are measured for gamma radionuclides (^{137}Cs, ^{134}Cs) using scintillation (NaI(Tl)) or semiconductor (HPGe) detectors shielded with lead. Counting time is 72000 s, whenever possible.

7.4.4 Measurement devices

Ten laboratories are equipped with NaI(Tl) (ETL 2" type 9266 – Scionix, 2003). Moreover, six of them have also coaxial HPGe detectors (efficiency up to 30% – Canberra, 1999–2015). Detectors are calibrated with a multinuclide source (Czech Metrology Institute) regularly. Maintenance and other services, scheduled according to the quality system procedures, are provided by Canberra-Packard. Results are calculated using Genie 2000 software.

7.4.5 Measurement results

Measurement results are recorded and archived electronically and in a paper form. They are analysed yearly and reports prepared by the National Reference Laboratory (NRL) are sent to the Veterinary Chief Officer and then published in the internet. Results below detection limits (ranging from below 1 to about 2 Bq/kg depending on analytical system configuration) are booked as "<MDA", where MDA is a value calculated using Genie 2000 software or obtained during validation.

7.4.6 Data handling and reporting tools

Data are stored in database and/or laboratory information systems.

7.4.7 Sample storage

Samples are stored and archived in appropriate conditions. After measurements they are kept for 30 days and then disposed of according to the quality system procedures.

7.4.8 Quality assurance and control procedures

The laboratories use ^{137}Cs point sources for general assessment of the detector performance and IAEA reference materials or laboratory control samples (^{133}Ba+^{137}Cs+^{60}Co standard) for internal QA/QC.

7.4.9 Laboratory accreditation

All the laboratories are accredited according to PN-EN ISO/IEC 17025. Regional Veterinary Laboratories participate in proficiency tests organised by NRL regularly (every 2 years). CRMs provided by IAEA are used for preparing test samples and the IAEA methodology is applied in laboratory performance assessment. NRL participates in proficiency tests organised by the Reference Materials Group of the IAEA Terrestrial Environment Laboratory.

7.5 INSTITUTE OF NUCLEAR CHEMISTRY AND TECHNOLOGY

The Institute of Nuclear Chemistry and Technology is a provider of the proficiency tests on the determination of radionuclides for laboratories participating in the national radioactivity monitoring network. The proficiency tests are provided in accordance with the ISO/IEC 17043: 2010 standard. The results supplied by the participating laboratories are statistically evaluated by means of z and zeta scores in accordance to ISO 13528 and IUPAC harmonised protocol (2006). The proficiency tests are organised annually at the request of the National Atomic Energy Agency. In addition, the PMS station in Warsaw is located at the Institute.

8 VERIFICATIONS

8.1 NATIONAL ATOMIC ENERGY AGENCY

Poland plans to have an operational nuclear power plant by 2027 and the PAA have already recruited 40 people, who are currently undergoing training in Poland or abroad to deal with the licencing issues. Given the amount of baseline data which will be generated during the approval process for the future NPP it was judged useful to develop a robust system to handle the data, and which would be a key tool in informing the general public. The verification team suggested contacting the French authorities, where, during a verification in June 2016 the "Réseau national de mesures de la radioactivité de l'environnement – RNMRE" was demonstrated.

Currently mixed diet is sampled in two or three different cities annually, there is no permanent monitoring location.

The Radiation Emergency Centre (CEZAR) is housed within the building partially occupied by the PAA. Considerable investment has been undertaken since the previous verification in 2012, leading to greater quality and quantity of information being received. The latest PMS now give important information on wind direction and speed.

A national warning system for major emergencies, including nuclear/radiological is operated in Poland to which members of the public can subscribe, allowing them to receive SMS notifications. The nearest NPP is in the Czech Republic, around 300 km from the Polish border.

> *Verification does not give rise to recommendations. Nevertheless it is suggested to consider introducing a permanent location for mixed diet samples to enable trends to be followed.*

8.2 CENTRAL LABORATORY FOR RADIOLOGICAL PROTECTION (CLOR)

The Central Laboratory for Radiological Protection (CLOR) was under the responsibility of the Ministry for the Economy at the time of the verification.

Around 10% of its funding comes from the State, whilst the majority of its income comes from private customers who need the support of their expertise in this domain. Since 2012 they have a bilateral agreement with the PAA as Technical Support Organisation.

Total staff comprises 46 persons (incl. 4 external), mainly scientists, engineers and professors; the annual budget is around €1.8 million.

In the grounds the verification team was presented an ASS 500 high volume air sampler, featuring temperature and humidity probes and heating sited in a fenced area with a locked gate. At the time of the visit the sampler showed a flow rate of 460 m^3/h and the run time since the last filter change was 21 h 44 min, for a total of 10030m^3. An older model air sampler, which had experienced problems due to a nearby coal fired power station, was also at the same location.

Indoors a mobile air sampler developed by CLOR as a commercial product was demonstrated. Comprising only 3 parts it can be easily set up without tools. The filter is wrapped around a wire mesh, and power is provided by a separate petrol generator.

