EUROPEAN COMMISSION
DIRECTORATE-GENERAL FOR ENERGY

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

Verification under the terms of Article 35 of the Euratom Treaty

Technical Report

CYPRUS

Nicosia

Routine and emergency radioactivity monitoring arrangements
Monitoring of radioactivity in drinking water and foodstuffs

8 – 10 March 2023

Reference: CY 23-01

VERIFICATIONS UNDER THE TERMS OF ARTICLE 35

OF THE EURATOM TREATY

FACILITIES	- Facilities for monitoring environmental radioactivity - Facilities for monitoring food and drinking water radioactivity - Associated analytical laboratories
LOCATIONS	- Nicosia and the surrounding area
DATES	8 – 10 March 2023
REFERENCE	CY 23-01
TEAM MEMBERS	Mr Vesa Tanner, DG ENER (team leader) Ms Faidra Tzika, DG ENER
REPORT DATE	29 September 2023
SIGNATURES	

V. Tanner F. Tzika

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Annexes

Legend

Abbreviation	Explanation
AMS	Automatic monitoring station
DFMR	Department of Fisheries and Marine Research
DLI	Department of Labour Inspection
EC	European Commission
ECURIE	European Community Urgent Radiological Information Exchange
EPR	Emergency Preparedness and Response
EU	European Union
EURDEP	EUropean Radiological Data Exchange Platform
EWS	Early Warning System
HPGe	High-purity Germanium (detector)
IAEA	International Atomic Energy Agency
LIMS	Laboratory Information Management System
LLD	Lower limit of detection
LSC	Liquid Scintillation Counting
NaI	Sodium Iodine (detector)
NORM	Naturally occurring radioactive material
NPP	Nuclear Power Plant
RICS	Radiation Inspection and Control Service
SGL	State General Laboratory

TECHNICAL REPORT

1 INTRODUCTION

Under Article 35 of the Euratom Treaty, all Member States must 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 to verify their operation and efficiency. The radiation protection and nuclear safety unit of the European Commission's Directorate-General for Energy is responsible for undertaking these verifications. The EC's Joint Research Centre (JRC) provides technical support during the verification visits and in drawing up the reports.

The main purpose of the verifications 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 from a site into the environment;
- levels of environmental radioactivity at the site perimeter and in the marine, terrestrial and aquatic environment around the site, for all relevant exposure pathways;
- levels of environmental radioactivity on the territory of the Member State.

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

2 PREPARATION AND CONDUCT OF THE VERIFICATION

2.1 PREAMBLE

The EC notified Cyprus of its decision to conduct an Article 35 verification in a letter addressed to the Permanent Representation of Cyprus to the European Union. The Cyprus Government subsequently designated the Department of Labour Inspection (DLI) to lead the preparations for this visit.

2.2 PROGRAMME OF THE VISIT

The EC and DLI agreed on a programme of verification activities in line with the Commission Communication of 4 July 2006 (Annex 1).

The opening meeting held at the DLI premises included presentations on the following:

- Commission Article 35 verification programme
- DLI introduction
- Environmental radioactivity monitoring in Cyprus

[1] 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; repealing Directives 89/618/Euratom, 90/641/Euratom, 96/29/Euratom, 97/43/Euratom and 2003/122/Euratom with effect from 6 February 2018 (OJ L 13 of 17.1.2014)

[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, pp. 2-5)

The verification team pointed to the quality and comprehensiveness of all the presentations and documentation. The team carried out the verifications in accordance with the programme in Annex 1. It met the following representatives of the national authorities and other parties involved:

Department of Labour Inspection

Ms Evangelitsa Tsoulofta	Senior Labour Inspection Officer, Acting Director
Mr Michalis Tzortzis	Labour Inspection Officer, Radiation Inspection and Control Service (RICS)
Ms Anastasia Sisou	Labour Inspection Officer, RICS
Mr Demetris Sakkas	Labour Inspection Officer, RICS

State General Laboratory

Ms Eleni Prokopiou	Senior Chemist
Ms Antigoni Achilleos	Chemist-Analyst, Head of the Radioactivity Lab of Food and Environmental Samples
Mr Argyris Argyrou	Chemist-Analyst

Civil Defence Administration

Ms Panayiota Elia	Assistant Civil Defence Officer, 1st Grade
Mr Nicholas Italos	Civil Defence Officer

3 RADIOLOGICAL MONITORING FRAMEWORK IN CYPRUS

3.1 OVERVIEW

Cyprus has no nuclear facilities, of any kind. There are no nuclear facilities in the vicinity of the country that may have a radiological impact on the environment in Cyprus. This situation will however change in the future, due to the construction of the first Turkish nuclear power plant at Akkuyu (100 km away from the Cyprus capital).

A radioactive waste storage facility is located at the Nicosia General Hospital, where only disused radioactive sources are stored.

With respect to the NORM industries, cement production industry is present in the country, at Vasiliko, as well as oil and gas industry, but currently only at the level of exploration.

Other possible sources of radioactivity in the environment exist also across the country, consisting of

- Cyclotron in operation at the German Oncology Center in Lemesos;
- Research laboratories using open sources at the University of Cyprus in Nicosia;
- Diagnostic nuclear medicine departments (both in vivo and in vitro) at the Bank of Cyprus Oncology Center in Nicosia, the German Oncology Center in Lemesos, the Nicosia General Hospital, the Lemesos General Hospital, as well as in other small private centres.

A NORM contaminated area (Vasiliko) is reported as having been remediated in 2020-21. The area was contaminated with phosphogypsum from the operation of a phosphate acid production facility until 1998 and was decommissioned in 2005-2007. The area is not inhabited.

There are no radon prone areas in Cyprus, or areas contaminated with artificial radionuclides.

3.2 NATIONAL LEGAL FRAMEWORK FOR RADIOACTIVITY MONITORING

The main legal document organising the radiological monitoring in Cyprus is the Protection Against Ionizing Radiation and Nuclear and Radiological Safety and Security Law N. 164(I)/2018.

