EUROPEAN COMMISSION
DIRECTORATE-GENERAL FOR ENERGY

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

TECHNICAL REPORT

VERIFICATIONS UNDER THE TERMS OF ARTICLE 35 OF THE EURATOM TREATY

Central and Southern Italy
Campania, Molise, Abruzzo, Marche, Umbria and Lazio
Garigliano NPP

12 to 17 September 2011

Reference: IT-11/06

VERIFICATIONS UNDER THE TERMS OF ARTICLE 35

OF THE EURATOM TREATY

FACILITIES:	Installations for monitoring and surveillance of environmental radioactivity in central and southern Italy (Campania, Molise, Abruzzo, Marche, Umbria and Lazio) as well as discharge and environmental radiological monitoring of the former Garigliano NPP site.
SITE:	Campania, Molise, Abruzzo, Marche, Umbria and Lazio.
DATE:	12 to 17 September 2011
REFERENCE:	IT-11/06
VERIFICATION TEAM:	Mr C. Gitzinger (Head of team) Mr E. Henrich Mr. E. Hrnecek Mr. A. Ryan
DATE OF REPORT:	28 March 2012

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TABLE OF CONTENTS

TECHNICAL REPORT

ABBREVIATIONS AND ACRONYMS

ADSL	Asymmetrical Digital Subscriber Line (telecommunication)
AGIRE - POR	*Attivazione Gemellaggi Internalizzazione Regionale Esperienze di successo - Programma Operativo Regionale*
ANPA	*Agenzia Nazionale della Protezione dell'Ambiente* (National Environmental Protection Agency)
APAT	(former) *Agenzia per la Protezione dell'Ambiente e per i Servizi Tecnici* (Agency for Environmental Protection and Technical Services)
APPA	*Agenzia Provinciale per la Protezione dell'Ambiente* (Autonomous Province Agency for Environmental Protection)
ARPA	*Agenzia Regionale di Protezione Ambientale* (Regional Agency for Environmental Protection)
ARPAC	*Agenzia Regionale Protezione Ambientale Campania* (Regional Agency for the Environmental Protection of Campania)
ARTA	*Agenzia Regionale per la Tutela dell'Ambiente* (Regional Agency for the Environmental Tutelage of Abruzzo)
ASL	*Azienda Sanitaria Locale* (Local Public Health Service)
a.s.l.	above sea level
AUSL	*Azienda Unità Sanitaria Locale* (Local Public Health Service)
BWR	Boiling Water Reactor
CIP	*Comitato Interministeriale Prezzi* (Interministerial Committee on Prices)
CIPE	*Comitato Interministeriale per la Programmazione Economica* (Interministerial Committee on Economic Planning)
CNVVF	*Corpo Nazionale dei Vigili del Fuoco* (Italy fire service)
CRI	*Croce Rossa Italiana* (Italian Red Cross)
CRR	*Centro Regionale Radioattivitá* (Regional Reference Centre for Radioactivity)
CD-ROM	Compact Disk Read Only Memory
cpm	counts per minute
cps	counts per second
DBRad	Data Base on environmental radioactivity
DG	Directorate-General
DSA	General Direction for Environmental Safeguard
DVA	General Direction for Environmental Evaluation
EC	European Commission
ECURIE	European Community Urgent Radiological Information Exchange
EML	Environmental Measurements Laboratory
ENEA	*Ente per le Nuove tecnologie, l'Energia e l'Ambiente* (National Agency for New Technology, Energy and Environment)
Enel Spa	Italy's largest electric power company
ENER	Energy
EURDEP	EUropean Radiological Data Exchange Platform
GAMMA	The national on-line gamma dose rate monitoring network (part of the national early warning system)
HEPA	High Efficiency Particulate Air (filter)
HPGe	High Purity Germanium (gamma detector)
IAEA	International Atomic Energy Agency
ICP-MS	Inductively Coupled Plasma - Mass Spectrometry
ICRAM	(former) *Istituto Centrale per la Ricerca scientifica e tecnologica Applicata al Mare* (Central Institute for Scientific and Technological Research applied to the Sea)
INFS	(former) *Istituto Nazionale per la Fauna Selvatica* (National Institute for Wildlife)
INMRI	*Istituto Nazionale di Metrologia delle Radiazioni Ionizzanti* (National Institute of Ionizing Radiation Metrology; of ENEA)
IR	Ionising Radiation

