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

ITALY

Rome

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

15 – 18 November 2022

Reference: IT 22-05

VERIFICATIONS UNDER THE TERMS OF ARTICLE 35

OF THE EURATOM TREATY

FACILITIES	- Facilities for monitoring environmental radioactivity in Rome - Facilities for monitoring food radioactivity in Rome - Associated analytical laboratories
LOCATIONS	- Rome and the surrounding area
DATES	15 – 18 November 2022
REFERENCE	IT 22-05
TEAM MEMBERS	Mr Vesa Tanner, DG ENER (team leader) Ms Elena Luminita Diaconu, DG ENER
REPORT DATE	27 October 2023
SIGNATURES	

V. Tanner E.L. Diaconu

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Legend

Abbreviation	Explanation
ARPA	Regional Environmental Protection Agency
APPA	Autonomous Provinces Environmental Protection Agency
CBRN	Chemical, Biological, Radiological and Nuclear
CEVaD	Data Elaboration and Evaluation Centre
CNVVF	National Fire and Rescue Service of Italy
CRNR	National reference center for radioactivity research
CTBTO	Comprehensive Nuclear Test Ban Organisation
EC	European Commission
EU	European Union
EURDEP	EUropean Radiological Data Exchange Platform
ENEA	Italian National Agency for New Technologies, Energy and Sustainable Economic Development
EuSoft Lab	Cloud Database
GPS	Global Positioning System
GAMMA	Early warning automatic network operated by ISIN
HPGe	High-purity Germanium (detector)
IAEA	International Atomic Energy Agency
IARMA	International Atomic Reference Material Agency
ICP-MS	Inductively Coupled Mass Spectrometer
IIZZS	Experimental Zoo-Prophylactic Institutes
ISIN	Inspectorate for Nuclear Safety and Radiation Protection
IRP	ENEA Radiation Protection Institute
IRP-SFA	Laboratory for radiological and environmental surveillance, ENEA Casaccia
IRP-DOS	Laboratory for dosimetry, ENEA Casaccia
IZSLT	Istituto Zooprofilattico Sperimentale del Lazio e della Toscana « M. Aleandri »
JRC	Joint Research Centre (EC)
LIMS	Laboratory Information Management System
LSC	Liquid Scintillation Counting
MDA	Minimum Detectable Activity
NETRAD	Network for detection of radioactivity in the air at national level operated by the CNVVF
NPP	Nuclear Power Plant
NCP	Multi-Year National Control Plan
PIPS	Passivated Implanted Planar Silicon (detector)
SINRAD	National data base of the RESORAD network
TAPIRO	Fast neutron source reactor operating at the Casaccia Research Center
TLD	ThermoLuminiscent Dosimeter
TRIGA	Training, Research, Isotopes, General Atomics Reactor (Mark II reactor)
UPS	Uninterrupted Power Supply

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 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 Commission notified Italy of its decision to conduct an Article 35 verification in a letter addressed to the Permanent Representation of Italy to the European Union. The Italian Government subsequently designated the Inspectorate for Nuclear Safety and Radiation Protection (ISIN) to lead the preparations for this visit.

2.2 DOCUMENTS

To assist the verification team in its work, the Italian Inspectorate for Nuclear Safety and Radiation Protection supplied an information package in advance[3]. Additional documentation was provided during and after the visit. The information provided was used extensively in drawing up the descriptive sections of this report.

2.3 PROGRAMME OF THE VISIT

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

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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)*

3 *Replies to the preliminary information questionnaire addressed to the national competent authority, received on 7 November 2022*

The opening meeting held at the ISIN Headquarter in Rome included presentations on the following:

- Commission Article 35 verification programme
- The roles of Italian authorities involved in environmental monitoring in Italy and Rome
- National network for environmental radioactivity surveillance
- Environmental radioactivity monitoring in Italy and Rome
- Emergency monitoring arrangements in Rome

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:

Inspectorate for Nuclear Safety and Radiation Protection (ISIN)

- Sonia FONTANI, Dr. - Art. 35 and 36 Euratom Treaty contact person – Responsible of environmental radioactivity Section, Radiological Area, Radioprotection, radioactive source, environmental radioactivity and radiometric laboratory Service
- Valeria INNOCENZI, Dr. – Environmental radioactivity Section, Radiological Area, Radioprotection, radioactive source, environmental radioactivity and radiometric laboratory Service
- Giuseppe MENNA, Dr. – Environmental radioactivity Section, Radiological Area, Radioprotection, radioactive source, environmental radioactivity and radiometric laboratory Service
- Stefano ZENNARO, Dr. – Radiological Area, Radioprotection, radioactive source, environmental radioactivity and radiometric laboratory Service
- Leandro MAGRO, Dr. – Responsible of radiometric laboratory Section, Radiological Area, Radioprotection, radioactive source, environmental radioactivity and radiometric laboratory Service
- Daniela CONTI, Dr. – Radiometric laboratory Section, Radiological Area, Radioprotection, radioactive source, environmental radioactivity and radiometric laboratory Service
- Sara MARIANI, Dr. – Radiometric laboratory Section, Radiological Area, Radioprotection, radioactive source, environmental radioactivity and radiometric laboratory Service
- Carmelina SALIERNO, Eng. – Section for use of radiation sources, Radiological Area Radioprotection, radioactive source, environmental radioactivity and radiometric laboratory Service
- Silvia SCARPATO, Dr. – Delegate of the Director for the management of nuclear and radiological emergencies

Ministry of Environment and Energetic Security

- Margherita ARPAIA, Dr. – Head of IV Division – Acoustic, electromagnetic and ionizing radiation pollution, Directorate-General for environmental assessments, Sustainable development Department

Ministry of Health

- Anna BALSAMO, Eng. – Directorate-General for health prevention
- Angela CONIGLIO, Dr. – Directorate-General for health prevention
- Alessandro MAGLIANO, Dr. – Directorate-General for health prevention

Ministry of Interior – National Fire and Rescue Service

- Sergio SCHIAROLI, Arch. – Head of contrast CBRN risk and specialized service office
- Damiano ZURLO, Eng. – Responsible of the CBRN National Centre

ENEA, Casaccia Research Centre, Radiation Protection Institute, Laboratory for radiological and environmental surveillance (IRP-SFA)

- Ignazio VILARDI, Dr. – Laboratory manager
- Enrico BORRA, Dr. – Researcher and Radioprotection expert of the laboratory
- Alessandro RIZZO, Dr. – Researcher and Radioprotection expert of the laboratory
- Luciano SPERANDIO, Dr. – Researcher and Radioprotection expert of the laboratory
- Lorenzo FLORITA, Mr. – Technician and Radioprotection expert of the laboratory
- Giuseppe ANTONACCI, Mr. – Technician
- Massimo ASTARITA, Mr. – Technician
- Nadia DI MARCO, Ms. – Technician
- Giovanna LA NOTTE, Ms. – Technician
- Valerio PUDDU, Mr. – Technician
- Stefano RUSCITTI, Mr. – Technician
- Luigi SCARAMUZZO, Mr. – Technician
- Francesca ZAZZARON, Ms. – Technician

ARPA Lazio

- Giorgio EVANGELISTA, Dr. - Head of radiometric measurements at the ARPA Lazio Radioactivity laboratory in Viterbo

IZS Lazio e Toscana

- Olga LAI, Dr. – Technical Director
- Antonella NARDONI, Dr. – Technician
- Lorenza DIONISI, Ms. – Technician

3 LEGAL FRAMEWORK FOR RADIOACTIVITY MONITORING IN ITALY

3.1 NATIONAL LEGISLATION

3.1.1 Legislative acts regulating environmental radioactivity monitoring

The following legal texts regulate environmental radioactivity monitoring in Italy:

- Legislative Decree No. 101/2020 "Implementation of Directive 2013/59/EURATOM, which establishes basic safety standards relating to protection against the dangers deriving from exposure to ionizing radiation, and which repeals Directives 89/618/EURATOM, 90/641/EURATOM, 96/29/EURATOM, 97/43/EURATOM and 2003/122/EURATOM and reorganization of the sector regulations in implementation of article 20, paragraph 1, letter a), of law no. 117 of 4 October 2019“
  https://www.normattiva.it//uri-res/N2Ls?urn:nir:stato:decreto.legislativo:2020;101
- Legislative Decree No. 45/2014 “Implementation of the Council Directive 2011/70/Euratom, establishing a Community framework for responsible and safe management of spent fuel and radioactive waste
  https://www.normattiva.it/uri-res/N2Ls?urn:nir:stato:decreto.legislativo:2014;045
- Legislative Decree No. 137/2017 “Implementation of the Council Directive 2014/87/Euratom amending the Directive 2009/71/ Euratom establishing a Community framework for the nuclear safety of nuclear installations”
  https://www.normattiva.it//uri-res/N2Ls?urn:nir:stato:decreto.legislativo:2017;137
- In the Lazio region, the environmental radioactivity monitoring program is established in Regional Deliberation (Delibera Giunta Regionale) No.39 of 28/01/2021

  https://www.lazioinnova.it/app/uploads/2021/02/DD_G00798_28_01_2021_15comuni.pdf

3.1.2 Legislative acts regulating radiological surveillance of foodstuffs

The following legal texts regulate foodstuffs radioactivity monitoring in Italy:

- Legislative Decree No. 101/2020 "Implementation of Directive 2013/59/EURATOM, which establishes basic safety standards relating to protection against the dangers deriving from exposure to ionizing radiation, and which repeals Directives 89/618/EURATOM, 90/641/EURATOM, 96/29/EURATOM, 97/43/EURATOM and 2003/122/EURATOM and reorganization of the sector regulations in implementation of article 20, paragraph 1, letter a), of law no. 117 of 4 October 2019 “
  https://www.normattiva.it//uri-res/N2Ls?urn:nir:stato:decreto.legislativo:2020;101
- Legislative Decree No. 28/2016 “Implementation of Directive 2013/51/Euratom laying down requirements for the protection of public health in relation to radioactive substances in water intended for human consumption”
  https://www.normattiva.it//uri-res/N2Ls?urn:nir:stato:decreto.legislativo:2016;028
- Commission Implementing Regulation (EU) 2020/1158 of 5 August 2020 on the conditions governing imports of food and feed originating in third countries following the accident at the Chernobyl nuclear power station
  https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:32020R1158&from=EN

3.1.3 Legislative acts regulating emergency monitoring

The following legal texts regulate emergency radioactivity monitoring in Italy:

- Presidential Decree Council of Ministers n. 898, March 14, 2022 "Adoption of the National Plan for radiological and nuclear emergencies”
- National Plan for management of radiological and nuclear emergencies, in accordance with art. 182, c. 2, Legislative Decree No. 101/2020.

https://www.protezionecivile.gov.it/it/normativa/decreto-del-presidente-del-consiglio-dei-ministri-n-898-del-14-marzo-2022

- Legislative Decree No. 01/2018 "Civil Protection Code" https://www.normattiva.it/uri-res/N2Ls?urn:nir:stato:decreto.legislativo:2018-01-02;1
- Legislative Decree No. 101/2020 as above (in particular Capo XIV)
- Legislative Decree 8 March 2006 n. 139 Reorganization of the provisions relating to the functions and tasks of the National Fire Brigade, pursuant to article 11 of law no. 229. https://www.normattiva.it/uri-res/N2Ls?urn:nir:stato:decreto.legislativo:2006-03-08;139
- DCEMER Circular no. 6 of 22/05/2002: Traditional and unconventional intervention scenarios - Organization of the response of the C.N.VV.F. to chemical, biological, nuclear and radiological emergencies
- DCF Circular no. 5 of 13/05/2004: Maintenance and retraining in the CBRN area
- DCF Note no. 3914 of 31/01/2020: Guidelines for the development of the skills of the operating staff in the CBRN sector https://olympus.uniurb.it/index.php?option=com_content&view=article&id=23622:vf3914 2020&catid=6&Itemid=137
- DCEMER Circular no. 1 of 28/02/2020 Reorganization of the Regional Mobile Columns and of the mobilization device for national disaster https://www.uilpavvf.com/wp-content/uploads/2020/02/EM-01-2020-Riorganizzazione-delle-Colonne-Mobili-Regionali-e-del-dispositivo-di-mobilitazione-per-calamit%C3%A0-nazionale.pdf

3.2 INTERNATIONAL LEGISLATION AND GUIDANCE DOCUMENTS

The lists below include 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.

3.2.1 Euratom and European Union legislation

- 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

3.2.2 International guidance documents

- *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
- *Handbook of parameter values for the prediction of radionuclide transfer in temperate environments*, Technical Reports Series No 364, IAEA, Vienna, 1994
- *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*, 4th ed. Fourth edition incorporating the first and second addenda 2022, World Health Organisation (WHO)

4 BODIES HAVING COMPETENCE IN THE FIELD OF ENVIRONMENTAL RADIOACTIVITY MONITORING IN ROME

4.1 INTRODUCTION

Environmental monitoring is performed in Italy at national, regional, and local levels.