The main regulatory documents include:

- Protection Against Ionising Radiation and Nuclear and Radiological Safety and Security (Basic Safety Standards for the Protection against the Dangers Arising from Exposure to Ionising Radiation) Regulations R.A.A. 374/2018;
- Protection Against Ionising Radiation and Nuclear Safety (Protection of the Health of the General Public from Radioactive Substances in Water Intended for Human Consumption) Regulations R.A.A. 54/2016;
- Protection Against Ionising Radiation and Nuclear and Radiological Safety and Security (Specifications for setting out and implementing a monitoring programme of the quality from radiological point of view of the water intended for human consumption) Notification R.A.A. 365/2019;
- Protection Against Ionising Radiation and Nuclear and Radiological Safety and Security (Specifications, requirements and obligations for building materials and classes or types of practice involving naturally-occurring radioactive material that lead to exposure which cannot be disregarded from a radiation protection point of view) Notification R.A.A. 392/2019;
- National emergency preparedness and response plan in case of nuclear or radiological accident 09/2015.

3.3 INTERNATIONAL LEGISLATION AND GUIDANCE DOCUMENTS

The list below includes the main international legislative and guidance documents issued by the European Union (EU) and the International Atomic Energy Agency (IAEA), that form the basis for environmental radioactivity monitoring, radiological surveillance of foodstuffs and surveillance of radioactive discharges.

Euratom and European Union legislation

- The Euratom Treaty
- 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
- 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
- Council Decision 87/600/Euratom of 14 December 1987 on Community arrangements for the early exchange of information in the event of a radiological emergency
- Regulation (EC) No 178/2002 of the European Parliament and of the Council of 28 January 2002 laying down the general principles and requirements of food law, establishing the European Food Safety Authority and laying down procedures in matters of food safety
- 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
- Council Regulation (EEC) No 2219/89 of 18 July 1989 on the special conditions for exporting foodstuffs and feedingstuffs following a nuclear accident or any other case of radiological emergency
- Council Regulation (EC) No 733/2008 of 15 July 2008 on the conditions governing imports of agricultural products originating in third countries following the accident at the Chernobyl nuclear power station
- Council Regulation (EC) No 1048/2009 of 23 October 2009 amending Regulation (EC) No 733/2008 on the conditions governing imports of agricultural products originating in third countries following the accident at the Chernobyl nuclear power station
- Commission Regulation (EC) No 1609/2000 of 24 July 2000 establishing a list of products excluded from the application of Council Regulation (EEC) No 737/90 on the conditions governing imports of agricultural products originating in third countries following the accident at the Chernobyl nuclear power station
- Commission Regulation (EC) No 1635/2006 of 6 November 2006 laying down detailed rules for the application of Council Regulation (EEC) No 737/90 on the conditions governing imports of agricultural products originating in third countries following the accident at the Chernobyl nuclear power station
- Commission Implementing Regulation (EU) 2016/6 of 5 January 2016 imposing special conditions governing the import of feed and food originating in or consigned from Japan following the accident at the Fukushima nuclear power station and repealing Implementing Regulation (EU) No 322/2014

- 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
- 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
- Commission Recommendation 2003/274/Euratom of 14 April 2003 on the protection and information of the public with regard to exposure resulting from the continued radioactive caesium contamination of certain wild food products as a consequence of the accident at the Chernobyl nuclear power station

International guidance documents, issued mainly by the International Atomic Energy Agency (IAEA)

- *Radiation Protection and Safety of Radiation Sources: International Basic Safety Standards*, IAEA Safety Standards Series No. GSR Part 3, IAEA, Vienna, 2014
- *Clearance of materials resulting from the use of radionuclides in medicine, industry and research*, IAEA-TECDOC-1000, IAEA, Vienna, 1998
- *Generic models for use in assessing the impact of discharges of radioactive substances to the environment*, Safety Reports Series No 19, IAEA, Vienna, 2001
- *Management of radioactive waste from the use of radionuclides in medicine*, IAEA-TECDOC-1183, IAEA, Vienna, 2000
- *Regulatory control of radioactive discharges to the environment: Safety Guide*, Safety Standards Series No. WS-G-2.3, IAEA, Vienna, 2000
- *Sources and effects of ionizing radiation*, United Nations Scientific Committee on the Effects of Atomic Radiation (UNSCEAR) 2000, Report to the General Assembly, Vol. I, United Nations, New York, 2000
- *Guidelines for drinking-water quality: fourth edition incorporating the first and second addenda*, 2022, World Health Organisation (WHO)

4 BODIES HAVING COMPETENCE IN THE FIELD OF ENVIRONMENTAL RADIOACTIVITY MONITORING

4.1 INTRODUCTION

The main authority in Cyprus in charge of monitoring of radioactivity in the environment, in foodstuffs and in drinking water, both in routine and emergency situations, is the nuclear regulatory body, i.e. the Radiation Inspection and Control Service (RICS) within the Department of Labour Inspection (DLI) of the Ministry of Labour and Social Insurance. Samples collected by RICS are measured at the Radioactivity Lab of Food and Environmental Samples of the State General Laboratory (SGL).

Other authorities involved in environmental radioactivity monitoring in Cyprus include:

- Health Services under the Ministry of Health, which are in charge of monitoring of food and drinking water in routine and emergency situations; the samples are measured at the SGL;
- Department of Agriculture, which is in charge of monitoring of food of non-animal origin in emergency situations; the samples are measured at the SGL;
- Veterinary Services, which are in charge of monitoring of food of animal origin in routine and emergency situations; the samples are measured at the SGL;
- Customs and Excise Department, in charge of supporting monitoring of food and feed in emergency situations, in collaboration with the Department of Agriculture and the Veterinary services; the samples are measured at the SGL;
- District Administrations, in charge of monitoring environmental, food and drinking water radioactivity in emergency conditions; the samples are measured at the SGL;
- Department of Fisheries and Marine Research (DFMR), in charge of environmental and food radioactivity monitoring in routine and emergency situations; marine samples are collected in collaboration with RICS and measured at the SGL;
- Department of Water Development, in charge of monitoring of drinking water in routine and emergency conditions; the samples are measured at the SGL;
- Department of Geological Survey, in charge of sampling and measurements of building materials; the samples are measured at their own laboratory and the SGL.