ISDN	Integrated Services Digital Network (telecommunication)
ISO	International Organization for Standardization
ISOCS™	In Situ Object Counting System
ISPESL	*Istituto Superiore Prevenzione e Sicurezza sul Lavoro* (National Institute for Occupational Prevention and Safety)
ISPRA	*Istituto Superiore per la Protezione e la Ricerca Ambientale* (Institute for Environmental Protection and Research)
IT	Information Technology
ITREC	*Impianto di Trattamento e Rifabbricazione Elementi di Combustibile* (Fuel Element Processing and Refabrication Plant)
LN_2	Liquid Nitrogen
LSC	Liquid Scintillation Counting/Counter (radiation detection)
MATTM	*Ministero dell'Ambiente e della Tutela del Territorio e del Mare* (Ministry of the Environmental and Protection of the Territory and the Sea)
MDA	Minimum Detectable Activity
MH	*Ministero della Salute* (Ministry of Health)
MI	*Ministero degli Interni* (Italian Ministry of Interior)
MRNS	Mixed RadioNuclide Source
NaI(Tl)	Sodium Iodide Thallium activated (gamma detector)
NEMP	Nuclear Electro-Magnetic Pulse
NIM	Nuclear Instrumentation Module
NIR	Non-Ionising Radiation
NORM	Naturally Occurring Radioactive Material
NPP	Nuclear Power Plant
OJ	Official Journal
PC	Personal Computer
POD	*Piano Operativo di Dettaglio* (Operative Details Plan)
POR	*Piano Operativo Regionale* (Regional Operative Programme)
PVC	PolyVinyl Chloride
QA / QC / QM	Quality Assurance / Quality Control / Quality Management
RADIA	System of transfer and storage of environmental radioactivity data
REM DB	Radioactivity Environmental Monitoring Data Base
REMRAD	*REte nazionale di Monitoraggio della RADioattivitá nel particolato atmosferico* (Automated national network for the on-line monitoring of airborne radioactivity; part of the national early warning system)
RESORAD	*REte nazionale di SOrveglianza della RADioattività ambientale* (National Environmental Radioactivity Surveillance Network)
SMOD	Sedimentable Mineral Organic Detritus
SOGIN	*Società Gestione Impianti Nucleari* (Nuclear Plant Management Co.)
TENORM	Technologically Enhanced Naturally Occurring Radioactive Material
TL	Thermo Luminescence
TLD	Thermo Luminescent Dosimeter/Dosimetry (radiation detector)
UHT	Ultra High Temperature
UKAS	United Kingdom Accreditation Service
UOS	*Unità Operativa Semplice* (Operative Unit)
UPS	Uninterruptible Power Supply
USD	United States Dollars
ZnS	Zinc sulphide (radiation detector)

1 INTRODUCTION

Article 35 of the Euratom Treaty requires that each Member State shall establish facilities necessary to carry out continuous monitoring of the levels of radioactivity in air, water and soil and to ensure compliance with the basic safety standards[1].

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

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

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

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

Taking into account previous bilateral protocols, a Commission Communication has been published in the Official Journal on 4 July 2006 with a view to define some practical arrangements for the conduct of Article 35 verification visits in Member States.

Two verification teams from DG ENER.D.4 (now DG ENER.D.3) visited (12 to 17 September 2011) central and southern Italy (Campania, Molise, Abruzzo, Marche, Umbria and Lazio) in order to verify the monitoring of environmental radioactivity in these regions as well as the monitoring of discharges and environmental radioactivity at the former Garigliano-NPP site. Representatives of Sardegna and Toscana provided full information of the environmental radiological monitoring in their regions on paper and during the opening meeting. These two regions could only be verified based on the submitted paper documentation, but not visited, due to time constraints. They will be included in a future verification.

The visit also included meetings with representatives of the national and regional authorities having competence in the field of radiation protection.

The present report is based on information collected from documents received and from discussions with various persons during the visit and contains the results of the verification team's review of relevant aspects of the radiological environmental surveillance in all above named regions and sites in central and southern Italy.

2 PREPARATION AND CONDUCT OF THE VERIFICATION

2.1 PREAMBLE

The Commission's request to conduct an Article 35 verification was notified to the Italian Permanent Representation to the European Union by letter ENER/D4/CG/cn/Ares (2011)74359.

Subsequently, practical arrangements for the implementation of both verifications were made with the Italian competent authority *Istituto Superiore per la Protezione e la Ricerca Ambientale* (ISPRA).

The present report covers the verifications in the regions of Campania, Molise, Abruzzo, Marche, Umbria and Lazio. The teams received also documentation concerning the situation in the regions of

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

Sardegna and Toscana. Due to a lack of time these two regions could not be included in the present verification.

2.2 PROGRAMME OF THE VISIT IN CENTRAL AND SOUTHERN ITALY

On 12 September an opening meeting was held in Salerno (Campania) in the premises of ARPA-Campania. The Italian competent authority (ISPRA) and representatives of eight regions of Italy participated in this meeting. Both the political and the operational levels (ARPAs) of each region were represented. The regions (Campania, Molise, Abruzzo, Marche, Umbria Lazio, Sardegna and Toscana) presented the radiological monitoring programmes already implemented in their regions and the activities that are to be implemented in the near future. The programme of verification activities was discussed and finalized, based on a Communication by the EC[2], setting out the framework and modalities within which Article 35 verifications may be conducted.

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

- The verification was focused on the environmental radiological monitoring programmes and activities as implemented by all six visited regions of Central and Southern Italy including sampling and monitoring systems, analytical methods, quality assurance and control aspects, reporting, etc..
- Verification activities at the different regional ARPA laboratories, addressing infrastructure, analytical methods, quality assurance and control aspects, reporting. At the same time the monitoring and sampling provisions located on the laboratory premises were also subjected to verification.
- Verification of different gamma probes of the national surveillance network GAMMA.
- Verification of the radiological monitoring of the Garigliano NPP site including sampling and monitoring systems, analytical methods, quality assurance and control aspects, reporting, etc..

2.3 DOCUMENTATION

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

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

2.4 REPRESENTATIVES OF THE COMPETENT AUTHORITY AND OF EIGHT REGIONS OF CENTRAL AND SOUTHERN ITALY

During the verification visit, the following representatives of the national authority, the regional authorities and of the regional ARPAs were met.