At national level, monitoring of radioactivity is performed by the National Inspectorate for Nuclear Safety and Radiation Protection (ISIN), which is an independent regulatory authority responsible for nuclear safety and radiation protection.

At regional level, regions and autonomous provinces are responsible for regional radioactivity monitoring in the environment and foodstuffs. The regional monitoring programs are implemented by the ARPA/APPA laboratories. The Lazio Region is responsible for the regional radioactivity monitoring in Rome though the ARPA Lazio laboratory.

At local level or site-specific source monitoring, a local radioactivity program is developed to monitor radioactivity in air, water, soil and foodstuffs. In Rome, local environmental radioactivity monitoring is carried out by the Laboratory for radiological and environmental surveillance (IRP-SFA) of the Radiation Protection Institute of ENEA Casaccia Research Centre.

4.2 MINISTRIES

The Ministry of Environment and Energy Security (MASE, previously MITE and MATTM) is responsible for environmental radioactivity monitoring.

The Ministry of Health holds the responsibility for radioactivity monitoring in foodstuffs and feed through the competences of the General Directorate of Health Prevention and the General Directorate for Food Safety and Nutrition. The monitoring activities are carried out by the Experimental Zooprophylactic Institutes (IIZZSs), ARPA/APPAs and by the peripheral and territorial veterinary offices for community compliance and border inspection posts.

4.3 NATIONAL INSPECTORATE FOR NUCLEAR SAFETY AND RADIATION PROTECTION

The National Inspectorate for Nuclear Safety and Radiation Protection (ISIN, formerly ISPRA, APAT and ANPA) is the independent regulatory authority responsible for nuclear safety and radiation protection. ISIN is responsible for operating two early warning automatic networks (GAMMA and REMRAD), and for the technical coordination of the national network for environmental radioactivity surveillance (RESORAD), which is operated by the Regional/Autonomous Provinces environmental protection agencies (ARPA/APPAs) and the Experimental Zoo-prophylactic Institutes (IIZZSs). In Rome, ARPA Lazio and the IZS Lazio and Toscana (IZSLT) participate to the RESORAD network.

4.4 REGIONAL ENVIRONMENT PROTECTION AGENCIES

Regional/ Autonomous Provinces Environment Protection Agencies (ARPA/APPA) laboratories are part of the Italian State Department of the Environment - Air Quality Service and Environmental Monitoring of Physical Agents, implementing the regional radioactivity monitoring in the environment and foodstuffs. In the Rome region there are two ARPA laboratories: ARPA Lazio in Viterbo responsible for regional radioactivity monitoring and ARPA Laboratory in Latina, which is not dealing with radioactivity measurements.

The main institutional activities carried out by the ARPA Lazio laboratory in the field of radioactivity monitoring are:

- Monitoring of radioactivity in air, water, soil and food by sampling and laboratory analysis;
- Analytical support to the competent bodies for the control of water intended for drinking water;

- Indoor radon monitoring.

Both laboratories are part of the national plan of the RESORAD network.

4.5 National Agency for New Technologies, Energy and Sustainable Economic Development

The laboratory for radiological and environmental surveillance (IRP-SFA) of the Radiation Protection Institute (IRP) of the Italian National Agency for New Technologies, Energy and Sustainable Economic Development (ENEA) is involved in the environmental radioactivity monitoring and emergency planning for the nuclear facilities located in the Casaccia Research Center (e.g. two nuclear research reactors - TRIGA and TAPIRO - and one former plutonium plant in decommissioning).

The environmental radioactivity monitoring programme in the ENEA Casaccia Research Centre was established in 1985 by ENEA in agreement with the ENEA-DISP (ENEA Nuclear Safety and Health Protection Department), whose functions have been absorbed by the National Inspectorate for Nuclear Safety and Radiation Protection (ISIN). The monitoring network covers an area around the Casaccia Research Centre within 5 km from the TRIGA reactor ventilation stack. The matrices measured are the following: air, surface water, underground water, drinking water, wastewater, soil, sediments, vegetables (grass and forage, vegetables and cereals) and milk. The environmental radioactivity monitoring programme includes also measurements of ambient dose equivalent H*(10) using TLD dosimeters located in 25 monitoring points (15 inside the ENEA site and 10 outside).

The ENEA Radiation Protection Institute (IRP) network of laboratories provides full and various services related to radioactivity measurements and continuous monitoring of the environment, in normal operation and in emergency situations.

4.6 Fire and Rescue Service

The Italian Fire and Rescue Service is organised in 4 central directorates, 18 regional directorates, 103 central fire stations and 334 professional fire stations. 256 volunteer fire stations, 32 dive and water rescue units, 24 harbour fire stations, 38 airport fire stations and 14 helicopter bases are part of the same organisation.

The fire service works with more than 30.000 permanent fire fighters and more than 6.500 voluntary fire fighters; 5.500 administrative, accounting, IT specialists, engineers and other technicians are part of the organisation.

The main activity of the National Corp of Fire Brigades (CNVVF) in the radioactivity field is to perform measurements, to detect presence of radiation, to identify and delimitate the contaminated areas and to take preliminary actions.

4.7 Experimental Zoo-prophylactic Institutes

The Istituto Zooprofilattico Sperimentale del Lazio e della Toscana “M. Aleandri” (IZSLT) laboratory located in Rome, performs radioactivity analysis in foodstuffs. The laboratory takes part in the Multiannual National Control Plan, analysing both terrestrial and marine food matrices.

The laboratory carries out gamma-emitting radionuclides analyses by high resolution gamma spectrometry using two High-Purity Germanium (HPGe) detectors. The laboratory is accredited according to the ISO standard UNI ISO/IEC 17025:2018. It participates every year in an international proficiency test.

5 RADIOACTIVITY MONITORING IN ROME AND THE SURROUNDING AREA

5.1 INTRODUCTION

Environmental radiation surveillance in Italy has three levels of surveillance: national, regional and local.

The national monitoring program is developed as a composition of the regional environmental monitoring programs, adapted to the EU Recommendation 2000/473/EURATOM. The RESORAD network is the national network for environmental radioactivity surveillance operated by the Regional/ Autonomous Provinces environmental protection agencies (ARPA/APPAs) and the Experimental Zoo-prophylactic Institutes (IIZZSs). As a part of this network, environmental and foodstuffs samples are analysed. The data obtained by RESORAD network is collected in the National Informatics System for Radioactivity (SINRAD). Collected data is routinely transmitted to the European REM database. In Rome, ARPA Lazio and the IZS Lazio and Toscana are part of RESORAD network.

Regional radioactivity monitoring is performed under the responsibility of Regions and Autonomous Provinces and carried out by the Regional/Autonomous Provinces environmental protection agencies (ARPA/APPAs). At this level, environmental and foodstuffs samples are analysed in the regional laboratories. In Rome the regional radioactivity monitoring is carried out by the ARPA Lazio laboratory.

At local level or site-specific source monitoring, a local radioactivity program is developed, to monitor radioactivity in air, water, soil and foodstuffs. In the Rome region such local environmental radioactivity monitoring is carried out at the facilities located at the Casaccia Research Centre by the Laboratory for radiological and environmental surveillance (IRP-SFA) of the Radiation Protection Institute of the ENEA Casaccia Research Centre. The monitoring network covers the Casaccia Research Centre and an area within 5 km from the reactor TRIGA chimney. The matrices analysed under the local programme are air, surface water, underground water, drinking water and wastewater; soil and sediment; vegetables (grass and forage, vegetables and cereals) and milk.

The food and feed control system along with control of the entire food chain in Italy is performed under the Multiannual National Control Plan (PCNP) and the National Animal Nutrition Plan (PNAA) of the Ministry of Health. These plans ensure the correct application of European Community legislation and ensure food safety and a high level of protection of human, animal and environmental health at national level in Italy. Radiological analysis of food and feed are included in these plans. The IZS of Lazio and Toscana, as well as the IZS of Puglia and Basilicata, which is the National Reference Center for Radioactivity Research (CRNR) in the Zootechnical-Veterinary sector, are carrying out radiological analysis of food and feed as a part of the mentioned plans.

5.2 AMBIENT RADIATION DOSE AND DOSE RATE

Ambient radiation is monitored in Italy through several early warning networks operated by the CNVVF and the ISIN.

5.2.1 CNVVF Early warning network

The CNVVF performs radiation monitoring on the Italian territory using its own measurement network composed of 1452 stations homogenously distributed nationwide. In Rome and the surrounding area there are 40 such stations. The network performs measurements using three types of stations/probes:

- XR-33 stations measure the gamma radiation on the ground every 30 minutes. In case of an alarm the station is automatically set to measure every 5 minutes. These stations are homogenously distributed in Italy. There are in total 1237 XR-33 stations (due for replacement in the coming years). All XR33 stations will be gradually replaced by MIRA stations in the future. The threshold alarms are set to 1 µSv/h and 1 mSv. The stations have radio and phone transmission of measurement results.

- MIRA stations are probes that measure the equivalent gamma dose rate, performing a measurement every hour. In case of an alarm the stations automatically set themselves to measure every minute. MIRA stations functioning is similar to XR33 stations, but technologically more advanced. The threshold alarms are set to 1 µSv/h and 1 mSv. The stations have radio and phone transmission of measurement results.
- SARA stations are gamma spectrometric probes used for air monitoring, with automatic detection of nuclides. SARA operates without time limits and in any climatic condition, performing a measurement every hour. In case of an alarm SARA stations automatically set themselves to measure every minute. The threshold alarms are set to 1 µSv/h and 1 mSv. The stations have radio and phone transmission of measurement results.

All stations described above are 24/7 connected to the CBRN National Centre and the VF Regional Direction/Commander. The distribution of stations of the CNVVF network can be seen in Fig. 1 and 2, and the number of stations in Table I. Data from some of the stations of this network is sent to the EURDEP platform.