4.2 DEPARTMENT OF LABOUR INSPECTION

Under the Protection Against Ionizing Radiation and Nuclear and Radiological Safety and Security Law N. 164(I)/2018, the Radiation Inspection and Control Service (RICS), within the Department of Labour Inspection (DLI), was established as the regulatory authority for Radiation Protection, Nuclear Safety and Radioactive Waste Management in Cyprus. RICS reports to the Department of Labour Inspection of the Ministry of Labour and Social Insurance (MLSI).

The regulatory authority has the following responsibilities:

- Enforce legislation;
- Perform environmental radioactivity monitoring;
- Report regularly to the European Commission (EC) on the basis of Article 36 of the Euratom Treaty;
- Ensure emergency preparedness and response in the event of a radiological accident;
- Deal with all matters concerning the relations of Cyprus with the EU, the IAEA, and other international organisations in this field.

RICS is presently staffed with four Labour Inspection Officers with engineering and science (medical physics) backgrounds, trained in radiation protection and nuclear safety. RICS has established networks for continuous monitoring of ambient gamma radiation and radioactivity in air, and a

sampling programme for particles in the atmosphere for radioactivity concentration monitoring. RICS has also procured various portable radiation monitoring instruments (alpha, beta, gamma and neutron survey, contamination monitors and portable spectrometers) for inspection and monitoring purposes.

The statutory tasks of RICS to be mentioned in the context of this report are:

1. Protection of radiation workers, the general public and the environment from the use of ionising radiation through implementation of:
   - Monitoring the environmental radioactivity by measuring air, water and soil samples;
   - Management of the personal dosimetry data of radiation workers in Cyprus;
   - Recurrent inspection of all installations handling radioactive materials in the medical, industrial, research, and educational sectors;
   - Licensing of all applications of ionising radiation in the medical, industrial, research and educational sectors;
   - Licensing of import, export, transport, storage, use and disposal of fissile and non-fissile radioactive materials;
   - Licensing of the import and use of radiation producing equipment;
   - Control of scrap metals export and illicit trafficking.
2. Implementation, in compliance with EU Directives, of radiation protection regulations, safety standards and codes of practice for ionising radiation installations;
3. Ensure education and training of radiation workers on radiation protection issues;
4. Environmental radioactivity monitoring;
5. Implementation of emergency preparedness and response plans;
6. Security of sources and combating radiological or nuclear (RN) terrorism activities.

RICS, within its regular radioactivity monitoring programme, has conducted a number of investigations and measurements concerning foodstuffs, animal feeding stuffs, building materials, drinking water, sea water and milk. RICS can perform monitoring throughout the territory of Cyprus and its economic zone, including the offshore oil platforms.

4.3 Civil Defence Emergency Centre

Cyprus is divided into five civil protection districts, each having 5-8 volunteer civil protection officers. The Civil Defence Emergency Centre coordinates civil protection actions in Cyprus and maintains a 24h duty service for emergency situations, including radiological emergencies. This service does not have radiation monitoring and interpretation capability of its own, so it relies on the RICS to provide a monitoring team if needed. The stand-by duty service has a real-time on-line access to the national ambient gamma dose rate monitoring data; the emergency contact details of RICS personnel are available in case a radiological emergency occurs (specific national EPR plan “ELECTRA”).

4.4 Department of Fisheries and Marine Research

The Department of Fisheries and Marine Research (DFMR) collaborates with RICS on marine radioactivity sampling. DFMR main offices are located in Nicosia. District Units are located in Larnaka, Lemesos, Paralimni, Zygi and Paphos. DFMR has an integrated Marine Service for operations at the sea concerning the compliance controls of legislation that the DFMR implements. Four persons from the DFRM are involved in sampling related to the radioactivity monitoring programme, however the DFMR laboratory is not involved in the measurements. All sample (sea water, aquatic biota, sediment and fish) measurements for both routine and emergency monitoring are carried out by the SGL.

5 RADIOACTIVITY MONITORING IN CYPRUS

5.1 AUTOMATIC MONITORING

5.1.1 Radiation dose rate

Cyprus operates an on-line automatic radiation dose rate monitoring network. The network has seven monitoring stations located in Lefkosia (Nicosia), Larnaca, Limassol, Paphos, Paralimni, Polis and Evrychou (red dots in Fig. 1). The stations are equipped with:

- solar panels for providing several days of autonomy in the event of an extended power failure;
- proportional counters for measuring the ambient gamma dose rate in air (with a measuring range of 10 nSv/h-10 Sv/h);
- precipitation meters.

The network is fully automatic. It measures ambient gamma dose rates, detects rain (with the possibility of collection) and triggers alarms if the alarm levels are exceeded. The stations can measure ambient gamma dose rates every minute. They are currently set up to send the measured data to the DLI control centre every 10 minutes.

This network also serves as the country's Early Warning System (EWS) in case of a radiological emergency. Ambient gamma dose rates measured by the monitoring stations are also sent to the Civil Defence Operations Centre in real time. The Civil Defence Operations Centre operates as the 24/7 general warning point of the country.

Every hour, the Telemetric Radiation Monitoring Network automatically sends the one-hour average gamma dose rate values from all stations in Cyprus to the EURDEP data server at the JRC Ispra. Also, air radioactivity concentration data (Cs-137, I-131, artificial alpha and beta radiation and Rn-222/Rn-220) and meteorological parameters are reported to EURDEP. Long-term averages of environmental radioactivity measurements and off-line data are sent to the EC's Radioactivity Environmental Monitoring (REM) database.

In addition to the fixed monitoring stations, the system also comprises a mobile monitoring station, consisting of a standalone portable spectroscopic sodium-iodine (NaI) detector, which can measure the concentration of certain radioisotopes (e.g. K-40, Cs-137, I-131, Te-132, Ba-140, etc.) in the air, and a Geiger-Müller detector to measure the ambient gamma dose rate. The mobile station has a gamma energy range of 30 keV – 3 MeV and dose rate range of 1 nSv/h – 100 mSv/h. It can be installed anywhere in Cyprus. The mobile centre communicates data in real time to the DLI centre.