I. National level

Ministry of Environment and Protection of the Territory and of the Sea; *Ministero dell'Ambiente e della Tutela del Territorio e del Mare* (MATTM)

Ms. Barbara Castrucci	Biologist, Environmental Assessments Department

[2] 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 2006/C 155/02).

Ministry of Health; ***Ministero della Salute***

Mr. Alessandro Magliano	Chemist, Prevention and Communication Department

Institute for Environmental Protection and Research; *Istituto Superiore per la Protezione e la Ricerca Ambientale* (ISPRA), Rome

Mr. Giancarlo Torri	Engineer, responsible for the Control Service of the Environmental Radiation
Ms. Sonia Fontani	Biologist, Radioprotection Department, Monitoring Network Sector
Mr. Giuseppe Menna	Physicist, Radioprotection Department, responsible for the Monitoring Network Sector
Mr. Lamberto Matteocci	Engineer, responsible for Control of Nuclear Activities Division
Mr. Fausto Zambardi	Engineer, responsible for Garigliano and Trino NNP Licensing Section
Ms. Rita Ocone	Physicist, responsible for reliability control on effluents and environmental measurements at nuclear installations
Ms. Carmelina Salierno	Engineer, Nuclear Installations Radiation Protection Section, charged for environmental monitoring radiation protection verifications and art. 36 data preparation
Ms. Anna Picardi	Physicist, Garigliano and Trino NNP Licensing Section, charged for decommissioning licensing procedure

ISPRA personnel involved in Euratom Art. 35 verification visit at GAMMA network monitoring stations

Paolo Zeppa	Engineer, Responsible for Nuclear Emergencies Coordination Section
Stefano Zennaro	Physicist, charged for GAMMA network management activity
Mario Casciolo	Technician, charged for GAMMA network stations maintenance activities
Giuseppe Amadio	Technician, charged for GAMMA network stations maintenance activities

II. Regional level

Region of Abruzzo

Iris Flacco	Biologist	Responsible for the Environmental Sector
Andrea Veschi	Engineer	Officer of the Environment Prevention and Protection service of the Molise Region

Region of Campania

Giovanni Romano	Lawyer	Regional Assessor of the Environment and Territory
Michele Palmieri	Geologist	Responsible of the Environmental Department of the Campania Region
Margherita Arpaia	Physicist	Officer of the Environmental Sector

Region of Marche

Corrado Pantalone		Head Environmental Radioactivity Laboratory

Region of Molise

Francesco Manfredi Selvaggi	Architect	Director of the Environment Prevention and Protection service of the Molise Region
Fedele Cuculo	Engineer	Officer of the Environment Prevention and Protection service of the Molise Region

Region of Lazio

Aldo Palombo	Geologist	Director of the Environmental Quality Conservation Area
Cecilia Sacchetta	Biologist	Officer of the Environmental Quality Conservation Area

Region of Sardegna

Salvatore Careddu	Engineer	Responsible for Prevention and Safety of the Working and Life Environments Sector

Region of Toscana

Tommaso Giunti	Engineer	Responsible for the Regional Network for monitoring environmental radioactivity

Region of Umbria

Marco Trinei	Architect	Officer in the Department of Environment and Territory
Vitaliano Palomba	Naturalist	Instructor Administration Department of Environment and Territory

ARPA – Abruzzo

Lorenzo Carnesale	Physicist	Responsible for laboratory radiometric
Sergio Palermi	Physicist	Laboratory Technician Professional
Gabriele Sulli	Physicist	Laboratory Technician Professional

Damiano Rancitelli	Chemist Technician	Laboratory Technician
Giancarlo Buccella	Technician	Laboratory Technician

ARPA – Campania

Alfonso Dubois	Geologist	Provincial Director
Pietro Mainolfi	Chemist	Responsible for laboratory radiometric
Annamaria Barbuto	Chemist	Laboratory Technician
Antonio Ingenito	Physicist	Laboratory Technician Professional
Guido Guerrasio	Physicist	Laboratory Technician Professional
Agostino Migliaccio	Physicist	Laboratory Technician Professional

ARPA – Marche

Mirti Lombardi	Physicist	Responsible for the Service of the Radiation/Noise
Corrado Pantalone	Physicist	Responsible for radiometric laboratory
Gianni Corvatta	Chemist	Scientific Director
Stefano Orilisi	Chemist	Department Director
Stefania Sarcina	Biomedical	Quality Assurance Manager
Marco Miecchi	Electrotechnical technician	Technical assistant
Jasna Miljak	Electronic technician	Technical assistant
Damiano De Petris	Engineer	Technical assistant

ARPA – Molise

Luigi Petracca	Lawyer	Director of ARPA Molise
Patrizia Ammazzalorso	Biologist	Director Department Environmental Surveillance
Claudio Cristofaro	Physicist	Responsible for the Regional Network for monitoring environmental radioactivity
Eduardo Patroni	Chemist	Scientific Director ARPA Molise
Pasqualina Fucci	Technician	Environment Prevention technician
Pierluigi Di Rocco	Programmer	Technical Programmer, Administrative
Roberto De Filippis	Technician	Administrative
Nicola Simonelli	Technician	Environment Prevention technician