Table I. Number of stations in the CNVVF network

	XR33	MIRA	SARA
ITALY	1242	200	10
ROME	26	12	2

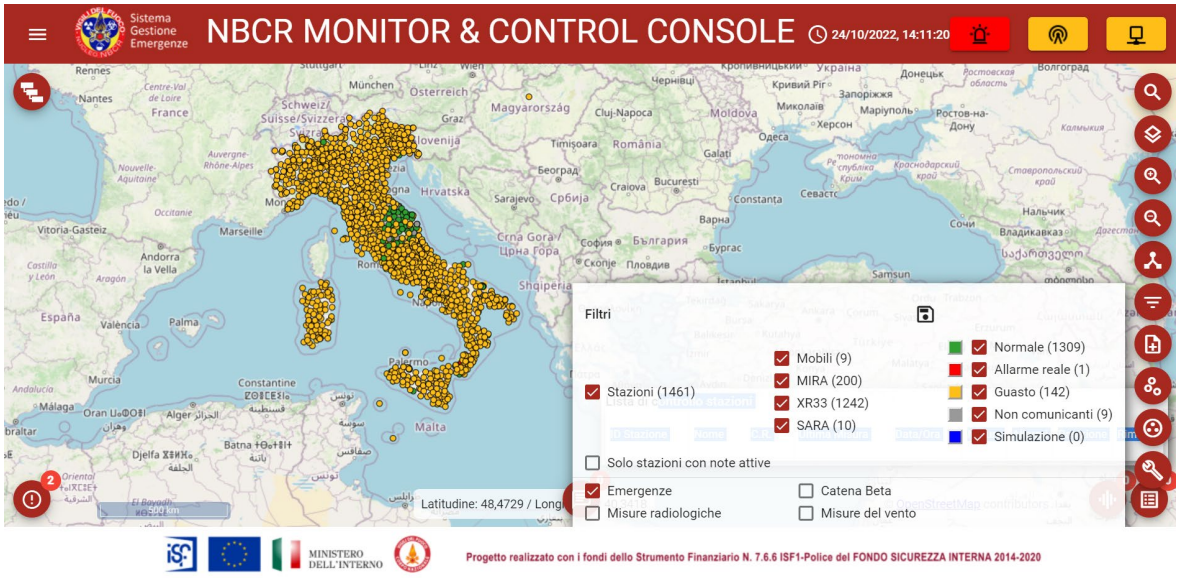

***Figure 1. Distribution of automatic monitoring stations in Italy (*CNVVF network)**

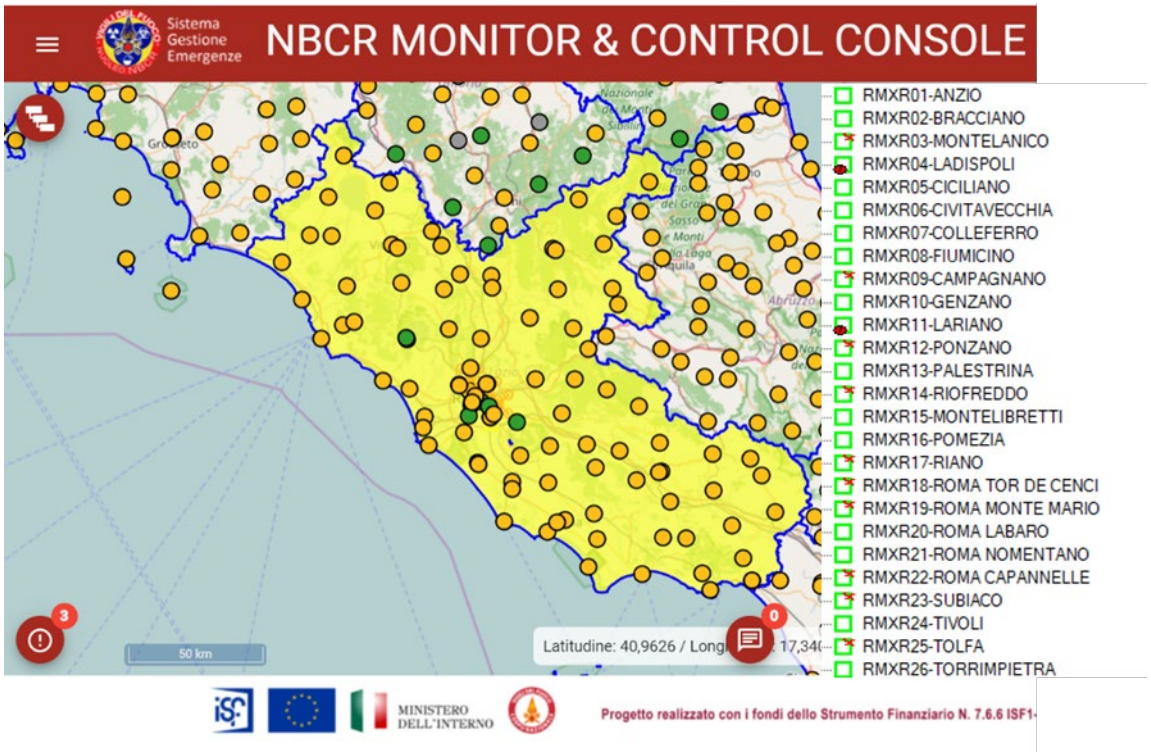

Figure 2. CNVVF stations in Rome and surroundings

5.2.2 ISIN GAMMA network

GAMMA network is the national early warning gamma dose rate automatic network composed of 62 stations. In the Lazio region there are four stations of this network. Under the current renewal programme, 39 new stations will be installed: 30 dose rate and spectrometric $LaBr_3$ probes (Fig. 3) and 9 dose rate probes. Dose rate stations are equipped with the following detectors: 2 GM for low dose rates and 1 GM for high dose rates. Measurement energy range is from 10 nGy/h to 10 Gy/h for photon energies of 40 keV-1.25 MeV; integration time is from 10 min to 1 h. The spectrometric stations, with $LaBr_3$ probes, have a sensitivity of 1 nSv/h for Cs-137 and the dose rate stations have a sensitivity of 10 nSv/h. The new stations can send data in real time.

Figure 3. GAMMA network automatic monitoring station

5.2.3 ENEA Casaccia Research Centre TLD network

The TLD network at the ENEA Casaccia Research Centre is composed of 25 TLDs; 15 TLDs spread on the entire perimeter of the ENEA Casaccia site (Fig. 4) and 10 others located outside the perimeter (Fig. 5). The TLDs at ENEA are type LIF (Mg, Cu, P) (GR 200A). They have a reading frequency of 45 days. Reading and calibration of TLDs is performed by the Laboratory for dosimetry, protection from natural radionuclides and calibration (IRP-DOS) at the ENEA Bologna Research Centre.

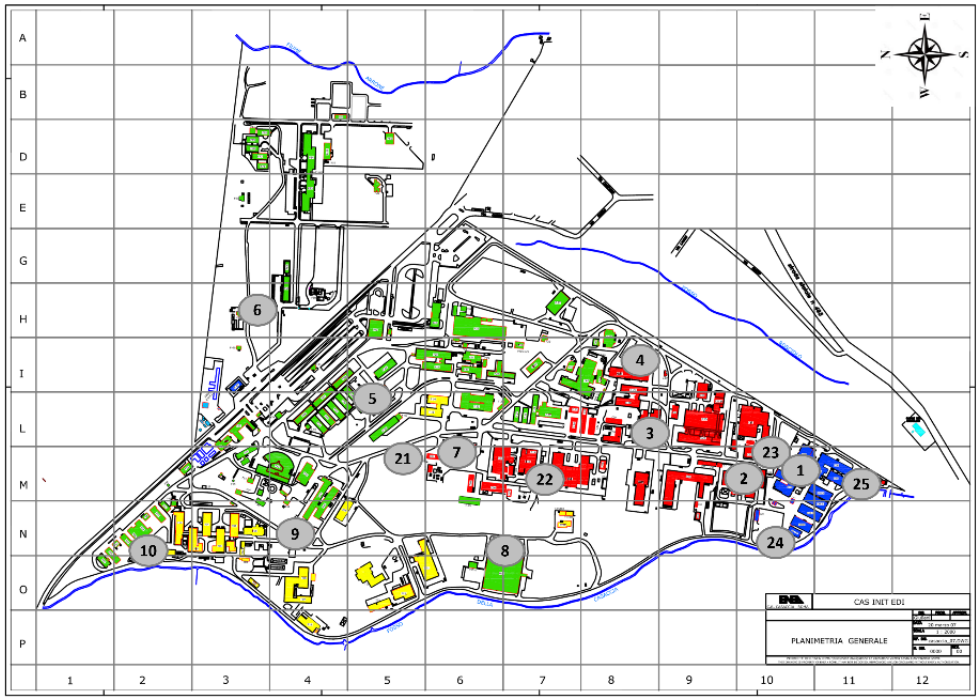

Figure 4. Network of 15 TLD's placed inside ENEA Casaccia Centre

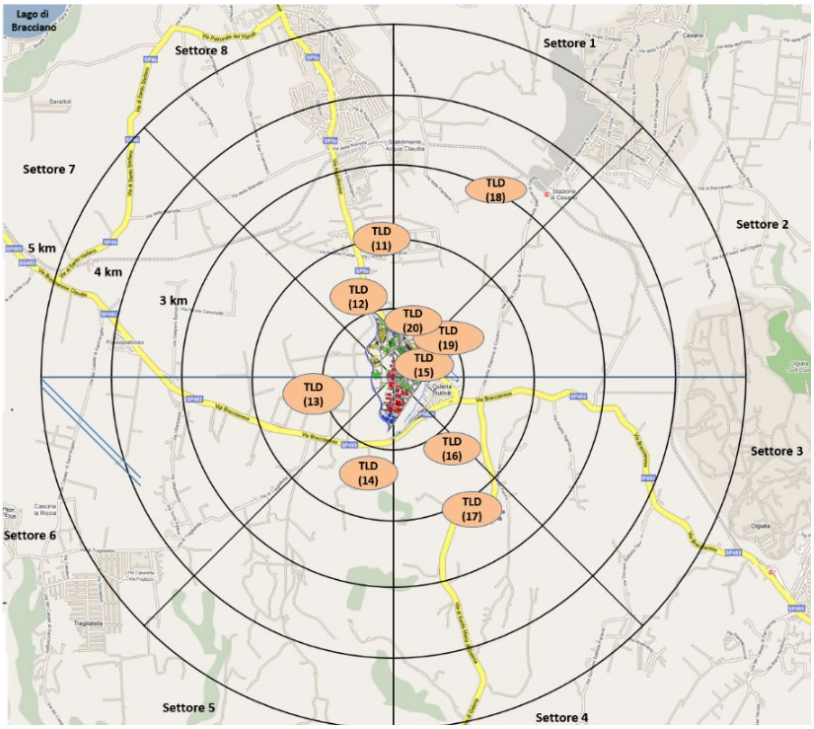

Figure 5. TLD control points outside the ENEA Casaccia Research Centre

5.3 RADIOACTIVITY IN AIR

5.3.1 ISIN REMRAD network

REMRAD is a national network of automatic monitoring stations, which carries out measurements of airborne radioactive particulates, operated by the ISIN. The stations are located in places of particular meteorological importance due to the main incoming winds in the Italian territory (Fig. 6).

This network is undergoing renovation with the installation of high-performance stations using high-volume air sampling systems. Two stations (Sgonico and Monte Sant'Angelo) have been renewed during 2022 and are in operation; the other stations will be replaced with new stations by the end of 2023.

The new stations of the REMRAD network sample airborne particulate matter with a sampling rate of 500 m^3/h. The analytical and early warning performance of stations includes:

- Off-line analysis by a HPGe detector (MDC (Cs-137) < 10 µBq/m^3 (24 hr sampling + 24 hr decay + 24 hr measuring));
- On-line analysis by a $LaBr_3$-detector (MDC (Cs-137) < 10 mBq/m^3 (2 hr measurement)).

The stations can function in both routine and emergency operation modes. The network acts as an early warning system on national level.

The network Control Centre is located in Rome, but no stations are installed in Rome.

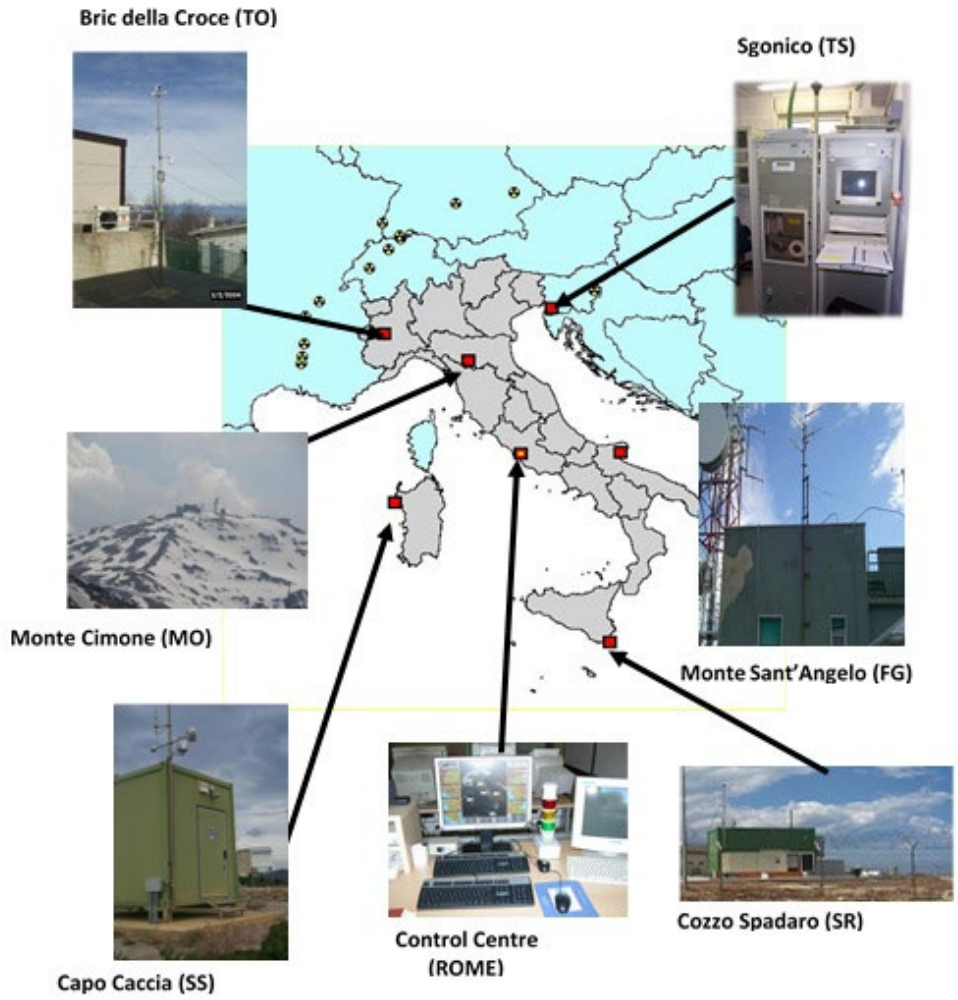

Figure 6. ISIN REMRAD network

5.3.2 ARPA Lazio air monitoring

ARPA Lazio has air samplers installed in Viterbo (Via Montezebio 17), Latina (Via Mario Siciliano 1,) and Rome (Via Boncompagni 101). The station located in Rome is currently out of order, a new sampling station will be installed in the near future.

The sampling stations are composed of filter holder, filters, suction pump with constant flow rate regulator and a low-volume volumetric flowmeter (about 40 l/min). Glassfiber, paper, acetate, or cellulose nitrate filters are used, with a diameter of about 47 mm (the effective suction diameter, when the filter is mounted on the filter holder, is less, about 40 mm). The suction cycle for each filter is 48 hours in normal situation. In emergency, the sampling time can be adjusted.