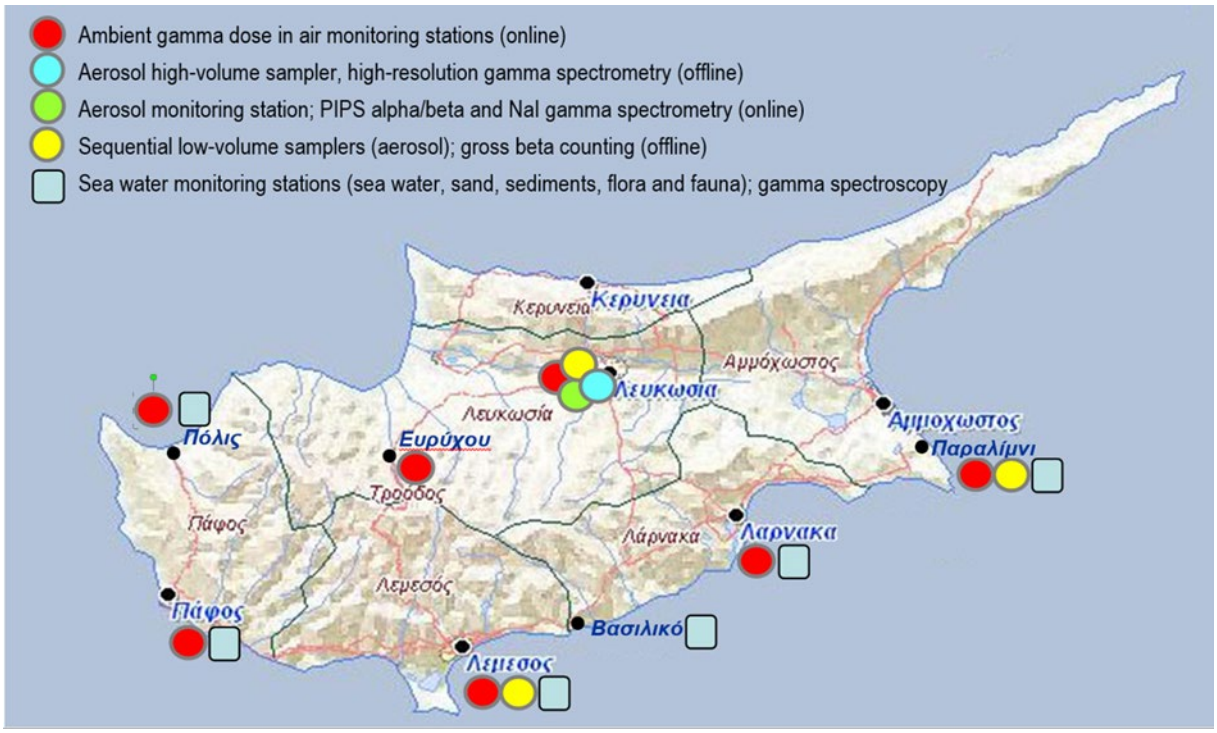

Figure 1. Cyprus radioactivity monitoring network and the marine sampling locations

5.1.2 Radioactivity in air

DLI operates an automatic on-line spectroscopic monitoring system (GIHMM AMS-02) in Nicosia for continuous total alpha, total beta counting and gamma spectrometry measurements in aerosols (green dot in Fig. 1). This system has also capabilities for measuring meteorological parameters (temperature, humidity, atmospheric pressure, wind speed and direction). The system has altogether 500 filters (400 glass fibre and 100 active charcoal), which are changed automatically. The system measures radioactivity on the filters using an electrically cooled HPGe detector, a NaI detector and a PIPS detector. If radioactive iodine is present, active charcoal filters are used. The 2x2" NaI(Tl) detector has 8% relative efficiency and an energy range of 0.06 – 3 MeV. The PIPS silicon detector has a 1,700 mm^2 active surface, 55 keV resolution for the alpha range and 30 keV resolution for the beta range. Typical LLDs (for 24h measurements of filters) are 0.066 Bq/m^3 for I-131 in aerosols, 0.044 Bq/m^3 for gaseous I-131, 0.056 Bq/m^3 for Cs-137, 0.042 Bq/m^3 for alpha activity and 0.052 Bq/m^3 for beta activity.

5.2 ENVIRONMENTAL SAMPLING

5.2.1 Introduction

Besides the automatic monitoring systems, Cyprus operates a monitoring system based on environmental sampling and sample measurements in laboratory. Sampling is conducted by the RICS staff, while sample preparation and measurement is done at the SGL. The sampling and analysis programmes have been designed by the DLI, in close collaboration with the laboratories involved. They are subject to periodic reviews.

5.2.2 Air

Air is monitored through continuous sampling of aerosols and wet atmospheric deposition (rain), followed by periodic measurements. RICS has three low-volume sequential pumps and a high-volume pump, which are used for sampling of air particulates (blue and yellow dots in Fig. 1). Low-volume pumps are loaded with 47 mm nitrate cellulose filters, while the high-volume pump is loaded with a 44x44 cm chlorinated vinyl polychloride filter. The pumps are located in Nicosia (centre), Lemesos (south) and Paralimni (east). The filters are measured at the SGL by gamma spectrometry. Filters from the low-volume pumps are changed every 48 hours, while the filters from the high-volume pump are changed every week.

5.2.3 Atmospheric deposition

Atmospheric deposition samples (rain and dust) are collected at the same locations where the automatic monitoring stations are positioned and are measured two times per year by gamma spectrometry.

5.2.4 Surface water

Sampling of surface water is conducted twice a year in four dams (Kourris, Yermasogeia, Asprokremmos and Kannaviou). Samples are analysed for gross alpha and gross beta radiation, residual beta radiation, as well as for Cs-137, Cs-134 and K-40 concentrations.

5.2.5 Drinking water

Drinking water is monitored regularly in line with the Directive 2013/51/EURATOM on radioactivity in drinking water. Samples of drinking water are taken from water treatment plants, desalination plants, water distribution networks, street water dispensers, springs, etc. Sampling is conducted throughout the year; the samples are analysed for gross alpha and gross beta radiation, as well as for Cs-137, Cs-134 and K-40 concentrations.

5.2.6 Soil

Soil is not included in the routine programme, but capability to carry out soil monitoring exists.