Noble gases are collected indoors during 1 week every month, using an apparatus having an air flow of 60-70 litres/hour, on loan from the Federal Office for Radiation Protection (BfS) in Freiburg.

Also shown was a gaseous iodine sampler with a Petrianov filter in the inlet. The air flow of 2-10 m^3/h ensures optimal contact with the carbon cartridge which has a volume of 450 cm^3.

Details of the environmental matrices measured and the methods employed are given in Sections 7.1.1 to 7.1.5. The laboratory is accredited according to ISO 17025 and only handles low activity samples.

Samples arrive with the standard sample sheet provided by CLOR showing the person/organisation that was responsible for the sampling. Samples are registered in a central database and a sample sheet generated showing details relating to the sample and the required analyses. This sheet will accompany the sample to the preparation area, and thereafter to the counting rooms.

A UPS can supply power for 1hr to the gamma detectors, though thereafter there is no longer-term power supply. Samples are normally kept for approximately 2 weeks after analysis, though in some cases they are retained for up to 1 year. In any case they are not disposed of before the final analysis protocol, signed by the laboratory responsible has been sent to the client. All results are stored on a central computer and regular backups are made on external hard disks.

In addition to the main sample receipt and analysis area there is also a low background laboratory featuring a 2.5 m special concrete roof to reduce the background radiation. Currently there are 4 HPGe detectors, though there is space for a further 3.

Verification does not give rise to remarks.

8.3 INSTITUTE FOR NUCLEAR CHEMISTRY AND TECHNOLOGY

The institute, which is an IAEA collaborating laboratory for radiation technology, employs 230 people.

Of principal interest to the verification team was the PMS station sited in a fenced area on the secure grounds of the institute. Currently there are 14 older models running nationwide with a newer unit due to be deployed in July 2016. A technician from the supplier was present to explain the operation of these units which are covered by a 3-year maintenance contract.

Though no analysis is carried out as part of the national environmental monitoring programme the analytical laboratories have played a vital role for the last 15 years in the organisation of interlaboratory comparisons and proficiency tests which have seen participation by Polish labs, as a legal requirement, and also labs from abroad. Some commercial analytical activities are undertaken, but these fall outside the scope of Article 35.

International methods, largely inspired by the IAEA's programmes, are followed and concern 3 sample types (food, solid or liquid). ISO 17043 certification is held for the interlaboratory comparisons. The matrix and choice of isotope(s) are discussed each year with the PAA. Sand and water are commonly used as matrices. All samples are gravimetrically prepared, as distinct from being pipetted, using balances which have been calibrated by the Polish Metrology Authority. Mechanical homogenisation is employed for solid matrices. Liquid samples are homogenised using ultrapure argon gas as a carrier to avoid sorption on the internal walls of the bottles. Labs are informed of the quantity of carrier added in order to better adjust their measurement results.

Interlaboratory comparisons are organised yearly. In 2016 milk to which ^{137}Cs and ^{90}Sr had been added was the chosen matrix. Some stabilisers were added to ensure that the labs would have a window of 3-4 weeks to perform the analyses satisfactorily. Normally extra samples are prepared, over and above the number required, firstly as reference samples, but secondly in case a lab needs to repeat the analyses. Typical quantities which have to be prepared are of the order of 30-40 kg for sand or vegetables.

5 - 6 long-term, experienced staff are involved in the interlaboratory comparison exercises and ensure all tasks, from sample preparation, packaging, through to production of the final results.

Verification does not give rise to remarks.

8.4 INSTITUTE FOR METEOROLOGY AND WATER MANAGEMENT (IMWM)

Under an agreement with the Ministry of Environment dose rate and fallout data is collected and transmitted manually to the PAA. Discussions are under way to give the PAA online access to the IMWM network. Currently the service operates on a 7/7 basis but this could change if direct access was granted.

Full details of the PMS stations operated are given in Section 5.4 . No maintenance service contract is currently in place due to the fact that a reserve of 5 stations is held in case of breakdown at any of the 9 stations operating. Two stations, 1 of which is of the newer type, are mounted in secure areas on the grounds of the Institute. Each probe has its own profile.

In the meteorological garden fallout is collected in cuvettes filled with distilled water fitted with a mesh cover to prevent birds and leaves affecting the sample. No heating is maintained in winter, if ice forms it is simply heated in the laboratory. After collection (daily/monthly) the liquid is placed in dishes containing blotting paper, dried and ashed at 450^0C, before a gross beta measurement is performed. Monthly samples are analysed by gamma spectrometry using a HPGe detector which uses Genie 2000 software on a PC running Windows 7. These samples are later transferred to Gdynia for further analysis.