The filter sample is measured directly "as it is", without any treatment or manipulation. The practice is to wait about 1 hour before carrying out the gamma spectrometry measurement to allow the decay of a large part of the short-lived natural radioactivity (mainly Pb-214 and Bi-214), which could interfere in measurements, decreasing the sensitivity due to the increase of Compton background. The radionuclides analysed by gamma spectrometry are Co-60, Cs-134; Cs-137, K-40 and Be-7. Total beta activity is measured with a proportional gas flow meter only for samples taken in Viterbo.

5.3.3 ENEA Casaccia air monitoring

At the ENEA Casaccia Research Centre three air particulate samplers are installed inside the site perimeter (Fig. 7). The air particulate samplers are automated sampling devices (10-11 m^3/h) manufactured by Zambelli. The samplers are equipped with an automatic filter exchanger (up to 8 filters). The samplers (Fig. 8) use Sartorius cellulose filters (discs Grade 388, diameter 55 mm, active diameter 47 mm). Frequency of filter exchange is 24 hours. A diesel power generator is available for electrical backup. A message to duty staff mobile phones is sent if the pump is off.

Alpha and beta emitting radionuclides are assessed through gross alpha/beta counting, gamma-emitting radionuclides (Be-7, Co-60, I-131, Cs-137) with gamma spectrometry and Pu-238 and Pu-239/240 with radiochemistry analyses. Altogether 1095 filters are measured every year at the Lab IRP-SFA of the ENEA Casaccia Research Centre.

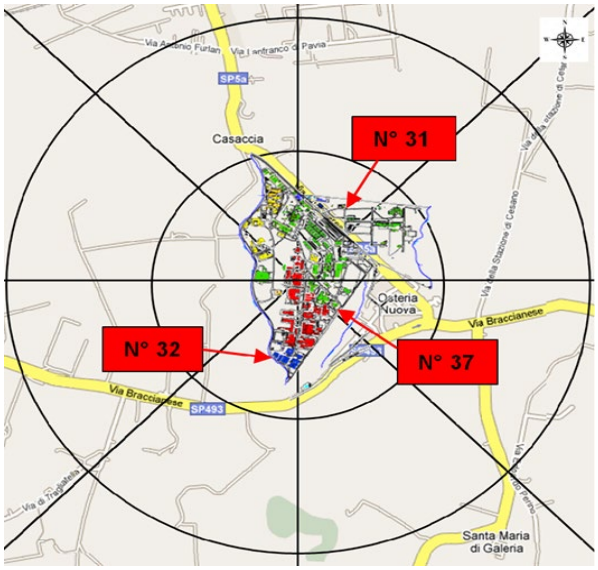

Figure 7. Map of air sampling devices

Figure 8. Air sampler at the ENEA Casaccia Research Centre

5.3.4 CNVVF air monitoring

Each CNVVF provincial command station is equipped with air sampling systems (Fig. 9 and 10). The air sampler has a pump with a pre-set aspiration of 4 m^3 of air. Also a pre-set value of 1 m^3 of air can be

used. The filter is analysed two times at a time interval of 2 hours for measurement consistency. If the second measurement in cps (counts per second) is halved it is assumed that on the filter there are only natural radionuclides. In case the second measurement is not halved, or the count rate value is significantly higher than the long-term average of the measurement point, the presence of artificial radionuclides is assumed, and consequently the filter will be analysed in the laboratory with a Germanium or Lanthanum Bromide spectrometer to identify any artificial radionuclides.

Each CNVVF Command is equipped also with portable equipment (AMS Analytics sampler, Fig. 10), which uses a pump with 60 - 600 l/min flow rate and a paper filter. The air sampling procedure is carried out for identification of presence of I-131 or any other artificial radionuclides (U-238, Ra-226, Pb-210, U-235, Ac-227, Th-232, Ra-228, Th-228, K-40).

Figure 9. Provincial VF Commands having air sampling equipment

Figure 10. Air samplers at the CNVVF

5.4 ATMOSPHERIC DEPOSITION

ARPA Lazio monitors atmospheric deposition at its territorial headquarters of Viterbo (Via Montezebio 17). The fallout is collected in a stainless steel vessel with a collection area of approximately 2 m^2 (Fig. 11). The inside part of the container is kept wet by adding distilled water with addition of an acid to obtain a pH <2. The quantity of added distilled water depends on the local weather conditions. The containers are emptied regularly to avoid overflow of water content due to heavy rain.

At the end of the sampling period (monthly) the water is carefully collected, and the recipients washed with deionized water or with an acid solution (pH <2) prepared with deionized water to remove all deposited material. All the collected material is dried very slowly at temperatures not exceeding 105°C. The solid residue obtained is collected by scraping the container with a metal spatula and then introduced into the measuring container. The sample is measured with a high-resolution HPGe gamma spectrometer. The analysed radionuclides are Co-60, Cs-134, Cs-137, K-40 and Be-7.

Figure 11. Atmospheric deposition collectors at the ARPA Lazio

5.5 WATER

5.5.1 Surface waters

Measurements of radioactivity in surface waters in Rome and the region around Rome is performed by the ARPA Lazio laboratory and by the ENEA Casaccia Laboratory.

The environmental radioactivity monitoring programme of ARPA Lazio includes monitoring of rivers, lakes and sea, as shown in the map in Fig. 12. Samples are collected in polyethylene containers of 20 to 50 litres. Immediately after collection, nitric acid (to reach pH <3) is added in the collection container to minimize absorption on the walls of container. Sample treatment can be done by two methods: (1) passage of the sample on a column with ion exchange resins (freshwater), or (2) sample reduction by evaporation (seawater).

Samples are collected and analysed quarterly (four times a year) for freshwater and two times a year for seawater. Gamma-emitting radionuclides (Co-60, Cs-134; Cs-137, K-40) are analysed by gamma ray spectrometry on resins or dry residue. In freshwater, the total beta activity is also analysed by counting in a liquid scintillation counter (LSC) a pre-concentrated sample (1 to 10), for the evaluation of residual beta activity.

Figure 12. ARPA Lazio surface water sampling locations

The local environmental radioactivity monitoring programme of the ENEA Casaccia Research Centre includes sampling of surface waters in two locations (points 28 and 34 on Fig. 13). Sampling is carried out weekly for the control point 28 and quarterly for the control point 34, collecting 12 litres for each sample. Alpha and beta emitting radionuclides are measured by gross alpha/beta counting, gamma-emitting radionuclides (K-40, Co-60, I-131, Cs-137) with gamma spectrometry and Pu-238 and Pu-239-240 (just for control point 28) with radiochemistry analyses.

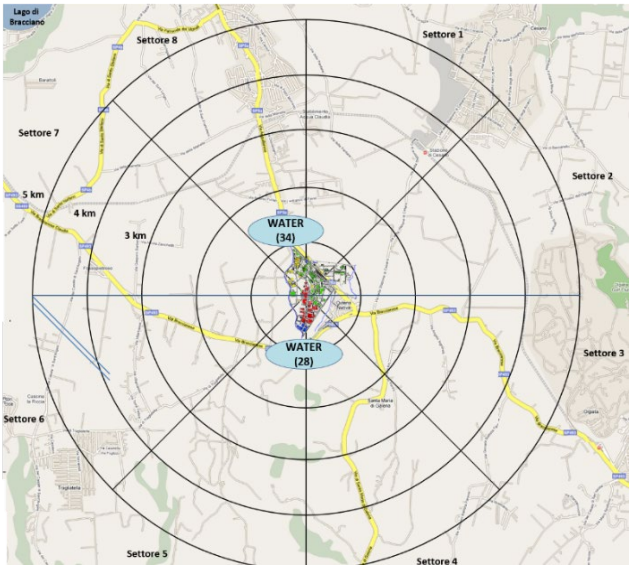

Figure 13. ENEA Casaccia surface water sampling locations (vicinity of the Casaccia site)

5.5.2 Ground water and drinking water

In ARPA Lazio drinking water monitoring is carried out by taking samples from a public fountain in the municipality of Rome with connection to the main aqueduct of the metropolitan area of Rome (Peschiera aqueduct which serves about 70% of the resident population in Rome). Sampling is carried out every six months. Samples are collected in polyethylene containers of 20 to 50 litres. Immediately after sampling, nitric acid is added to the sample (to pH <3) to minimize absorption on the walls of the collection vessels. The reduction of the sample, necessary to perform the measurement in gamma

spectrometry, is obtained through the passage of the sample on a column with ion exchange resins. Gamma-emitting radionuclides (Co-60, Cs-134; Cs-137, K-40) are analysed by gamma ray spectrometry on dried resins. Total alpha and total beta activity and Tritium are determined by counting a pre-concentrated sample (1 to 10) in a liquid scintillation counter (LSC).

The local environmental radioactivity monitoring programme of the ENEA Casaccia Research Centre includes two sampling locations for underground waters (points 14 and 29) and one for drinking water (point 35) as shown in Fig. 14. Point 35 is located inside the Casaccia Research Centre, whereas points 14 and 29 are outside the Centre. Sampling is carried out manually, collecting for each sample 12 litres. Sampling frequency is 6 months for control points 29 and 35 and annually for the control point 14. Alpha and beta emitting radionuclides are assessed through gross alpha/beta counting and gamma-emitting radionuclides (K-40, Co-60, I-131, Cs-137) by gamma spectrometry.

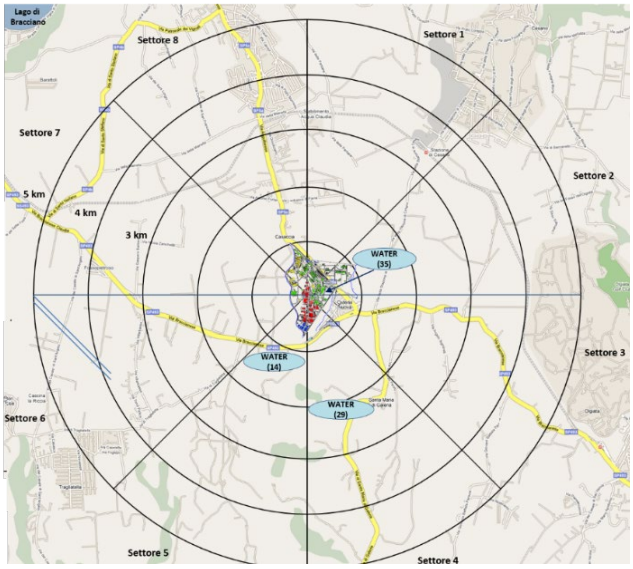

Figure 14. ENEA Casaccia ground and drinking water sampling locations

5.5.3 Waste waters

The local environmental radioactivity monitoring programme of the ENEA Casaccia Research Centre includes collection of samples in one sampling location for waste waters inside the Casaccia Centre (point 36, near to point 28 of Fig. 13). Sampling is performed automatically once a day, collecting 1 l of water using an automatic sampling device (Teledyne ISCO, 3700 portable programmable liquid sampler). Gamma-emitting radionuclides (K-40, Co-60, I-131, Cs-137) are assessed every week.

5.6 SOIL AND SEDIMENTS

Soil and sediments programme in Rome and the surrounding area is performed by both ARPA Lazio laboratory and the ENEA Casaccia laboratory.

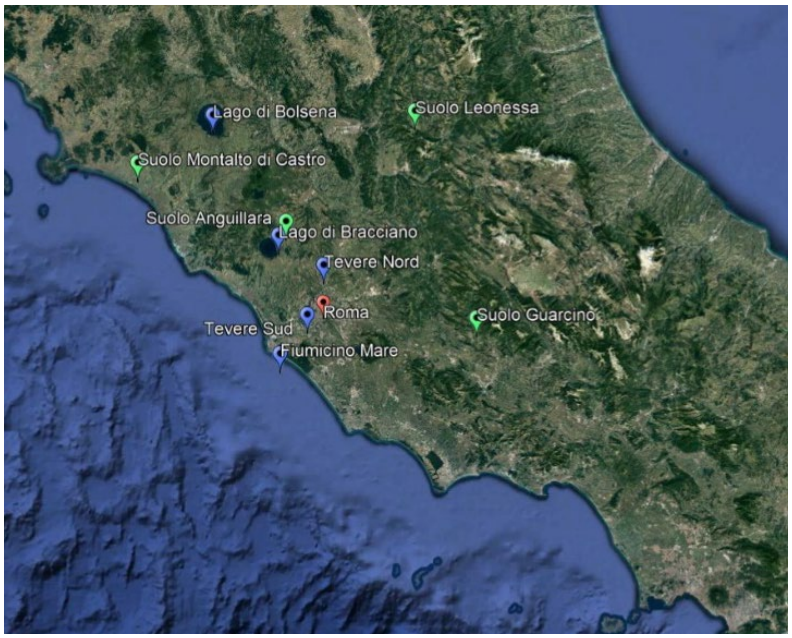

Figure 15. Map of ARPA Lazio soil/sediment sampling locations

The sampling locations of soil and sediments of environmental radioactivity monitoring programme of ARPA Lazio are shown in Fig. 15. In the ARPA Lazio Laboratory, the sample treatment procedure involves drying of sample up to a constant mass to reduce the moisture content; drying can be carried out in the air or, accelerated in a ventilated oven at (40 ± 5)°C (24 to 48 hours depending on the humidity of the sample). The sample is homogenised and sieved at 2 mm to separate the fine soil component. The analysis of the sample is performed with a high-resolution HPGe spectrometer to determine presence of radionuclides (Co-60, Cs-134, Cs-137 and K-40).