5.2.7 Terrestrial biota

Terrestrial biota is not included in the routine programme, but capability to carry out biota monitoring exists.

5.2.8 Marine

Marine sampling is carried out twice a year by the DFMR at three sampling stations (Polis Chrysochous, Vasilikos and Paralimni). Sea water, beach sand, sediment, seaweed, molluscs and fish are collected and measured by gamma spectrometry at the SGL for artificial radionuclides (Cs-137) and natural radionuclides (U-238 and Ra isotopes in the areas of interest for NORM); beach sand is measured for additional gamma emitting radionuclides.

5.3 FOOD SAMPLING

5.3.1 Milk

Quarterly sampling of milk is conducted at the milk processing plants in Nicosia and Limassol. Milk is measured by Sr-separation and gamma spectrometry. The main monitored radionuclides are Cs-137, Cs-134, Sr-90 and K-40.

5.3.2 Fish

Fish is sampled twice a year from Polis Chrysochous, Vasilikos and Paralimni. Analysis of samples is performed by SGL. The main monitored radionuclides are Cs-137, Cs-134 and K-40.

5.3.3 Other

A routine programme for monitoring foodstuffs and mixed diet is in place. It covers prepared meals, wild berries, game, mushrooms, cereals, vegetables, baby milk and creams, freshwater and sea water fish etc. RICS regularly collects samples of infant food, cereals, locally produced and imported cheese and flour. The SGL conducts the laboratory analysis for these samples.

Food imports are declared by the Customs to RICS, which decides on whether such imports should be sampled and measured by the SGL. Samples of imported milk, infant food, water and cheese are currently analysed. In the future sampling of imported meat, cereals, animal feed etc. is planned. Certificates for imported foodstuffs from third countries are issued.

Animal feeding stuff is not routinely monitored. Capability to carry out animal feeding stuffs monitoring exists in the country.

5.4 EMERGENCY MONITORING

Monitoring of radioactivity in the environment in the event of an emergency is carried out by the DLI inspectors, in collaboration with various other governmental authorities participating the national emergency preparedness and response plan ELECTRA. The DLI has a large collection of portable radiation dose rate meters, nuclide identification devices and surface contamination monitors. In addition, there is one mobile gamma spectrometry system for in-situ measurements. The DLI inspectors can also collect environmental samples from the affected area for analysis at the SGL.

Fire Service and Police have limited capability to measure radiation dose rates, as well as surface contamination, and to identify nuclides. However, in case of an emergency it is within the competence of the DLI to perform analytical radiological assessment. The Civil Defence does not have such capabilities.

Radioactivity in air is monitored by the air sampling systems. The AMS system in Nicosia is capable of monitoring also gaseous radioactive iodine.

5.5 INFORMATION FOR THE GENERAL PUBLIC

The public in Cyprus is informed about environmental radioactivity in both normal and emergency situations. There is information transmitted on-line, in real time, as well in the form of periodic reports (also posted on-line on the nuclear regulatory body website[3]).

The operators of facilities discharging radioactivity in the environment and the nuclear regulatory body are in charge of informing the public, in normal as well as in accident conditions.

RICS/DLI has launched in April 2018 a radiation monitoring website[4] where the ambient gamma dose rates, the concentrations of I-131, Cs-137, Cs-134, Rn-222 and Rn-220 in air, as well as the meteorological parameters in the locations of the automatic monitoring stations are recorded and can be consulted in real time. Data is also available in real time with no validation at the EURDEP and IRMIS sites. On the same website, 5-year reports issued by the RICS on the environmental radioactivity monitoring results can be consulted and downloaded. The reports include the measured values, the doses to the public estimated based on these results, details about the monitoring program, as well as interpretation of the measured values.

[3] www.mlsi.gov.cy/dli

[4] https://radiation.dli.mlsi.gov.cy/

6 LABORATORIES PARTICIPATING IN ENVIRONMENTAL RADIOACTIVITY MONITORING PROGRAMMES IN NICOSIA

6.1 STATE GENERAL LABORATORY

The only certified radiological monitoring laboratory in Cyprus is the State General Laboratory for Food and Environmental Radioactivity, which is involved in routine and emergency monitoring of:

- Air: aerosols, rain;
- Water: ground, surface, drinking and sea water;
- Aquatic biota: seaweed, fish;
- Vegetation: e.g. vegetables, fruits, grain, grass, wild berries, mushrooms;
- Food: e.g. milk, meat, fish, game, mixed diet, infant food, cheese, flour;
- Supplements for feeding stuff.

The laboratory holds an accreditation for ISO 17025:2017 for gamma spectrometry (energy range 60-1836 KeV) in food and environmental samples. It is recognized by the nuclear regulatory body. SGL laboratory is also a member of the IAEA ALMERA network. It has in total 170 staff members in 19 laboratories (dealing with chemical, biological, microbiological, toxicological and radiological controls in Cyprus). Two staff members are currently working in the radioactivity measurements laboratory.

The laboratory is equipped with:

- Two gamma spectrometry systems with HPGe detectors, with relative efficiencies of 40% and 50% and 60-1836 keV energy range;
- 6-chamber alpha spectroscopy system, with 40% relative efficiency;
- Proportional counter for gross alpha/beta measurements (alpha particles with energies above 3.9 MeV, beta particles with maximum energies above 0.1 MeV), with relative efficiencies of ~20% for alpha particles and ~40% for beta particles, typical LLD is 0.04 Bq/l for gross alpha and 0.06 Bq/l for gross beta measurements;
- Liquid scintillator counter, with an alpha counting window of 50-600 keV and beta counting window of 10-600 keV and relative efficiencies of ~ 88% for alpha and ~ 93% for beta; the measuring method is under development (intended for monitoring of water); typical LLD is 0.04 Bq/l for gross alpha, <0.4 Bq/l for gross beta (measurements on drinking water samples).

The proportional counter and the gamma spectrometry systems are also available for monitoring in emergency situations.

6.2 DEPARTMENT OF LABOUR INSPECTION

The RICS of the Department of Labour Inspection has its own small laboratory in Nicosia, which performs occasional measurements on imports and exports of food, as well as dose rate measurements and identification of radioactive sources in emergency situations. The laboratory is not accredited. RICS staff consists of four persons, who are also dealing with RICS laboratory issues.