> *Verification does not give rise to recommendations. The verification team encourages establishing a service contract for the PMS stations to safeguard continuous operation of the 9 stations.*

8.5 SANITARY EPIDEMIOLOGICAL STATION IN WARSAW (WSSE)

Samples analysed consist mainly of food/feedstuffs, surface water and drinking water, primarily from the city of Warsaw, but also from the administrative region. Throughput is of the order of 25 samples per year, the analysis of which can be handled by the single full-time employee. A trained backup person is available, and additionally other staff can be brought in during an emergency. Including the remaining 4 Sanitary –Epidemiological Stations in the Mazovian Voivodship the number of samples does not exceed 100 per year.

Radionuclides analysed are mainly ^{137}Cs on a routine basis and ^{90}Sr if required. As they are obliged to participate regularly in national interlaboratory comparisons they currently only do this for ^{137}Cs, but would also partake for ^{90}Sr if the need arose.

An appropriate level of equipment for sample storage (fridge) and preparation (furnace, evaporator) is present. The SAPOS 90 used for radiochemical analyses contains parts salvaged from another instrument; nevertheless a new beta monitor has been ordered and is expected to be delivered by the end of 2016.

Calibration of the gamma spectrometer detector is carried out using 4 Cs sources of different activities and performed twice a year.

Owing to the low number of samples analysed annually it makes no sense to invest in a Laboratory Information Management System (LIMS). All registration of samples and results is done manually. Samples are analysed one by one, moreover it would be very exceptional to have 2 samples of the same type present in the laboratory at the same time. Results are transmitted to the PAA every 3 months.

> *Verification does not give rise to remarks. The laboratory is "fit for purpose" and would provide basic supplementary analytical capacity in the event of a radiological emergency.*

9 CONCLUSIONS

All verification activities that had been planned 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 activities, was useful.

The information provided and the verification findings lead to the following observations:

(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 in Warsaw are adequate. The Commission could verify the operation and efficiency of a representative part of these facilities.

(2) A number of suggestions are made, in particular relating to the National Atomic Energy Agency.

(3) The suggestions are detailed in the 'Main Conclusions' document that is addressed to the Polish competent authority through the Polish Permanent Representative to the European Union.

(4) The Commission Services ask the Polish competent authority to inform them of any achievements with regard to the situation at the time of the verification, before the end of 2018.

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

APPENDIX 1

REFERENCES & DOCUMENTATION

1. Replies to the preliminary information questionnaire addressed to the national competent authority, received on 20 June 2016.

APPENDIX 2

THE VERIFICATION PROGRAMME

DAY 1 - 27 JUNE 2016 (MONDAY)
(venue - National Atomic Energy Agency (PAA), Krucza St. 36, Warszawa,

15:00 Welcome by the PAA host
15:10 Introduction by the Verification team
15:45 Presentation of the radioactivity monitoring system in Poland *(PAA)*
16:30 Presentation of the emergency preparedness and response system in Poland *(PAA)*
17:00 Implementation of the *"Council Directive 2013/51/Euratom of 22 October 2013 laying down requirements for the protection of the health of the general public with regard to radioactive substances in water intended for human consumption"* in Poland *(Chief Sanitary Inspectorate)*
17:30 Discussion
18:30 End of the meeting

DAY 2 - 28 JUNE 2016 (TUESDAY)
(visits in the entities dealing with monitoring systems in Warsaw)
9:00 -12:00 Central Laboratory for Radiological Protection (specialized unit)
(venue: Central Laboratory for Radiological Protection, Konwaliowa St. 7, Warszawa)
Programme:
Management of the aerosol sampling station network (ASS-500):
Station design and parameters;
Network of stations;
Measurement equipment and procedures.
Mobile air sampling equipment:
Mobile aerosol sampling station;
Mobile gaseous iodine sampling station;
Noble gas sampling station.
Laboratory visits (focused on environmental and food and feedstuffs measurement activities):
Soil;
Water: surface (Baltic Sea, rivers and lakes) and groundwater (local monitoring);
Mixed-diet;
Food and feedstuff;
ILCs for basic units.
12:30 -14:00 Institute for Nuclear Chemistry and Technology (ILC and PT provider)
(venue: Institute for Nuclear Chemistry and Technology, Dorodna St. 16, Warszawa)
Programme:
PMS station;
Visit in the laboratories dealing with preparation of ILCs and PTs for specialized units

DAY 3 - 29 JUNE 2016 (WEDNESDAY)
9:00 -11:00 Institute for Meteorology and Water Management (IWMW)
(venue: Institute of Meteorology and Water Management in Warszawa, Podleśna St. 61, Warszawa)
Programme:
IWMW monitoring stations
Auxiliary monitoring station

11:30 -12:30 Sanitary Epidemiological Station in Warszawa (basic unit)
(venue: Voivodship Sanitary-Epidemiological Station in Warszawa, Radiation Hygiene Section, Żelazna St. 79, Warszawa)
Programme:
Visit to the laboratories dealing with measurement of foodstuffs and environmental samples

14:00 Discussions
(venue: National Atomic Energy Agency (PAA), Krucza St.36, Warszawa)

16:30 End of the verification