The sampling locations of soil and sediments of the local environmental radioactivity monitoring programme of the ENEA Casaccia Research Centre are shown in Fig. 16 and 17. Outside the ENEA Casaccia Centre site, 8 soil sampling locations and 3 sediment sampling location are part of the environmental programme. One soil sampling point (FA) is located on the Arrone river mouth, next to the Tyrrhenian Sea.

Figure 16. Map of ENEA Casaccia soil sampling locations (outside the Casaccia Centre)

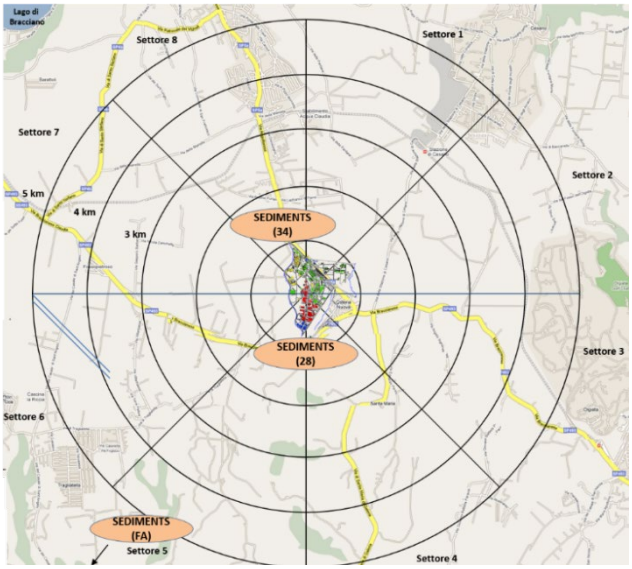

Figure 17. ENEA Casaccia sediment sampling locations (outside the Casaccia Centre)

Soil is sampled manually each year from eight locations using a 20x25 cm^2 template (sample depth 10 cm).

Sediment is sampled manually from three sampling locations, using a shovel. Monthly a sample of 5-6 kg is collected from the control point 28, quarterly from the control point 34 and two times a year from the control point FA (Fig. 17).

Radionuclides assessed in soil and sediment samples are alpha and beta emitting radionuclides through gross alpha/beta counting, gamma-emitting radionuclides (for soil K-40, Co-60, Cs-137 and for sediment Co-60, I-131, Cs-137) with gamma spectrometry, and Pu-238 and Pu-239-240 with radiochemistry analyses.

5.7 TERRESTRIAL AND AQUATIC BIOTA

Terrestrial biota monitoring programme is performed by the IZSLT in the Rome region and surroundings.

The IZSLT samples aquatic biota and performs analyses on bivalve molluscs, tunicates, echinoderms according to the regional plan. Sampling locations of terrestrial biota are presented in Fig. 18.

Mushroom samples (import/export) are analysed with gamma spectrometry to identify the presence Cs-137, Cs-134, I-131 and K-40.

Figure 18. IZSLT aquatic biota sampling locations

5.8 FOOD

5.8.1 Milk

In Rome and the surrounding region, ARPA Lazio, IZSLT and the ENEA Casaccia laboratories have milk monitoring programmes.

ARPA Lazio carries out milk sampling from a public market where milk comes from local farms. Gamma spectrometry analysis is performed on the sample without sample treatment. Milk samples are weighted before analysis and gamma-emitting radionuclides (Co-60, Cs-134; Cs-137, K-40) are assessed by gamma ray spectrometry.

IZSLT carries out gamma spectrometry analyses on milk samples taken from the Centrale del Latte di Roma. The analyses are performed on the samples without prior treatment. The following radionuclides are assessed: Cs-137, Cs-134, I-131 and K-40.

The ENEA Casaccia laboratory samples milk from four local farms located outside the site, sampling points no 14, 26, 30 and 33 (Fig. 19). Milk samples are collected quarterly in 10 L containers for collection points no. 14, 30 and 33 and every 6 months from point no. 26, which is considered a blank sample. Gamma-emitting radionuclides (K-40, I-131, Cs-137) and Sr-90 are assessed.

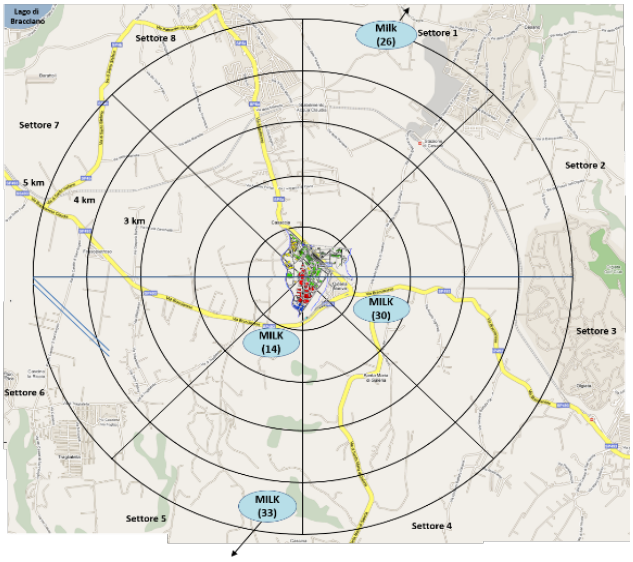

Figure 19. ENEA Casaccia milk sampling locations (outside the Casaccia Centre)

5.8.2 Mixed diet

Mixed diet radioactivity monitoring is performed in Rome and the surrounding region by ARPA Lazio and by IZSLT, according to the regional monitoring plan.

In the ARPA Lazio, mixed diet is sampled monthly at the company canteen (which distributes about 1300 meals a day). The analyses are performed quarterly on a composite sample. To improve the homogeneity of the sample, drying in a ventilated oven and stirring is performed before the analysis. Drying has the purpose of reducing the volume of the sample by eliminating water. Since the dried mass is not used for the calculation of the activity concentration, the drying times and temperatures used are not critical (temperature is above 80 °C for approximately 3 - 5 hours). After homogenization, gamma-emitting radionuclides (Co-60, Cs-134; Cs-137, K-40) are assessed by high resolution gamma spectrometry.

The IZSLT carries out mixed diet analyses according to the regional plan for Monitoring radioactivity in food, included in the Multi-Year National Control Plan (NCP).

5.8.3 Foodstuffs

Control of radioactivity in foodstuffs and beverages in Italy is accomplished by regional plans on the basis of State-Regions agreement. According to national legislation[4], the Ministry of Health exercises control over food and beverages for human and animal consumption and is the contact point for Italy on the Rapid Alert System for Food and Feed (RAFFS).

In Rome and the surrounding region, foodstuffs monitoring is performed by the ARPA Lazio and by the IZSLT, under the regional monitoring plan, and by the ENEA Casaccia laboratory, under the local monitoring plan.

In the ARPA Lazio Laboratory, samples of foodstuffs (fruit, leafy vegetables, leafless vegetables, meat, fish, oil, cereals) are collected quarterly from a market in the municipality of Rome.

For oil and in general all liquid samples, gamma spectrometry analysis is performed on the sample without other preparation than weighting before the analysis.

For other samples, for example, meat, fruit and vegetables, homogenization of sample and density checks are necessary. If the sample density differs from the density of the calibration source (usually 1

[4] Decree No 101/2020, the article n. 152, comma 1

g/cm^3), a correction of self-absorption is performed. After homogenization, gamma-emitting radionuclides (Co-60, Cs-134; Cs-137, K-40) are assessed by high resolution gamma spectrometry.

IZSLT analyses by gamma spectrometry various foodstuffs: aquatic biota (mussels, seaweed), leafy vegetables, other vegetables and fruits, grain, milk, meat and fish. The radionuclides usually assessed are Cs-137, Cs-134, I-131 and K-40.

In the ENEA Casaccia Research Centre vegetables and cereals from local production are collected and analysed. Eight samples of 10 kg each of vegetables, four in winter and four in summer are collected. 5 or 6 samples of cereals, 5 kg each, depending on the growing are also sampled yearly. Radionuclides assessed are the alpha and beta emitting radionuclides through gross alpha/beta counting, gamma-emitting radionuclides (K-40, Co-60, Cs-137), Sr-90, Pu-238 and Pu-239/240.

5.9 FEEDING STUFFS

In Rome and surrounding area monitoring of feeding stuff (feed and forage) is performed by the ARPA Lazio and by the IZSLT under the regional monitoring plan. In the ENEA Casaccia grass and forage are sampled and analysed under the local environmental monitoring.

In the ARPA Lazio laboratory feeding stuff (feed and forage) is sampled quarterly at the market in the municipality of Rome. Samples are homogenized; and density of the sample is checked. If the sample density differs too much from the density of the calibration source (usually 1 g/cm^3) a correction of self-absorption is performed. Gamma-emitting radionuclides (Co-60, Cs-134, Cs-137 and K-40) are assessed by high resolution gamma spectrometry.

The IZSLT, according to the PNAA (National Animal Feeding Plan), is involved in feeding stuff (feed and forage) monitoring. Gamma spectrometry analysis are performed to assess Cs-137, Cs-134, I-131 and K-40. For determination of Sr-90, the samples are sent to IZS of Puglia and Basilicata.

In the ENEA Casaccia Research Centre the grass sampling locations are the same as those for the soil (Fig.16). Eight samples of 1 m^2 (at least 3 kg) are sampled annually from each location. Alpha and beta emitting radionuclides are assessed by gross alpha/beta counting, gamma-emitting radionuclides (K-40, Co-60, Cs-137) by gamma spectrometry and Sr-90, Pu-238 and Pu-239/240 by radiochemistry analyses.

5.10 EMERGENCY MONITORING SYSTEMS

5.10.1 Introduction

The main bodies involved in the response in a national radiological emergency are the Civil Protection Department of the Presidency of Council of Ministers, the Ministry of Health, the Ministry of Interior (through the National Corp of Fire Brigades (CNVVF)) and the Nuclear Emergency Center of ISIN. The coordination of response is performed through the Operational Committee chaired by the Chief of Civil Protection Department.

In case of a national emergency the Operational Committee is advised by the Data Elaboration and Evaluation Centre (CEVaD), which is a technical centre of the Civil Protection Department. The CEVaD, hosted and coordinated by ISIN, has in an emergency the responsibility to evaluate the exposure level of the population in order to advise the Operational Committee about protective measures to be implemented. All radiological data collected during the emergency are made available to the CEVaD, which can give indications of specific operating methods to monitoring networks available on the national territory (Ex.: RESORAD network).

The authority having competence in nuclear and radiological emergency preparedness at local level is the Prefect, who is responsible for drafting the emergency plans for domestic nuclear installations, for transport of nuclear material and irradiated fuel, for orphan source recovery and for seaports where the nuclear-powered vessels are allowed to dock.

In case of a local emergency, the monitoring activities are carried out by the CBRN teams of the CNVVF and by the regional laboratory (ARPA/APPA). These teams are supported by the radiological monitoring capabilities of the nuclear installation.

5.10.2 ENEA Casaccia Research Centre

The Italian National Agency for New Technologies, Energy and Sustainable Economic Development (ENEA) is involved in the emergency plan for the nuclear facilities located at the Casaccia research Centre (e.g. nuclear research reactors TRIGA and TAPIRO run by the ENEA).

The mobile radiation monitoring equipment in the ENEA Casaccia Research Centre available to be used in case of an emergency includes dose ratemeters (gamma and neutron), contamination detection equipment, atmospheric deposition collectors, air sampler (pumps and volumetric counters) with filter (cellulose paper, glassfibre filter and charcoal), a portable scintillator spectrometer and a portable HPGe spectrometer.

5.10.3 CNVVF CBRN National Centre

The CBRN National Centre of the National Fire and Rescue Service (CNVVF) is responsible for detection of radioactivity in the air at national level through the NETRAD network. The CNVVF is equipped with the following mobile radiological monitoring equipment:

- A rugged handheld gamma radiation detector with georeferencing designed to search for radioactive materials (type SPIR-ID);
- A compact and mobile gamma radiation detector with georeferencing that can be configured for easy deployment in vehicles or helicopters (type SPIR-IDENT MOBILE).
- A lightweight mobile gamma radiation detector with georeferencing designed to be installed on a Drone or Robot for a wide range of applications where gamma radiation detection, measurement and nuclide identification is needed (type SPIR-EXPLORER).
- A lightweight gamma radiation detector with georeferencing designed to be used in a backpack for “in disguise” monitoring (type SPIR-PACK). The detector can be connected to a smartphone for real time monitoring results. The equipment can be used for detection and identification of radiological sources.
- A compact and mobile gamma radiation detector with georeferencing (type SPIR-ACE BrLa), used for detection and identification of radiological sources.
- A compact gamma radiation detector with georeferencing used for detection and identification of radiological sources in sea, river or lake waters, or wastewater. The equipment can be used also for detection and identification in the air.