ARPA – Lazio

Giovanni Cherubini	Physicist	Responsible for radiometric laboratory

Luca Amendola	Chemist	Laboratory Technician Professional
Giorgio Evangelisti	Physicist	Laboratory Technician
Marco Valentini	Physicist	Laboratory Technician
Tina Fabozzi	Biologist	Responsible for Physical Agents Latin Section
Pier Antonio Di Legge	Physicist	Laboratory Technician

ARPA – Sardegna

Massimo Cappai	Physicist	Responsible for the Regional Network for monitoring environmental radioactivity

ARPA – Toscana

Silvia Bucci	Physicist	Responsible for the Regional Network for monitoring environmental radioactivity

ARPA – Umbria

Paola Sabatini	Biologist	Responsible for the Ionizing Radiation service
Leonardo Merlini	Chemist	Responsible for the Water Chemistry and Physics sector
Giuseppe Augelli	Bio Medical Laboratory Technician	Laboratory Technician
Valeria Fabbri	Physicist	*Titolare assegno ricerca FSE per la misura della radioattività nelle acque tramite scintillazione liquida*

SOGIN S.p.A., Nuclear Power Plant Garigliano (CE)

Ivo Velletrani	Regulatory Affairs, Communication and Internal Relations (Institutional Relation Manager)
Franco Bambacigno	Regulatory Affairs, Communication and Internal Relations
Francesca Landucci	Regulatory Affairs, Communication and Internal Relations
Ivo Tripputi	Regulatory Affairs, Communication and External Relations (International Relation Manager)
M. Iorio	Engineer, NPP Project Manager
A.M.Esposito	Physicist, Qualified Expert
F.Pisciotta	Chemist, responsible for laboratory
E.Casapulla	Laboratory Technician
L.Laudante	Laboratory Technician
M.Esposito	Laboratory Technician
G.Ercolano	Laboratory Technician

L.Corvino	Laboratory Technician

Italian Red Cross, Rome

Amos Dawodu	Medical Director of the Central Laboratory
Claudia Fontana	Biologist. Responsible for Environmental Radioactivity Service
Paolo Bennati	Bio-medical laboratory technician

3 COMPETENT AUTHORITIES AND RELEVANT LEGISLATION

3.1 LEGAL BASIS

The main legislative act, establishing the responsibilities of the various actors in environmental radioactivity monitoring, in the radiological surveillance of foodstuffs and in emergency preparedness is Legislative Government Decree Nr. 230 of 17 March 1995 (amended by Legislative Decrees 187/2000, 241/2000, 257/2001 and 151/2001; the latter implementing European Directives 89/618/Euratom, 90/641/Euratom, 92/3/Euratom and 96/29/Euratom).

Decree Nr. 230, in Article 54 specifies that:

- Operators of authorised nuclear installations shall supply and operate the equipment necessary for permanent surveillance of the level of radioactivity of the atmosphere, waters, soil and foodstuffs, both within the site perimeter and within the surveillance area around the site.

Decree Nr. 230, in Article 104 specifies that:

- The responsibility for monitoring environmental radioactivity in Italy is with the Ministry of Environment and Protection of the Territory and the Sea (hereafter MATTM).
- The responsibility for the radiological surveillance of foodstuffs and feedstuffs is with the Ministry of Health (hereafter MH).
- Both Ministries shall exchange radiological information gathered during the exercise of their respective responsibilities.
- Radiological surveillance shall be established through national and regional monitoring networks.
- The implementation and operation of regional networks is under full responsibility of the regional governments; the latter shall abide by directives issued at national level by both the MATTM and the MH. National directives shall aim at reaching harmonisation over the regions where it concerns the standardisation and comparability of methods and techniques for sampling and sample analysis.
- The national monitoring networks shall be operated by bodies, entities or organisations having the necessary competence in the field of radiological protection.
- An independent national radiological emergency network is under the responsibility of the Ministry of Home Affairs.

European Council Decision n° 87/600/Euratom[3]:

- ISPRA (*Istituto Superiore per la Protezione e la Ricerca Ambientale*) is the Italian Nuclear Safety Authority and has, at national level, the responsibility for the European Community Urgent Radiological Information Exchange (ECURIE) system and thus for two associated networks. The first is the RESORAD network that includes all Regional/Provincial agencies for environmental

[3] 87/600/EURATOM Council Decision of 14 December 1987 on Community arrangements for the early exchange of information in the event of a radiological emergency (OJ L-371 of 30 December 1987, page 76)

protection and some other qualified institutions. The second is a national telemetric radiological warning network of alarm consisting of a system for measuring ambient gamma dose (GAMMA network) and automatic stations for air particulate measurements (REMRAD network).

3.2 COMPETENT MINISTRIES

3.2.1 Ministry of the Environment and the Protection of the Territory and of the Sea (MATTM)

The Ministry of the Environment and the Protection of the Territory and of the Sea (*Ministero dell'Ambiente e della Tutela del Territorio e del Mare* - MATTM) is responsible for the radiolocical surveillance of the environment (art. 104 – Legislative Decree 230/95). It has been established under the Law n.349 of 8 July 1986 and further modifications and integrations. It is organised in six directorates-general.

3.2.2 Ministry of Health (MH)

The Ministry of Health (MH, *Ministero della Salute*) is responsible for the radiological surveillance of foodstuffs (art. 104 – Legislative Decree 230/95). It is the top level body of the national health system which also comprises bodies at regional level and involves the *Istituto Superiore de Sanitá*, the leading scientific and technical institution in Italy in this field, as well. MH, in accordance with Law n. 317 of 2001, was created by separation from the Ministry of Welfare. It has been attributed 'the functions of human and veterinary health protection, the coordination of the national sanitary system, as well as the hygiene and surveillance of foodstuffs'.