The available equipment consists of:

- Gamma spectrometry system with a HPGe detector with 40% relative efficiency and 50 keV – 3 MeV energy range; typical LLD is generally < 1 Bq/m^3;
- Portable gamma spectroscopy system with 40% relative efficiency and 20 keV – 3 MeV energy range; typical LLD is generally < 1 Bq/m^3;

- Three sodium-iodide high-efficiency food and contamination monitors with 8.5% relative efficiency and 50 keV – 3 MeV energy range (1 L Marinelli geometry, 1 hour counting);
- Geiger-Mueller detector for ambient gamma dose rate measurements, with a measurement range of 10 nSv/h – 10 Sv/h;
- Several hand-held dose rate meters for the measurement of ambient gamma dose rate and radionuclide identification (including back-packs for field emergency monitoring);
- Several hand-held contamination monitors for measurements of artificial contamination.

All RICS equipment can be used in emergency situations too.

7 VERIFICATIONS

7.1 INTRODUCTION

Verifications were carried out in accordance with the agreed programme (Annex 1). This chapter summarises the verifications carried out the by the verification team. The team has assessed the monitoring arrangements based on their own expertise and comparison with similar arrangements in other Member States.

The outcome of the verification is expressed as follows:

- A '*Recommendation*' is made when there is a clear need for improvement in implementing Art. 35. These are included in the main conclusions of the verification. The Commission requests a report on the implementation of the recommendations – lacking implementation of a recommendation can lead to a reverification.
- A '*Suggestion*' is made when the verification team identifies an action, which would further improve the quality of the monitoring.

In addition, the team may '*commend'* particularly good arrangements, which could serve as a best practice indicator for the other EU Member States.

7.2 DEPARTMENT OF LABOUR INSPECTION

7.2.1 Monitoring programme

The verification team verified the structure of the environmental radioactivity monitoring programme in Cyprus (Chapter 5.2). The team notes that the current programme is sufficient to cover the most relevant environmental compartments, but there is room for improvement both in terms of sampled media and sampling frequencies.

The verification team suggests increasing the monitoring frequency of surface water and mixed diet to at least quarterly, in line with Regulation 2000/473/Euratom[5].

The verification team suggests more frequent monitoring of atmospheric deposition (dust and rain).

The verification team suggests monitoring of radioactivity also in animal feedstuffs on a regular basis.

The verification team suggests including soil and/or terrestrial biota in the annual sampling programme.

[5] Commission recommendation of 8 June 2000 on the application of Article 36 of the Euratom Treaty concerning the monitoring of the levels of radioactivity in the environment for the purpose of assessing the exposure of the population as a whole, (OJ L 191, 27.7.2000, p. 37–46)

7.2.2 Fixed monitoring equipment

DLI office

The verification team verified the following fixed monitoring systems located at the roof of the DLI office in Nicosia (Fig. 2 and 3):

- Low-volume air sampler with a flow rate of 3 m^3/h (which can be increased up to 6 m^3/h) and automatic filter change (Sven Leckel SEQ47/50 low-volume air sampler). This device has an automatic system for changing filters; currently filters are changed every 48 hours. The filter cartridge, which has a 15-filter capacity, is changed every 30 days by the RICS staff. Analysis is carried out at the SGL. The system is equipped with an internal memory card recording the flow data for each filter along with temperature and atmospheric pressure data. Flow meter calibration has been carried out by an external contractor.
- Dose rate monitor ENVINET SARA IGS71x. This is a standard station of the monitoring network, equipped with a solar panel providing power autonomy to the station. It is able to provide the NaI gamma spectrum and gamma dose rate (Ambient Dose Equivalent rate H*(10)). A special heat shield is installed to protect the detector from excessive heat during the summer.
- BITT RS04/X Gammameter and its data logging unit WEBDL2, which are also used in the automatic monitoring network. This detector is based on a proportional counter, allowing an extremely large measurement range of gamma dose rate (10 nSv/h – 10 Sv/h). A special heat shield is installed to protect the detector from excessive heat during the summer.
- Precipitation monitor
- AMS station BITT AMS02 located in an air-conditioned container. The system is equipped with particulate as well as charcoal filters for measurement of gaseous radioactive iodine. The system alarm threshold is set at 300 nSv/h. The system was originally equipped with two NaI detectors, but it has been upgraded recently with the replacement of one of these detectors with an electrically cooled HPGe detector.

In addition, the team witnessed a demonstration of the data centre website, which compiles the data received from the dose rate monitoring network. The data is provided also to the EURDEP system.

No remarks.

Figure 2. Continuous monitoring equipment at the DLI office roof (Sven Leckel SEQ47/50 low-volume air sampler, BITT RS04/X Gammameter with data logging unit and ENVINET SARA Dose rate monitor)

Figure 3. Continuous monitoring equipment at the DLI office roof (BITT AMS02 automatic radioactivity monitoring station)

Civil protection depot in Nicosia

Outside central Nicosia, the team verified the high-volume air sampler POLON-IZOT ASS-500, which is located in an industrial area at the local civil protection depot (Fig. 4). This device has a large 45x45 cm filter; typically, the airflow is between 450 and 850 m^3/h depending on the amount of dust on the filter. The system is equipped with a flow meter, and it records the total air flow volume. The filter is changed every 10 days, more frequently during an emergency. Calibration of the flow counter is performed every 10 years. The system has no electrical back-up.

No remarks.

Figure 4. High-volume air sampler POLON-IZOT ASS-500

7.2.3 Counting equipment

The DLI does not have an actual radiological laboratory, but it has a few laboratory devices, which can be used for qualitative analysis of radiological samples (Fig. 5). The verification team verified the availability of the following equipment:

- HPGe-detector Ortec (1)
- Portable HPGe-detector Canberra (1)
- NaI spectrometer Atomtex (3)

These devices are available and in good condition, but there is no formalised system (written procedures) nor necessary calibrations for carrying out quantitative measurements; the DLI does not have dedicated personnel for this type of work either. The actual analytical work for the radiological monitoring programme is carried out by the SGL.