Each CBRN teams is equipped with:

- A Thermo Scientific gamma and neutron detector (type FH40)
- A neutron dose rate detector FHT762 with high sensitivity due to He-3 filling gas (type REM COUNTER). The FHT762 is a probe that is used with the FH40.
- Small, light and rugged gamma and neutron dose measurement (UDR13) that is used by the fire fighters in addition of TLDs.
- A handheld gamma and neutron radiation detector (type HDS 101) designed to search and identify radioactive materials
- Personal protective equipment
- Communication systems

5.11 INFORMATION TO THE PUBLIC

The public in Italy is informed about environmental radioactivity in both normal conditions and emergency situations. Periodic reports and other information about environmental monitoring are made available on the ISIN website[5].

The national information system SINRAD[6] is available to the public and has two parts, the RESORAD section and the RADON section.

Civil Protection Department[7] is responsible for informing the public in case of a national emergency.

The National plan for the management of radiological and nuclear emergency is provided on the Civil protection website[8]. A summary of emergency provisions is provided on the ISIN website[9], in both Italian and English languages.

GAMMA network data, with a certain periodicity (not in real time) is made available on the ARPA Lazio web site[10]. The website has a direct link with EURDEP.

5 hhttps://www.isinucleare.it
6 https://sinrad.isinucleare.it/
7 http://www.protezionecivile.gov.it
8 https://www.protezionecivile.gov.it/static/da3c780d38a2f1abe6d0cf618c93a467/piano-nazionale-gestione-emergenze-radiologiche-nucleari-20220309-21_1.pdf
9 https://www.isinucleare.it/it/gestione-emergenze
10 https://www.arpalazio.it

6 LABORATORIES PARTICIPATING IN THE ENVIRONMENTAL RADIOACTIVITY MONITORING PROGRAMMES IN ROME

6.1 ARPA LAZIO RADIOLOGICAL LABORATORY

6.1.1 Introduction

The ARPA Lazio laboratory is part of the Air Quality Service and Environmental Monitoring of Physical Agents of the Environmental State Department. There are physically two laboratories, one located in Latina, south Rome area and the second one located in Viterbo, north of Rome. Both laboratories are responsible for the regional environmental monitoring programme and they are part of the national monitoring plan of the RESORAD network.

The main activities carried out by ARPA Lazio in the field of radioactivity are:

- Monitoring of radioactivity in air, water, soil and food by sampling and laboratory analysis;
- Analytical technical support to the competent bodies for the control of drinking water by laboratory analysis;
- Indoor radon monitoring.

6.1.2 Sample registration and preparation

Samples received in the laboratory are labelled with a unique progressive code and recorded in a cloud database (Eusoft Lab).

Samples are prepared in the laboratory; sample preparation depends on the media and on the radiometric analyses required.

6.1.3 Measurement devices

Measurement devices available in the laboratory are three gamma spectrometry systems (HPGe ORTEC), two liquid scintillation counters (Hidex) and a proportional gas flow counter. All calibrations are made with certified calibration sources.

6.1.4 Data handling and reporting

The measurement results are processed using specific Excel calculation files. All data are recorded and stored in a cloud database (Eusoft Lab). The samples are stored in the laboratory for at least three months.

All data are archived in the SINRAD database. All measurement results are available on the ARPA Lazio institutional website.

6.1.5 Quality assurance

The ARPA Lazio laboratory in Viterbo is ISO 17025 accredited for high resolution gamma spectrometry analyses on atmospheric particulate, water, soil and food, for total beta analysis on atmospheric particulate and for the determination of total alpha and total beta activity on water by liquid scintillation counting (LSC).

6.2 ENEA CASACCIA RADIOLOGICAL LABORATORY

6.2.1 Introduction

The Laboratory for radiological and environmental surveillance at the ENEA Casaccia Research Centre, Radiation Protection Institute, is responsible for local environmental radioactivity monitoring on the ENEA Casaccia Research Centre site.

6.2.2 Sample registration and preparation

Upon receipt in the laboratory, each sample is labelled with a unique number (formed by 5 digits) and recorded in a locally developed database (Microsoft Access). Samples are prepared in the laboratory based on media and the type of analyses required.

Atmospheric deposition

Atmospheric deposition samples for alpha spectrometry (Pu-238 and Pu-239/240) analyses need chemical separation and electrodeposition on stainless steel disks as part of sample preparation. For gross alpha and beta counting and for gamma measurements, measurements are carried out on samples as they are (cellulose filters), no chemical preparation is needed.

Water samples

For gross alpha and beta counting 1 L of water sample is evaporated, the fixed residue is deposited on stainless steel disks (1 mg/cm^2 for gross alpha measurements and 10 mg/cm^2 for gross beta measurements). First measurement of sample in gamma spectrometry is carried out on the sample as it is for determination of I-131 and the second measurement is performed after concentration of sample from 10 L to 1 L through evaporation. For alpha spectrometry analyses to assess Pu-238 and Pu-239/240 chemical separation and electrodeposition of samples on stainless steel disks is performed before the measurement.

Soil and sediment

For gross alpha and beta counting the samples are dried, sieved and incinerated. The resulted matrix is deposited on stainless steel disks (1 mg/cm^2 for gross alpha measurements and 10 mg/cm^2 for gross beta measurements) and sent to the analyses.

Sediment samples are measured with gamma spectrometry for assessment of I-131 without prior preparation. Soil samples are going through drying and sieving processes before measurement.

For alpha spectrometry analyses of soil and sediment to assess Pu-238 and Pu-239/240 chemical separation and electrodeposition of samples on stainless steel disks is performed before the measurement.

Vegetables, grass, forage and cereals

For gross alpha and beta counting samples are dried, homogenised and incinerated. The resulted matrix is deposited on stainless steel disks (1 mg/cm^2 for gross alpha measurements and 10 mg/cm^2 for gross beta measurements) and analysed.

For gamma spectrometry the samples are dried and homogenised before the analyses.

For alpha spectrometry analyses, to assess Pu-238 and Pu-239/240 chemical separation and electrodeposition of samples on stainless steel disks is performed before the measurement.

For Sr-90 measurements chemical separation and two chemical precipitations at an interval of at least 20 days of sampling are performed. The residue is deposited on stainless steel disks and analysed by gross beta counting for Y-90 evaluation.

Milk

Gamma spectrometry is performed on the first measurement on milk samples without prior preparation for I-131 assessment. For the second measurement chemical treatments of milk samples, with DOWEX resins is performed.

For Sr-90 determination in milk samples, chemical treatments with DOWEX resins and two chemical precipitations at an interval of at least 20 days is performed. The residue is deposited on stainless steel disks for gross beta counting for Y-90 evaluation.

6.2.3 Measurement devices

Measurement equipment available in the ENEA Casaccia laboratory includes gamma spectrometers, X-gamma spectrometers, alpha spectrometers and proportional counters for simultaneous measurement of gross alpha and beta radiation (Table II.).

Table II. Measurement devices at the ENEA Casaccia laboratory

Device	N°	Manufacturer and type
Gamma spectrometers	4	Detectors: Ortec, GEM series HPGe, Coaxial Detector System Electronics/Software: Canberra, Genie 2000 system, Apex
X-Gamma spectrometers	3	Detectors: Ortec, GMX series, Gamma X HPGe, Coaxial Detector System Electronics/Software: Canberra, Genie 2000 system, Apex
Alpha spectrometers	6	Detectors: Alpha Analyst Canberra Electronics/Software: Canberra, Genie 2000 system
Proportional counters	1	Detector: Tennelec LB 5100 with automatic sample exchanger
	2	Detectors: Berthold LB 770, Low level Counter, 10 acquisition channels

Counting times vary depending on the type of analyses: 600 ks for alpha spectrometry, 18 ks for gross alpha and beta counting for atmospheric particulate, 180 ks (a cycle of 6 measurements of 30 ks each) for gross alpha and beta counting, 300 ks for gamma spectrometry, 900 ks (a cycle of 150 measurements of 6 ks each) for Sr-90 measurements.

Radionuclides assessed are gamma-emitting radionuclides (in particular Be-7, K-40, Co-60, I-131 and Cs-137), Sr-90, Pu-238 and Pu-239/240. Measurements of gross alpha and gross beta are performed with proportional counters.

Calibration of measurement equipment is performed using multi gamma certified standard sources (both sealed and not sealed) for gamma spectrometry. For alpha spectrometry calibration is performed using a Pu-242 certified source (not sealed). For gross alpha and beta counting calibration is carried out using Am-241 and Sr-90 certified sources (sealed).

Energy calibration of the gamma spectrometry equipment is performed at each measurement by checking the position of K-40 peak. Once a month a background spectrum is acquired.

For alpha spectrometry equipment, energy calibration is checked at each measurement by checking the position of Pu-242 peak. Every 6 months a background spectrum is acquired.

For gross alpha and beta counting equipment, calibration is performed at the end of each measurement (atmospheric particulate) using Am-241 and Sr-90 sealed sources. Every month a background counting is carried out also.

Efficiency calibration of all equipment is verified by participating in intercomparisons exercises.

6.2.4 Data handling and reporting

Measurement results are recorded and archived in a Microsoft Excel database. Gamma measurement results are calculated in Genie 2k software and recorded and archived in Mirion-Apex database. When results are below detection limits, no action is taken.

For alpha spectrometry calculation of measurement results is performed using the ROI method using specific Excel calculation files.

For gross alpha and beta counting calculation of measurement results is performed using specific Excel calculation files for atmospheric particulate samples and the built-in AMS software (Berthold) for other measurements.

All data is stored in the Database (Microsoft Excel, Microsoft Access and Mirion-Apex). All samples are stored in the laboratory for at least five years.

The ENEA Radiation Protection Institute prepares an annual report on environmental radioactivity around the Casaccia nuclear site and sends it to the competent authority ISIN. The ENEA Casaccia does not provide information on the radiological monitoring to the public.

6.2.5 Quality assurance

The Laboratory for radiological and environmental surveillance of the ENEA Casaccia Research Centre does not use LIMS and is not accredited. The Laboratory is included in the IAEA Almera network of laboratories, participating periodically in proficiency and inter-comparison exercises. The laboratory participates in national inter-comparison exercises and proficiency tests organized by the Italian Institute of Ionizing Radiation Metrology, or by the Italian Radiation Protection Association. The laboratory participates also in international intercomparisons organized by the IAEA and the EC JRC.

6.3 EXPERIMENTAL ZOO-PROPHYLACTIC INSTITUTE

6.3.1 Introduction

The Istituto Zooprofilattico Sperimentale del Lazio e della Toscana “M. Aleandri” (IZSLT) performs radioactivity analysis of foodstuffs in the Lazio and Toscana region.

6.3.2 Sample registration and preparation

Sample identification and registration are carried out according to the internal procedure IZSLT: PG ACC 002. Samples are prepared, ensuring homogeneity, and transferred to the container for analysis to reproduce the desired geometry. No pre-concentration of samples is performed, only a slight pre-treatment aimed to deprive the sample of the non-edible parts further to improve its homogeneity by chopping or grinding. Fruits and vegetables are washed and dried to eliminate soil residues. Samples are stored in a storage room, refrigerated or frozen.

6.3.3 Measurement devices

The sample measurements are carried out on individual samples. Measurement devices used are high resolution gamma spectrometry systems with HPGe detectors. Radionuclides assessed are those with energy range 50-2000 Kev, mostly Cs-137, Cs-134, I-131 and K-40. Minimum counting time is 7200 sec.

The measurement equipment available in the laboratory is:

- HPGe-detectors with analogue electronics consisting of power supply for electronic modules (NIM), preamplifier, high voltage generator MOD. 9646, amplifier MOD. 9615, analogue-to-digital converter (ADC) MOD. 9633;
- Multi-Channel Analyzer (MCA) MOD. AIM 556, Canberra Packard.

Energy calibration is performed using an Eu-152 point source; efficiency calibration is performed using multinuclide sources with different geometry. Calculation of results is carried out by GENIE 2000 software.

6.3.4 Data handling and reporting

Measurement reports are stored in the IZSLT server. For measurements results, detected by software GENIE-2000 below detection limits, on the report is recorded: ‘’*<to the value MDA (Minimum Detectable Activity)*’’.

For feedstuffs requiring determination of Sr-90 (beta emitting radionuclide), samples are sent to the IZS of Puglia and Basilicata, which is the National Reference Center for Radioactivity Research (CRNR) in the Zootechnical - Veterinary sector.

6.3.5 Quality assurance

The laboratory is accredited according to the ISO standard UNI ISO/IEC 17025:2018. The reference method is accredited according to UNI 11665:2017) by the ACCREDIA. The laboratory participates in International Atomic Reference Material Agency (IARMA) annual proficiency tests.