In order to fulfil it's responsibilities and the requirements of protection and promotion of health of the citizens and of veterinary health, MH is organized in directorates-general and departments. The Directorate-General of Sanitary Prevention is – among other tasks – responsible for the radiological surveillance of foodstuffs.

3.3 INSTITUTE FOR ENVIRONMENTAL PROTECTION AND RESEARCH (ISPRA)

3.3.1 Introduction

The Institute for Environmental Protection and Research (*Istituto superiore per la protezione e la ricerca ambientale* - ISPRA), has been established by Decree no. 112 of 25 June 2008, converted into Law no. 133 (with amendments) on 21 August 2008. ISPRA performs, with the inherent financial resources, equipment and personnel, the duties of:

- ex-APAT, Italian Environment Protection and Technical Services Agency (article 38 of Legislative Decree no. 300, 30 July 1999, and subsequently amended)[4];
- ex-INFS, *Istituto Nationale per la Fauna Selvatica* - National Institute for Wildlife (Law no. 157 of 11 February 1992, and subsequently amended);
- ex-ICRAM, *Istituto Centrale per la Ricerca scientifica e tecnologica applicata al Mare* - Central Institute for Scientific and Technological Research applied to the Sea (Decree no. 496, article 1-bis, 4 December 1993, converted into Law no. 61, Article 1, 21 January 1994, with amendments).

ISPRA is the Italian Nuclear Safety Authority, technically, scientifically and financially autonomous, and reports directly to the Ministry of the Environment and the Protection of the Territory and of the

[4] APAT (*Agenzia per la Protezione dell'Ambiente e per i Servizi Tecnici* - Agency for Environmental Protection and Technical Services), one of the predecessors of ISPRA, was created in 2002 by merging ANPA with the Department for National Technical Services of the Presidency of the Council of Ministers (provision of Presidential Decree Nr. 207 of 8 August 2002). the former National Environmental Protection Agency, ANPA (*Agenzia Nazionale della Protezione dell'Ambiente*), was established by Art. 38 of Legislative Decree Nr. 300 of 30 July 1999.

Sea (MATTM). ISPRA operates in three-year programmes which are annually updated. These programmes aim at the implementation of directives issued by MATTM, by setting objectives, defining priorities and allocating resources.

3.3.2 Main statutory responsibilities

The main duties and statutory responsibilities of ISPRA as the Italian Nuclear Safety Authority, so as to fulfil the obligations laid down in Decree Nr. 230 (as amended) are:

- Controls and inspections on existing nuclear installations.
- Licensing of new nuclear installations.
- Controls and inspections on the possession, commerce, transport, use and release of radioactive materials.
- Controls and inspections on radioactive waste management.
- Radiation protection of workers, the public and the environment.
- Nuclear emergency preparedness.
- Fulfilment of international agreements on control and surveillance of nuclear materials.
- Promotion of international co-operation in the field of nuclear safety and radiation protection.
- Promotion of actions aimed at maintaining and improving the national know-how and the national safety culture in the field of nuclear safety and radiation protection.

In addition to these duties, ISPRA has also to:

- Support the national administrations (environment, health, home affairs, industry) to issue decrees that implement primary nuclear legislation.
- Issue specific technical guidance.
- Realise a national database on all nuclear applications.
- Assess the safety analysis carried out by the operating organisation.
- Inspect equipment and materials during the design, construction and operational phases (systematic operational safety verification).
- Enforce actions to remedy any failure to meet the licensing conditions and/or operational safety criteria.

In order to guarantee homogeneity of survey criteria, and following the directives of both the Ministry of the Environmental and Protection of the Territory and of the Sea (MATTM), ISPRA

- Co-ordinates measurements carried out by the agencies and institutions belonging to the national network in order to assure uniform techniques and methodologies of sampling and analysis.
- Promotes the installation of sampling and measurement stations whenever this is necessary for the achievement of an appropriate network of survey on national scale.
- Transmits the collected data to the European Commission.
- Co-ordinates and supervises the implementation of the environmental radioactivity monitoring in the Italian regions by ARPAs (*Agenzia Regionale di Protezione Ambientale* - Regional Agency for Environmental Protection) and APPAs (*Agenzia Provinciale Per l'Ambiente* - Autonomous Province Agency for Environmental Protection).

4 ENVIRONMENTAL RADIOACTIVITY MONITORING IN ITALY

4.1 INTRODUCTION

In Italy, the Ministry for the Environment and the Protection of the Territory and of the Sea is responsible to control environmental radioactivity in accordance with article 104 of Legislative Decree no. 230/1995 and its subsequent amendments and integrations. The national system of environmental radioactivity monitoring is based on a set of networks for surveillance, measurements and controls carried out by different structures distributed throughout the territory. The abovementioned Legislative Decree entrusts ISPRA with the technical coordination functions of national surveillance networks. Italy has been divided, also on the basis of European Commission directives and recommendations, in three "macro-regional areas" and 21 autonomous regions/provinces. In compliance with the Italian legislation the surveillance of the environmental radioactivity in Italy is organized at three different levels:

At *national* level three networks are in place:

- National network of environmental radioactivity monitoring (RESORAD). This network is basically a collection of a subset of data from the regional/provincial networks.
- National telemetric alarm networks (REMRAD and GAMMA) managed by ISPRA;
- National network for the surveillance of gamma radiation under the responsibility of the Ministry of the Interior. Data collected from this network are considered confidential and are not publicly available. This network was not part of the verification.