> *The verification team recommends that the DLI considers, whether it needs an in-house radiological laboratory. If so, dedicated personnel should be made available and operation of the devices duly formalised and documented.*

Figure 5. Counting equipment at the DLI office
(Ortec HPGe-detector, Atomtex NaI-detector and Canberra portable HPGe-detector)

7.2.4 Mobile monitoring equipment

The verification team verified the following mobile monitoring equipment available at the DLI office in Nicosia (Fig. 6 and 7):

- Radiation monitoring backpack Atomtex (2)
- RIIDEye NaI nuclide identification device (2)
- RadEye B20 Survey meter (8)
- RadEye DRD-EP dose rate monitor (20)
- Flir Identifinder R400 (NaI) nuclide identification device (1)
- RadEye SPRD-GN spectroscopic radiation detector (2)
- Canberra Inspector 1000 (2)
- Canberra Radiagem contamination detector (3)
- Berthold LB 124 Surface contamination monitor (3)
- Electrically cooled Fulcrum HPGe Gamma-ray Spectrometers (2)
- Thermo TrueDose personal radiation dosimeters (20)
- RadonEye radon monitors for indoor radon measurements (3).

The equipment is available and in good condition (mostly in original factory packages). The verification team was informed, that currently the DLI does not have enough personnel to effectively operate the large number of mobile monitoring devices. The DLI would benefit from a more systematic approach to equipment management, for example by establishing written measurement instructions and a maintenance system for the equipment.

The verification team noted that there is no mobile capability to detect gaseous radioactive iodine in air. Fixed capability is available (BITT AMS02 system).

The verification team recommends that the DLI builds a formalised system and drafts written instructions for the maintenance and operation of the mobile monitoring devices in the event of a radiological emergency.

The verification team recommends that the DLI trains more staff (internal and external) for the operation of the mobile monitoring devices.

The verification team suggests development of mobile capability to detect gaseous radioactive iodine in air (portable air sampler with a charcoal filter).

The verification team commends the quality and number of mobile monitoring equipment available at the DLI.

Figure 6. Hand-held radiation monitors at the DLI (RIIDEye NaI Nuclide identification device, RadEye B20 Survey meter and RadEye SPRD-GN Spectroscopic radiation detector)

Figure 7. Hand-held radiation monitors at the DLI (Berthold LB 124 Surface contamination monitor, Flir IdentiFINDER R400 Nuclide identification device and Fulcrum electrically cooled portable HPGe-gamma spectroscopy systems)

7.2.5 Future developments

The verification team was informed, that the DLI is in process of implementing the following new monitoring equipment (Fig. 8):

- Two new automatic medium-volume air monitoring stations, type GIHMM ASU200, will soon be installed in Paralimni and Inia. The systems use two sequential filters of 240 mm diameter, one fibreglass (particulate gamma) and one charcoal (gaseous iodine), which are changed every second week and every fourth week respectively. The systems will also have capabilities for measuring meteorological parameters (temperature, humidity, atmospheric pressure, wind speed and direction). The systems measure the radioactivity on the filters using a 1.5x1.5" $LaBr_3$(Ce) detector.
- New automatic dry/wet atmospheric deposition collector is in preparation for installation.
- Three automatic radiation monitors mounted on sea surface buoys for monitoring artificial gamma radiation in the marine environment around Cyprus.

The verification team was informed, that staff training for the new equipment has not yet been initiated.

The verification team commends the quality of the new equipment.

Figure 8. New monitoring equipment, which are being implemented for operational use (Wet/dry atmospheric deposition sampler and medium-volume continuous air sampler)

7.3 STATE GENERAL LABORATORY

7.3.1 Radiological laboratory

The verification team visited the radiological laboratory of the State General Laboratory[6]. Apart from university nuclear and radiation physics laboratories, this is the only radiological laboratory in Cyprus. The arrangements for measuring radioactivity in environmental samples, food and drinking water were verified.

The laboratory is well organised and operates in a very professional manner. It has accreditation for measuring gamma radioactivity in food and environmental samples. There is a co-operation protocol with the DLI for carrying out the analytical work of the environment monitoring programme. The work is financed from the SGL general budget. The work can include analysis of mixed diet, soil, grass, seaweed, milk and feeding stuffs. In addition, radioactivity is measured in some private (commercial) samples (supplements for feeding stuff for export).

The laboratory equipment (Fig. 9, 10 and 11) includes two Ortec HPGe-detectors (one was out of order during the verification), an alpha spectroscopy system (Canberra Alpha Analyst, not operational), liquid scintillation counter (Quantulus GCT 6220) and a proportional counter[7] (measurement of low-volume air filters).

The existing analysis capabilities are sufficient for a routine programme. However, the laboratory measurement capacity would not be sufficient in an emergency situation, when the number of samples to be measured would significantly increase. Also, the number of trained staff is insufficient for this type of situation. The verification team was informed, that the SGL does not have sufficient space for storing and managing increased number of incoming (radioactive) samples in the event of an emergency. By reducing the counting times the laboratory capacity could be increased to facilitate higher sample throughput, but there is no formalised plan for this type of situation.

The verification team noted that the SGL has no back-up equipment for any of the main counting systems and the radionuclide laboratory operates in a very limited space. Due to the financial

[6] 44 Kimonos Str., Acropolis, 1451 Nicosia

[7] The verification team was informed, that this device will be replaced in the near future.

constraints, the plans for building a new laboratory building have been delayed and the funds for new equipment are very limited.

The verification team noted that the sample preparation for food and mixed diet samples does not include drying or ashing the samples. The mixed diet sample preparation procedure does not require mixing all daily meals together in one sample.

The verification team recommends, that the SGL drafts an internal preparedness plan for laboratory operation in an emergency situation, taking into account the increased number of incoming environmental and food samples with radioactive contamination. The plan should outline the methods for storing samples and avoiding contamination of the laboratory facilities.

The verification team recommends restoring the alpha spectroscopy capability as soon as possible.

The verification team suggests improvement of the SGL radiological analytical capacity by acquiring back-up counting systems for gamma and alpha spectroscopy.