6.4 ISIN RADIOMETRIC LABORATORY

6.4.1 Introduction

The Radiometric Laboratory of the National Inspectorate for Nuclear Safety and Radiation Protection (ISIN) does not have its own monitoring plan, but it is involved in CTBTO investigations, radiological characterization plans, special monitoring around plants or industries and, if required, it can provide support to the monitoring laboratories of the RESORAD network.

The radiometric laboratory of ISIN is one of the radionuclide laboratories of the CTBTO International Monitoring System. The laboratory is included in the IAEA Almera network laboratories, participating periodically in proficiency and inter-comparison exercises. The laboratory takes part also in national and international inter-comparison exercises or proficiency tests when organized.

6.4.2 Sample registration and preparation

Sample identification and registration are carried out according to the internal procedure: "IO.RDP.CAMP Gestione Campioni''. Sample preparation before measurement is carried out according to specific procedures "IO.RDP.PREP Preparazione campioni spettrometria gamma" and "IO.RDP.ESS Essiccazione campioni ambientali".

6.4.3 Measurement devices

The radiometric laboratory of ISIN is equipped with the devices listed in Table III.

Table III. Measurement devices at the ISIN radiometric laboratory

Devices	N°	Manufacturer and type
Gamma spectrometers	9	Detectors: HPGe, Mirion-Camberra , Coaxial Detector System Electronics/Software: Canberra, Genie 2000 system, LabSocs
Gas Flow Proportional Counter	1	Detectors: Berthold LB 770 Low level Counter, 10 acquisition channels
High resolution alpha spectrometry system	1	Detectors: Canberra 7401-VR Electronics/Software: Canberra, Genie 2000 system
Passive radon measurement	1	Passive radon measurement device SSNTD's, TASLImage™ image analysis system designed specifically for measuring etch tracks in TASTRAK™ (CR-39)
Active radon measurement	14	Continuous radon monitors: 1 PQ 2000 ALPHAGUARD, 1 MR-1 THESIS, 1 MR-1 PLUS THESIS, 1 TECNAVIA RADON MAPPER, 5 CORENTIUM PRO and 5 CORENTIUM CANARY

6.4.4 Gamma spectrometry

The laboratory is equipped with nine Canberra HPGe gamma detectors used for environmental monitoring programme and for the CTBTO as part of World Laboratories Network. Four of the high-resolution gamma spectrometry systems are in use to detect gamma emitting radionuclides as part of

environmental programme. One new detector has been ordered and planned to be used for both environmental analyses and for CTBTO analyses.

Calibration and correction for self-absorption is performed for each measurement.

6.4.5 Gas flow proportional counting

The Radiometric Laboratory of ISIN is equipped with one Low Level Gas Flow Proportional Counter (Berthold LB 770-2) with 10 acquisition channels. The equipment is used for gross alpha and beta counting for determination of beta emitters (Sr-90, Cs-137, Pb-210).

6.4.6 Alpha spectrometry

The Radiometric Laboratory of ISIN is equipped with one high resolution alpha spectrometry system (Canberra 7401-VR). The efficiency of the system is 30%. The alpha spectrometry system is used for measurements of Am-241, Po-210, Plutonium Isotopes (Pu-238, Pu-239, Pu-240), Uranium Isotopes (U-234, U-235, U-238), Thorium Isotopes (Th-232, Th-230) and Ra-226.

6.4.7 Quality assurance

All the activities of the lab are carried out following the quality management system (SGQ) according to ISO 9001:2015.

Gamma spectrometry measurements and archiving of results are carried out according to the internal procedure: “IO.RDP.GAM Acquisizioni di spettrometria gamma”.

Data handling and reporting is done using the management information system for procedures and activities. All information is stored in the server “URAL-ADL” and the database SIGPA.

7 VERIFICATIONS

7.1 INTRODUCTION

Verifications were carried out in accordance with the agreed programme (Annex 1). This chapter summarises the verifications carried out 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 MONITORING PROGRAMME IN ROME

The verification team verified the structure of the radiological monitoring programme in Rome and the surrounding region. The programme covers all the relevant environmental components with reasonable intensity.

The team noted that currently there is no air sampler in central Rome. The sampler operated by ARPA Lazio is out of order – the closest air sampling site is in Viterbo, some 80 km from the Rome centre.

> *The verification team recommends installation of a medium-volume automatic air sampler in central Rome. The sampler should have capability to collect particulate matter and also gaseous radioactive iodine, and preferably be equipped with an alarming detector on the collection filter and a battery for electrical back-up.*

7.3 CNVVF CBRN NATIONAL CENTRE

7.3.1 Introduction

The verification team verified the monitoring arrangements at the CBRN national centre of the CNVVF in Rome[11]. The CBRN centre staff presented the national organization covering all Italian regions. The organisation has three levels of competences:

- Basic competences (all personnel)
- Intermediate competences (at provincial level)
- Specific competencies (regional level with national coordination).

In the event of a radiological emergency the CBRN team intervention is limited to the first response actions:

- Check the presence of radiation
- Identify nuclides and delimitate the contaminated areas
- Monitor the radiological risk
- Take preliminary actions.

[11] Piazza Scilla 2, Rome

The national early warning gamma dose rate automatic network of the Ministry of Interior, operated by the CNVVF, contains 1452 stations homogenously distributed in Italy. In Rome and in the surrounding area 40 stations (26 XR-33 stations, 12 MIRA and 2 SARA stations) are operational.

The CBRN centre staff presented the organisational structure and the monitoring network web interface (Fig. 20) to the verification team.

The verification team noted that the Italian territory is well covered by automatic monitoring stations, but there are regions where data is not received on the EU EURDEP data exchange system.

The verification team suggests that the Italian authorities, together with the relevant Commission service, assess the possibilities of exchanging dose rate data from each monitoring network in Italy via the EURDEP system.

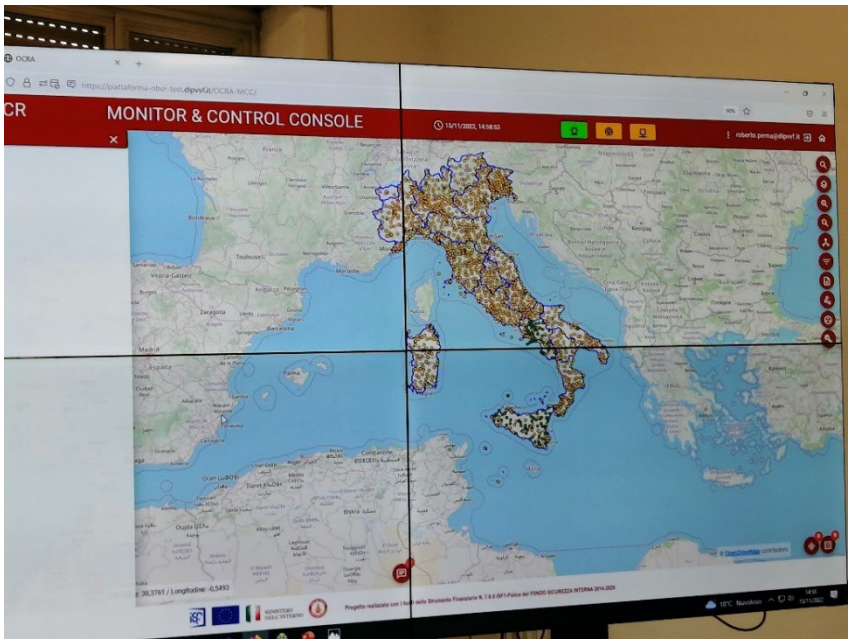

Figure 20. Web interface of the CBRN radiation monitoring network

7.3.2 Mobile monitoring equipment

The CBRN centre in Rome is equipped for carrying out mobile radiation monitoring. The verification team verified the following mobile monitoring equipment used by the CBRN staff in the event of an emergency:

- Dose rate monitors (Handheld: RADOS30, UDR13, FH40 with FHZ512 probe and backpack MIRION SPIR PACK)
- Portable BrLa gamma spectrometer (SPIR ACE BrLa) and NaI gamma spectrometer (HDS101)
- Neutron dose rate monitors (Thermo Scientific FHZ752 probe)
- Portable HPGe-gamma spectrometer (Ortec, electrically cooled)
- Car-based dose rate monitor (large NaI detector) for radioactive source location and dose rate mapping (Mirion SPIR MOBILE)
- Portable air sampler (new AMS Analitica with paper filter and charcoal cartridge; first 2-hour filter measurement by a FH40 with FHZ732 probe, then gamma spectroscopy if abnormal) (Fig. 21)
- Portable air sampler (Italelettronica GF145 with both paper and charcoal filters) (Fig. 21)

In addition, the CBRN units can carry out airborne monitoring (drone). Also underwater radiation probe is available (Fig. 22). A demonstration of radioactive source search operation was presented to the verification team.

No remarks.

Figure 21. CBRN centre mobile radiation monitoring equipment

Figure 22. Underwater radiation probe

7.4 EARLY WARNING AUTOMATIC NETWORK

The verification team verified the XR-33 station (Fig. 23) and the SARA station at the CNVVF centre in Rome. The XR-33 station is old (installed 1997) but has very robust and strong design (EMP-shielded). The GM-tube is directed downwards, making it useful for monitoring radioactive fallout on the ground. Data communication is via radio or telephone line. The station has also a local display (Fig. 23).

The verification team was informed, that the Italian authorities intend to replace all XR-33 stations by MIRA-stations in the future.

The verification team verified the spectroscopic SARA-station located on the roof of CBRN centre laboratory building; the electronics unit is inside. The station is operational (155 nSv/h). There are two such stations in Rome.

The verification team verified the on-site maintenance facility for the XR-33 stations. The facility has very good equipment, including climatic testing equipment. Maintenance of the MIRA and SARA stations is outsourced to the manufacturer company Envinet.

The verification team verified the ISIN GAMMA station located in Tuscania (VT - Madonnetta di Cerro locality). In this station there are dose rate probes (2 GM for low doses and 1 GM for high doses) and a spectroscopic $LaBr_3$ probe, with a sensitivity of 1 nSv/h for Cs-137. In the same location there is an old XR-33 station of the CNVVF network (Fig. 24).

No remarks.

Figure 23. XR-33 automatic fallout radiation monitoring station with a local display at the CNVVF centre

Figure 24. ISIN GAMMA station (left) and XR-33 station (right) at Madonnetta di Cerro

7.5 Regional Agency for the Environmental Protection of Lazio

7.5.1 Radiological laboratory

The verification team verified the radiological laboratory of ARPA Lazio located in Viterbo[12]. The laboratory carries out the environmental radioactivity monitoring programme in the Rome area. Main activities of the laboratory are monitoring of radioactivity in air, water, soil and food. In addition, the laboratory assures technical support to the competent authorities for the control of drinking water.

The environmental monitoring program of the ARPA Lazio laboratory is established by the Regional Council Resolution 39/2021 and consist of a total of 278 measures, of which 214 are part of the regional network.

There are two persons working in the laboratory performing radioactivity measurements. The laboratory has ISO17025 accreditation for gamma analyses and beta analyses of air filters.

Sample collection is performed by the employers of the laboratory (about 200 samples annually). The verification team visited the sample receipt and preparation rooms where samples are labelled and prepared to be analysed. Water samples were shown during the verification (Fig. 25). A LIMS system is used for labelling and recording of samples and data.

[12] Via Monte Zebio 17, 01100 Viterbo

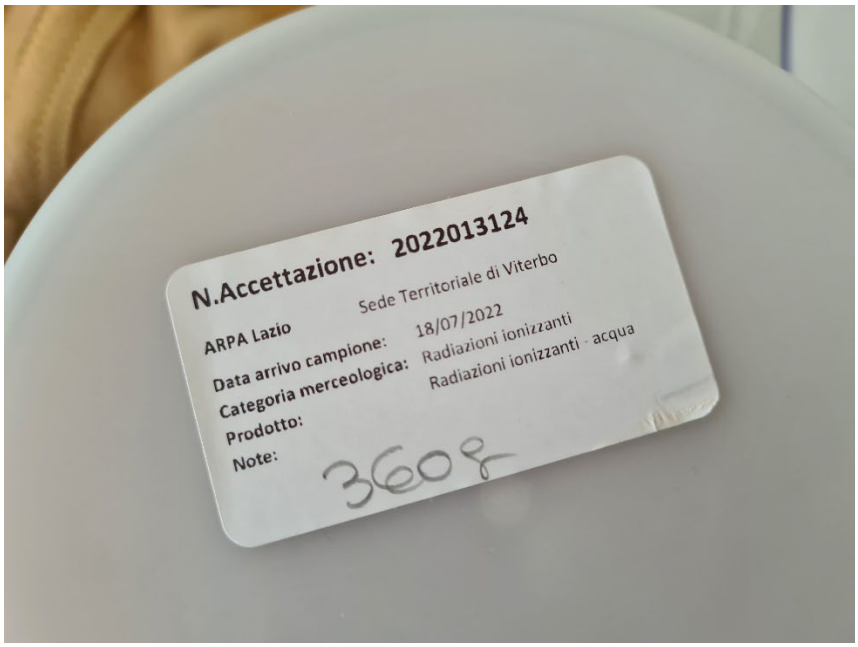

Figure 25. Water sample label

Sample preparation includes the following:

- evaporation (surface water, drinking water and sea water)
- Sieving and drying (soil and sediment)
- Drying and homogenisation (mixed diet)
- Homogenisation (foodstuffs)
- Radiochemical preparation for liquid scintillation counting (water)

The laboratory has the following counting equipment:

- Three gamma spectroscopy systems (1 Canberra, 2 Ortec) (Fig. 26)
- Two liquid scintillation counters (Hidex 300 XL) (Fig. 27)
- One Alpha/beta counter for air filters (Nutronic NT 200) (Fig. 28)

The counting equipment are operational and in good condition. Commercial standards are available for calibration of the detectors (efficiency, energy and resolution). Calibration can be corrected for different sample densities using the MAFFTRAN software. Air filters (2 days collection) are measured on gamma spectrometer and after 5 days decay on beta counter. Thereafter they are combined in 15-filter composite samples (one month) and analysed using gamma spectrometry.