At *regional* level, there are 21 regional/provincial environmental radioactivity surveillance networks, each of which is under the responsibility of the concerned region/autonomous province. Currently the related programmes are implemented by the laboratories of the regional/provincial environmental protection agencies (ARPA/APPA).

At *local* or site related level, a radioactivity monitoring network at the site of the nuclear installation has to be operated even if the site is under decommissioning. This network is under the responsibility of the plant operator.

4.2 NATIONAL NETWORKS FOR ENVIRONMENTAL RADIOACTIVITY MONITORING

The national monitoring programmes for environmental radioactivity (art. 104 Legislative Decree 230/95) and for alarm are established and co-ordinated by ISPRA.

In addition, a national network for the surveillance of gamma radiation exists under the responsibility of the Ministry of the Interior. Data collected from this network are considered confidential and are not publicly available. This network was not part of the verification.

The laboratory based national environmental radioactivity monitoring programme RESORAD is generally built up as a subset of the regional laboratory based environmental radioactivity monitoring programmes and has been strongly adapted to the EU Recommendation 2000/473/Euratom. The parameters covered by it are selected by the national agency ISPRA which also considerably influences and controls the regional implementation and the further development of the system. The RESORAD programme is implemented by the laboratories of the regional/provincial agencies system (ARPA, APPA) and other reliable and qualified institutions or bodies. The automatic systems GAMMA and REMRAD have been implemented and are managed directly by ISPRA. The GAMMA network is connected to the European Radiological Data Exchange Platform (EURDEP) set-up by the European Commission in the framework of the system for the early notification of nuclear and radiological emergencies within the EU Countries (European Community Urgent Radiological Information Exchange - ECURIE) in compliance with the EU Council Decision 87/600/Euratom.

The aim of the networks is the surveillance of the pattern of environmental and dietary contamination and the identification of anomalous variations of radioactivity as a result of a (nuclear) accident. They serve to assess the radiation doses which the Italian population may receive and to produce data for support to management and decisional processes in case of emergencies.

4.2.1 RESORAD network

The sampling network RESORAD has been set up in a way to give pertinent information on the average extent of environmental and dietary contamination. The 'ideal' sampling programme should provide representative samples able to reveal the average situation both in time and space. RESORAD is generally a subset of the regional/provincial sampling network with a selection of parameters to allow a picture at national level.

In order to guarantee that the laboratories participating in the RESORAD network perform measurements with a certain degree of accuracy and quality, ISPRA provides a reliability programme through the organisation of inter-comparison and inter-laboratory exercises. The reliability programme is performed with the collaboration of the National Institute of Ionising Radiation Metrology (INMRI) of the Italian National Agency for New Technologies, Energy and the Environment (ENEA).

The sampling programme has been defined in accordance with the EU Recommendation 2000/473/Euratom[5] and in agreement with the organisations participating in the National Environmental Radioactivity Network. A general overview of the programme is shown in table 1.

Table 1: Sampling programme of the RESORAD network

Matrix	Sampling frequency	Measurement frequency
Air particulates	Daily	Monthly
Fallout	Monthly	Monthly
Aquatic Environment	Six-Monthly	Six-Monthly
Drinking water	Six-Monthly	Six-Monthly
Milk	Weekly	Monthly
Meat	Monthly	Three-Monthly
Cereal and by-product	Seasonal	Seasonal
Complete meal = mixed diet	Three-Monthly	Three-Monthly
Vegetable	Seasonal	Seasonal
Fruit	Seasonal	Seasonal

4.2.2 National telemetric networks

The REMRAD and GAMMA automatic monitoring networks have been installed in compliance with the Council Decision 87/600/Euratom on the basis of the experience acquired after the Chernobyl accident.

The main tasks of these networks are to confirm the information produced by the international notification systems, in particular when the national territory is involved in a possible contamination situation, to generate an early warning in case if data exchange information would not be available. They are also meant to inform about the actual radiation level following radioactivity fallout due to contamination crossing the national territory. Data from these networks are routinely transferred to the ISPRA data centre in Rome.

To fulfil the institutional duties related to the role of ISPRA in the emergency preparedness at national level, the institute realized this integrated support system for decision making in the case of a nuclear emergency with functions of early notification and information exchange, early warning, prognosis of the possible evolution of the radioactivity released to the atmosphere and measurement of the actual contamination level on the national territory.

For the results of the verification of the national networks' facilities see the chapters referring to the respective region.

[5] 2000/473/Euratom. Commission Recommendation of 8 June 2000 on the application of Article 36 of the EURATOM Treaty concerning the monitoring of the levels of radioactivity in the environment for the purpose of assessing the exposure of the population as a whole (OJ L 191, 27 July 2000, page 37 – 46).

4.2.2.1 GAMMA network

In Italy external gamma dose rate monitoring is mainly performed by the national telemetric network GAMMA.

The GAMMA network consists of some 60 ambient gamma dose rate probes, mostly placed at sites of the National Forestry Corps.