The verification team suggests ensuring laboratory capabilities to monitor Sr-90 in foodstuffs and H-3 in drinking water, in view of the planned operation of an NPP in a nearby country.

The verification team suggests that the SGL reviews the food and mixed diet sample preparation procedures to be in line with the current best practise (combining all three daily meals, including beverages, in one sample; drying/ashing the sample before counting).

Figure 9. Automatic proportional counter system for measuring air filters and two HPGe-gamma spectrometers at the SGL radiological laboratory

Figure 10. Alpha spectroscopy system at the SGL radiological laboratory

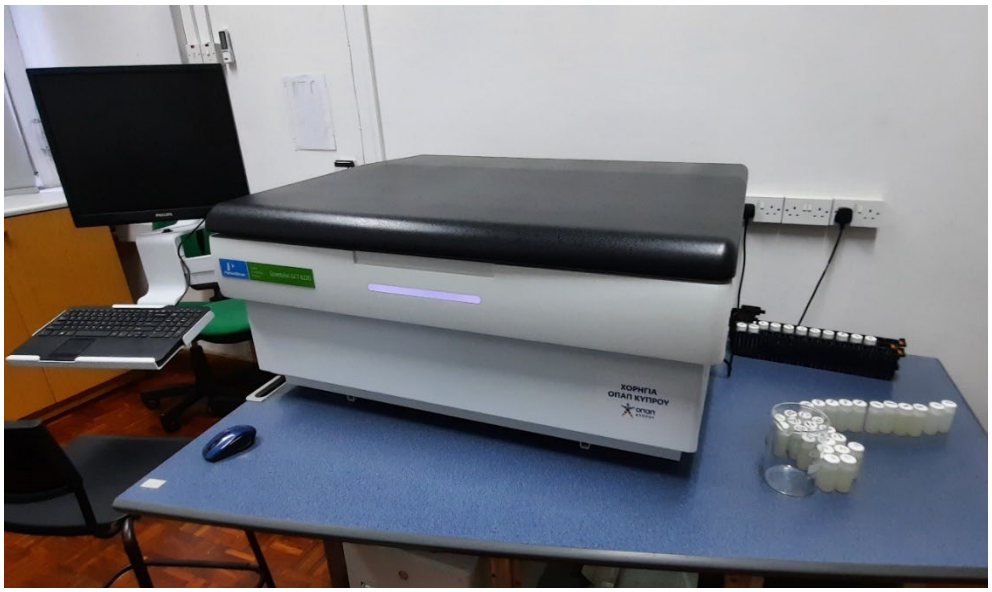

Figure 11. Liquid scintillation counter at the SGL radiological laboratory

7.4 Civil Defence Operations Centre

The verification team visited the Civil Defence Operations Centre[8], which provides a 24h stand-by duty service. The centre is also the ECURIE contact point in Cyprus. It has access to data from the automatic dose rate monitoring network. Alarm thresholds are 200 and 400 nSv/h.

The verification team noted that the centre receives dose rate data from the Cyprus national network, but it has no access to the European dose rate data exchange platform (EURDEP).

> *The verification team suggests providing the Civil Defence Operations Centre access to the restricted EURDEP website.*

[8] John Kennedy 23, 2314 Lakatamia, Nicosia

8 CONCLUSIONS

All planned verification activities were completed successfully. The information supplied in advance of the visit, as well as the additional documentation received during and after the verification activities, proved very 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 monitoring of levels of radioactivity in air, water and soil in Nicosia and in its vicinity are adequate. The Commission could verify the operation and efficiency of a representative part of these facilities.

(2) The verification activities that were performed demonstrated that the facilities necessary to carry out monitoring of levels of radioactivity in air, water and soil in Nicosia in the event of a radiological emergency are adequate. The Commission could verify the availability of a representative part of these facilities.

(3) Five recommendations and a few technical suggestions are formulated. Notwithstanding these remarks, the verified parts of the monitoring system for environmental radioactivity in place is in conformity with the provisions laid down under the Article 35 of the Euratom Treaty.

(4) The verification summary is presented in the 'Main Conclusions' document that is addressed to the Cypriot competent authority through the Permanent Representative of Cyprus to the European Union.

(5) The Commission services kindly request the Cypriot authorities to submit, before the end of 2024, a progress report on how the team's recommendations have been implemented, and on any significant changes in the set-up of the monitoring arrangements, in particular installation of the new monitoring systems (Chapter 7.2.5). Based on this report the Commission will consider the need for a follow-up verification.

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

ANNEX 1

VERIFICATION PROGRAMME

EURATOM ARTICLE 35 VERIFICATION IN CYPRUS

(NICOSIA)

8 – 10 MARCH 2023

PROGRAMME

Wednesday 8 March

09.30 **Opening meeting at the Department of Labour Inspection (DLI)**
(12 Apellis str., CY-1080 Nicosia)

- Welcome and introduction
- European Commission Art. 35 verification activities and programme of the verification mission
- Discussion on the past verifications in Cyprus by the Commission
- Other presentations
- Verification planning

11.00 **Overview of radioactivity monitoring arrangements in Cyprus and in Nicosia**

- Dose and dose rate monitoring
- Air sampling
- Dry/wet deposition sampling
- Soil sampling
- Water sampling
- Food stuff and feeding stuff sampling
- Mobile monitoring systems
- Emergency monitoring systems
- Public information arrangements

13.30 **Verifications at the Department of Labour Inspection (DLI)**
(*12 Apellis str., CY-1080 Nicosia)*

- Routine monitoring equipment
- Emergency monitoring equipment
- Laboratory

Thursday 9 March

10.00 **Verifications of fixed monitoring systems in Nicosia**

- Automatic dose rate monitors
- Air samplers
- Other

13.30 **Verifications at the Civil Defence Operations Centre**
(John Kennedy 23, 2314 Lakatamia, Nicosia)

- Early warning system

Friday 10 March

09.30 **Verifications at the State General Laboratory (SGL)**
(44 Kimonos Str., Acropolis, 1451 Nicosia)

- Radiological laboratory

13:30 **Review of Cyprus data in the Commission Art. 35 database**

15.00 **Closing meeting at the Department of Labour Inspection (DLI)**
(12 Apellis str., CY-1080 Nicosia)