After analysis all samples are stored for maximum three months, including filters. One shelf for incoming samples and two other shelfs for storage of analysed samples are organized in the sample storage room (Fig. 29).

The verification team notes, that having only one alpha/beta counter can decrease the reliability of the analytical work and the laboratory throughput in the event of an emergency.

The verification team notes that the ARPA Lazio laboratory does not carry out Sr-90 analysis on milk samples.

> *The verification team recommends that the ARPA Lazio laboratory prepares a method for analysing Sr-90 in milk.*
>
> *The verification team suggests that the ARPA Lazio laboratory acquires a second alpha/beta counting system for air filter measurements.*

Figure 26. Gamma spectroscopy systems at the ARPA Lazio laboratory

Figure 27. Liquid scintillation counters at the ARPA Lazio laboratory

Figure 28. Alpha/beta counter at the ARPA Lazio laboratory

Figure 29. Sample storage room at the ARPA Lazio laboratory

7.5.2 On-site monitoring equipment

The verification team verified the operation of the following on-site monitoring equipment at the ARPA Lazio laboratory:

- Air sampler (SKYPOPST TECORA). This low-volume sampler (40 litres/min) is equipped with an automatic filter change mechanism and a flowmeter (Fig. 30). It has no electrical back-up battery.
- Atmospheric deposition collector. This custom-designed collector is designed to be always wet, allowing better collection of particulate material. Water is added to the collector during the dry season (Fig. 31).

The equipment is operational and in good condition. The verification team noted that the deposition sampler is placed close to the wall, which may have an effect of the representativeness of the sample.

The verification team suggests placing the deposition sampler on an open area.

The verification team commends the sophisticated design of the atmospheric deposition sampler.

Figure 30. Automatic air sampler SKYPOPST TECORA at the ARPA Lazio laboratory roof

Figure 31. Atmospheric deposition collector at the ARPA Lazio laboratory roof

7.6 Italian National Agency for New Technologies, Energy and Sustainable Economic Development

7.6.1 Laboratory for radiological and environmental surveillance

The verification team verified the Laboratory for radiological and environmental surveillance (IRP-SFA), which is a part of the Radiation Protection Institute (IRP) of the ENEA Research Center in Casaccia[13]. The laboratory is responsible for the local environmental radioactivity monitoring. It contributes also to the radiological surveillance of the Rome region. The monitoring programme includes the following:

- Dose rate monitoring
- Air sampling (3 samplers)
- TLD dose monitoring
- Water sampling (drinking, surface, ground and waste)
- Soil sampling
- Sediment sampling
- Food and feed sampling (milk, vegetable and grass)

Sample management is based on MS Access database; typically there are about 2000 samples received annually. The laboratory does not have LIMS.

Samples are stored at the laboratory building for 5 years. ENEA provides an annual environmental monitoring report to ISIN.

The verification team verified the following laboratory equipment:

- Ovens (3) and furnaces (3) for sample drying and ashing
- HPGe-detector for gamma spectroscopy (7, two of them with C-window and one with Be-window) (Fig. 32)
- Automatic alpha/beta counter TENNELEC LB5100 for measurement of air filters (Fig. 33)
- Alpha/beta low-level Counter Berthold LB770 (Fig. 34)
- Alpha counter Canberra Alpha Analyst for Pu-analysis.

The verification team noted the following:

- The ENEA Casaccia laboratory uses a standard large nuclide library for gamma spectroscopy analysis. Since the nuclides in the environment are well known, using a custom library could shorten the analysis and present the results better.
- The ENEA Casaccia laboratory carries out calibration measurements when gamma spectroscopy system stability is controlled, but there are no long-term trend graphs prepared for system efficiency, energy, and resolution stability.
- The TENNELEC LB5100 counter is quite old (40 years).

The verification team recommends that the ENEA Casaccia laboratory initiates a practise of maintaining long-term trend graphs of gamma spectroscopy system stability parameters (energy, efficiency, and resolution (FWHM of the Co-60 peak at 1332 keV)).

The verification team suggests using a custom environment nuclide library for analysis of environmental gamma spectra.

The verification team suggests renewal of the air filter counting system in the near future.

[13] Via Anguillarese, 301, 00123 S. Maria di Galeria - Rome

Figure 32. Gamma spectroscopy systems at the ENEA Casaccia Research Centre

Figure 33. Automatic alpha/beta counter for measuring air filters at the ENEA Casaccia Research Centre

Figure 34. Alpha/beta low-level counter at the ENEA Casaccia Research Centre

7.6.2 On-site monitoring equipment

The verification team verified the following equipment installed at the ENEA site as part of the environmental monitoring programme:

- Air sampler 'Capanna' (Fig. 35). This sampler is equipped with an automatic filter change mechanism, which changes the filter every day. Typical airflow is 10-11 m^3/h. The system is equipped with a flow controller.
- TLD detectors at site F-15 (Fig. 36). There are two identical TLDs placed in a wooden cabinet. There are 15 on-site TLD measurement locations and 10 off-site. The TLDs are irradiated for 45 days, then measured in the ENEA Bologna laboratory TLD reader.
- Gamma dose rate monitor RSS-131ER (Fig. 37).

No remarks.

Figure 35. Air sampler 'Capanna'

Figure 36. TLD detectors at location F-15

Figure 37. Gamma dose rate monitor at the ENEA Casaccia Research Centre

7.6.3 Mobile monitoring equipment

The ENEA Casaccia laboratory operates two Land Rover vehicles for mobile monitoring. Both vehicles have identical equipment; they are equipped with AC-power generators. The verification team verified the following emergency mobile monitoring equipment in these vehicles:

- Air sampler installed in the emergency vehicle (Fig. 38) used to collect a 2 m^3 air sample on a 55 mm cellulose or charcoal filter. Typical collection time is 25 minutes.
- Contamination monitor Berthold LB 124. This device can be also used for dose rate monitoring and to check the air filters after collection.
- Dose rate monitor (Automess).

No remarks.

Figure 38. Air sampler in the emergency vehicle at the ENEA laboratory

7.7 RADIOACTIVITY LABORATORY OF THE ISTITUTO ZOOPROFILATTICO SPERIMENTALE DEL LAZIO E TOSCANA

The verification team verified the monitoring arrangements at the laboratory of the Istituto Zooprofilattico Sperimentale del Lazio e Toscana "M. Aleandri" (IZSLT)[14], which carries out monitoring of radioactivity in foodstuffs. This laboratory carries out gamma spectroscopy on about 1000 samples per year. About 50% of the samples come from commercial customers (import/export certificates); the rest belong to the regional radioactivity surveillance programme.

The IZSLT laboratory is accredited according to the ISO standard UNI ISO/IEC 17025:2018. It takes part in annual proficiency test exercises organised by IARMA.

Edible part of the samples is homogenised before placing in the Marinelli beaker (50, 190, 1000 or 3000 ml) for counting on a HPGe-spectrometer. Samples are discarded after counting.

The laboratory has two HPGe-spectrometers (Canberra) (Fig. 39). Genie2000 analysis software is used. Sr-90 analysis is outsourced to the Reference National Center for Radioactivity Research (CRNR) IZS Puglia e Basilicata. Energy and efficiency controls of the HPGe-detectors are carried out using an activity standard once a year. Technical control of the systems is performed annually.

Figure 39. HPGe-spectrometers (Canberra) at the IZSLT laboratory

The verification team noted, that the IZSLT laboratory does not maintain long-term trend graphs of the HPGe-detector stability parameters.

The verification team noted, that the IZSLT laboratory has no formalised plan for carrying out food radioactivity monitoring in the event of an emergency, when the number of samples can be much higher and some of the samples may contain elevated radioactivity levels (elevated counting room background radiation and danger of equipment contamination).

[14] Via Appia Nuova 1411, 00178 Roma

The verification team recommends that the IZSLT laboratory initiates a practise of maintaining long-term trend graphs of gamma spectroscopy system stability parameters (energy, efficiency and resolution (FWHM of the Co-60 peak at 1332 keV)).

The verification team recommends that the IZSLT laboratory prepares a contingency plan, which defines the practical sample management procedures in a situation where the number of incoming samples significantly increases, and some of the samples contain elevated amounts of radioactivity.

7.8 RADIOMETRIC LABORATORY OF THE ITALIAN INSPECTORATE FOR NUCLEAR SAFETY AND RADIATION PROTECTION

The verification team verified the monitoring arrangements at the Radiometric Laboratory of the National Inspectorate for Nuclear Safety and Radiation Protection (ISIN)[15]. The laboratory does not take part in the routine monitoring programmes, but it carries out targeted radiological environment surveys, in particular in areas with NORM contamination. In addition, it takes part on the CTBTO monitoring programme. It has a staff of 10.

The ISIN laboratory has very good facilities and equipment for sample preparation and associated radiochemistry. The counting room equipment includes the following:

- Alpha spectrometers (Canberra) (Fig. 40)
- Beta counter
- 2 alpha beta counters (Berthold LN 770-2) (Fig. 41)
- 3 HPGe detectors (Fig. 42)
- Portable gamma spectrometer (Fig. 43)
- One very large HPGe-detector for CTBTO gamma spectroscopy (Compton suppressed, Fig. 44).

No remarks.

Figure 40. Alpha spectrometers at the ISIN laboratory

[15] Via di Castel Romano 100, 00128 Rome

Figure 41. Alpha beta counters at the ISIN laboratory

Figure 42. Gamma spectroscopy laboratory at the ISIN laboratory

Figure 43. Portable HPGe gamma spectrometer at the ISIN laboratory

Figure 44. Large HPGe-detector for CTBTO gamma spectroscopy (Compton suppressed)

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 Rome 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 Rome 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 are 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 Italian competent authority through the Permanent Representative of Italy to the European Union.

(5) The Commission services kindly request the Italian authorities to submit, by 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. 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 ITALY

(ROME)

15 - 18 NOVEMBER 2022

PROGRAMME

Tuesday 15 November

10.00 **Opening meeting at the National Inspectorate for Nuclear Safety and Radiation Protection (ISIN) HQ**

(Via di Capitan Bavastro 116, 00154 Rome)

- Welcome and introduction of the Director of the National Inspectorate for Nuclear Safety and Radiation Protection (ISIN) – Dr. Maurizio Pernice
- European Commission Art. 35 verification activities and programme of the verification mission – Mr. V. Tanner and Ms. E.L. Diaconu, EC DG ENER D.3
- Discussion on the past verifications in Italy by the Commission
- Other presentations
- Verification planning

11.30 **Overview of radioactivity monitoring arrangements in Italy and in Rome (ISIN)**

- 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 CBRN National Centre**

(Piazza Scilla 2, Rome)

- Monitoring equipment
- Emergency equipment

Wednesday 16 November

10.00 **Verifications at the Regional Radioactivity Centre of the Regional Agency for the Environmental Protection of Lazio (ARPA)**
(Via Monte Zebio 17, 01100 - Viterbo)

- Radiological laboratory
- On-site monitoring equipment

14.00 **Verifications of monitoring equipment**
(Tuscania – località Madonnetta di Cerro)

- ISIN GAMMA network

Thursday 17 November

09:30 **Verifications at the ENEA Casaccia Research Centre**, **Radiation Protection Institute, Laboratory for radiological and environmental surveillance**
(Via Anguillarese, 301, 00123 S. Maria di Galeria)

- Radiological laboratory
- On-site monitoring equipment
- Mobile monitoring equipment

14.00 **Verifications at the Istituto Zooprofilattico Sperimentale del Lazio e Toscana (IZS)**
(Via Appia Nuova 1411, 00178 - Roma)

- Radiological laboratory

Friday 18 November

09.30 **Verifications at the ISIN laboratory**
(Via di Castel Romano 100, 00128 Rome)

14:00 **Review of the Italy data in the Commission Art. 35 database**

15.00 **Closing meeting at the ISIN HQ**
(Via Capitan Bavastro 116, Rome)