Each measuring device (gamma dose rate monitor *DLM 1450*, model *ROSA*, software version 15.01, gamma probe *IGS421B*, and data logger *LOGEM LGM 28.8D1*; manufacturer: *TechniData AG*, formerly *Hörmann*, now *Envinet*, Markdorf, Germany) is composed of three GM counting tubes. Two redundant large volume tubes for low dose rate levels, allow the detection of minor changes in the radiation level. The third counting tube is for higher radiation levels. The integrated control unit automatically switches between the detectors. Local data transfer to e.g. a notebook computer is possible via an RS232 interface.

A rain sensor (model *RD202*, on/off type) is connected to the system in order to allow taking into account the increase of the dose rate due to precipitation (washout effect: radon/radon decay products).

The detection range of the gamma dose rate devices is 10 nSv/h to 10 Sv/h for photon energies of 40 keV – 1.25 MeV; the operating temperature range is -40°C to +60°C. Data are presented as ambient dose equivalent rate H*(10).

The measuring time of the devices is 1 min. Data generally are collected every 10 minutes and every hour. Data transmission to the centre is by ISDN and analogue lines (six stations). Data are automatically checked by software and if necessary an alert by e-mail is given.

Technicians from ISPRA perform the routine service for all stations of the GAMMA system in Italy; check sources are available at the ISPRA headquarters. With regard to technical assistance, ISPRA still has a contact with *TechniData*; all instrument documentation from *TechniData* is available.

For protection the stations are fenced in. Local batteries provide a power buffer with a capacity of 72 hours.

Data collected by this network provide input to the European EURDEP platform, with a daily transmission in routine operational mode and with 10 minute transmission intervals under emergency conditions.

The network is designed to spontaneously send an alarm signal to the GAMMA network control centre at the ISPRA Emergency Centre enabling the operator to effectively supervise operation of the remote monitoring stations.

The alert threshold level is set at three times the background value.

The team was informed that some regions (e.g. Piemonte) use the same type of equipment within their regional monitoring system, albeit within their technical responsibility (not serviced by ISPRA).

In Central Regions and in the southern Campania Region 27 stations of the GAMMA network are located as shown in table 2, and two REMRAD automatic stations (currently not working) for the measurement of contamination of air are located in Capocaccia (Alghero-Sardegna) and in Rome. Available data of the national networks are regularly collected by ISPRA and sent to the EC.

Table 2: Location of Gamma network stations in central Italy regions and in Campania

Region	**District**	**Locality Name**
Abruzzo	L'Aquila	Castel del Monte
Abruzzo	L'Aquila	Magliano dei Marsi
Abruzzo	Pescara	Pescara
Campania	Benevento	Airola
Campania	Caserta	Castel Volturno
Campania	Salerno	Pisciotta
Campania	Salerno	Polla
Lazio	Latina	Priverno
Lazio	Rieti	Cittareale
Lazio	Rieti	Poggio Moiano
Lazio	Viterbo	Tuscania
Marche	Macerata	Fiuminata
Marche	Macerata	Villa Potenza
Marche	Ascoli Piceno	Monsampolo
Molise	Campobasso	Casacalenda
Molise	Campobasso	Petacciato Scalo
Molise	Isernia	Agnone
Sardegna	Cagliari – Poetto	Cagliari - Poetto
Sardegna	La Maddalena	La Maddalena
Sardegna	Oristano	Abbasanta
Toscana	Arezzo	Montevarchi
Toscana	Grosseto	Ansedonia
Toscana	Grosseto	Massa Marittima
Toscana	Livorno	Cecina Marina
Toscana	Lucca	Bagni di Lucca
Umbria	Perugia	Cascia
Umbria	Terni	Amelia

4.2.2.2 REMRAD network

The REMRAD network which was not included in this verification is a network of seven automatic monitoring stations, located mainly at Air Force sites, performing measurements of airborne radioactive particulates and acting as an early warning system. The stations are located in places of meteorological relevance chosen with a view of covering the most probable access routes of radioactivity in case of an accident in a plant outside Italy. The REMRAD automatic stations are able to perform the following functions:

- air particulate sampling on a continuous fibre-glass filter tape;
- on-line measurement of the alpha/beta total and artificial component;
- delayed (5 days after the sampling) measurement of artificial alpha/beta;
- on-line high resolution gamma spectrometry analysis by an HPGe electrically cooled detector;
- ambient gamma dose rate measurement;
- measurement of local meteorological parameters.

The monitoring equipment is manufactured by *Perkin Elmer Berthold*. The nominal air flow rate is 25 m^3/h and the filter tape is advanced by means of a capstan which is provided with slits allowing the sampled air to pass through them to the collection area at close distance (4 mm) from the detector.

The alpha/beta detectors (prompt and delayed measuring unit) are ZnS/plastic sandwich scintillators coupled to 2" photo-multiplier tubes. Integration time for alpha/beta measurement is 60 min in routine condition and 10 min in emergency mode. The detection limit for on-line artificial beta measurements is about 0.5 Bq/m^3.

For the high resolution gamma spectrometry devices, the spectrum analysis is performed every 2 hours on a sampling window of 24 hours. Besides, a daily sum spectrum is produced and analyzed. Detection limit of Cs-137 is less than 1 mBq/m^3 for the sum spectrum, a few mBq/m^3 on the 2 hours spectrum and less than 100 mBq/m^3 as early warning signal, after an aerosol sampling of 2 hours.

The dose rate detectors installed in this system are not connected to the general national dose rate monitoring system (GAMMA) and thus also not to the EURDEP system.

Data transmission to the centre at ISPRA in Rome is by ADSL.

4.3 NATIONAL ACTIONS TO IMPLEMENT RADIOACTIVITY MONITORING IN THE ENVIRONMENT AND IN FOODSTUFF

In December 2006 the Ministry for the Environment and the Protection of the Territory and of the Sea (MATTM) started a programme to support the environmental monitoring, part of which was devoted to implement and reorganize the radioactivity monitoring in the environment and in foodstuffs including radon and NORM.

The programme is carried out through an agreement between MATTM and ISPRA called "Technical support to the Ministry of Environment and Protection of the Territory and of the Sea for the elaboration of guide lines and methodological approaches in the framework of environmental safeguards". The financing of this part of the programme is about 923 000 €.

The Operative Details Plan (POD) of the Agreement has been elaborated during 2008, approved in 2009 and the activities started in September 2009. An amount of about 681 000 € has been assigned to the monitoring of radioactivity in the environment and in foodstuffs, the rest of the funding is dedicated to radon measurements and to NORM and TENORM activities.

The main objective is the harmonization between the national network RESORAD and the 21 regional/provincial networks. The foreseen activities are the revision of the regional monitoring plans in terms of matrices, sampling locations, radionuclides, frequencies of sampling and measurements, MDA's (Minimum Detectable Activity), in accordance with the Recommendation 2000/473/Euratom and the basic safety standards. Moreover, some guidelines will be developed and national inter-

comparison exercises, for a reliability programme of the laboratories, will be carried out in accordance with the National Primary Institute of Metrology for Ionizing Radiations (ENEA – INMRI). The end of this agreement is scheduled for January 2012.

4.4 REGIONAL ENVIRONMENTAL RADIOACTIVITY MONITORING IN ITALY (ARPA/APPA)

The regional/provincial programmes for environmental radioactivity monitoring are under the responsibility of the regional/provincial government. Following the directives of the Ministry of Health and of the Ministry for the Environment and the Protection of the Territory and of the Sea, under the coordination of ISPRA, the regional/provincial agencies for environmental protection (ARPA/APPA) propose and implement these programmes. These should include the sampling and subsequent laboratory analysis of air (particulates), precipitation (fallout), various waters, soil and food (milk, 'pasta', mixed diet, meat, cereals, vegetables, fruit).

Concerning environmental protection in Italy there are nineteen administrative regions and two autonomous provinces. Each of them has its own environmental protection agency (ARPA/APPA), established by special regional laws and responsible to the local government. The ARPA/APPAs are environmental control and technical support bodies for the regional/provincial, district and local authorities. Generally, the competences of the regional agencies are almost the same as those of ISPRA. Although sponsored by their regions/provinces the ARPA/APPAs are administratively and technically independent. A list of all agencies can be found in Appendix 3.

The regional programmes differed very much in the past – there were remarkable differences of implementation of the monitoring programme for environmental radioactivity proposed by ISPRA between North and South. In 2006 some regions in central and southern Italy had very little environmental radioactivity monitoring (if any at all). The purpose of this verification and the one in 2010 was to verify progress achieved in this area by the central and southern regions since the Article 35 verification in 2006.

4.4.1 Regional actions to implement radioactivity monitoring in the environment and in foodstuffs in central and southern Italy

Since 2006 a number of measurements have been carried out in the central and southern Regions. In table 3 the number of samples analysed by the regional laboratories in 2005, 2009, 2010 and 2011 are shown.

Table 3: number of samples analysed by the regional laboratories in 2005, 2009, 2010 and 2011

Region / ARPA	Samples 2005	Samples2009	Samples 2010	Samples 2011 (January – May)
Abruzzo	275	31	189	110
Lazio	0	76	170	135
Marche	347	113	71	151
Molise	93 (12 gamma dose)	40 (36 gamma dose)	41 (36 gamma dose)	66 (36 gamma dose)
Sardegna	399	582	403	45
Toscana	112	220	264	101
Umbria	757	757	768	407
Campania	0	57 (1)	0	0

(1) Data produced, but in a format that is not compatible with the REM database

Compared to the situation registered in 2005 the ARPA Lazio has carried out some improvements starting to produce data from 2008. Abruzzo and Sardegna regions have produced data on a discontinuous base. It is important to emphasize that ARPA Marche renewed its laboratory during 2009 and 2010, for this reason they produced less data in 2009 and 2010 compared to 2005.

In the following sections, detailed information on the currently performed activities and on the planned monitoring programme of Central Regions and Campania Region are reported.

The monitoring activities on radon and NORM are excluded unless explicitly mentioned.

5 NATIONAL SYSTEM FOR ENVIRONMENTAL RADIOACTIVITY MONITORING IN CENTRAL AND SOUTHERN ITALY – VERIFICATION

5.1 GENERAL

The verification team was informed that currently 56 of the 60 GAMMA stations are in operation, the others being re-located.

The team noted that the devices locally show the measuring values in Gy/hr, while the data are supposed to reflect ambient (gamma) dose equivalent rates (Sv/hr).

> *The verification team encourages all efforts to find solutions for placing the equipment in locations that are technically well suited and easily manageable in the long-term. The team recommends having all GAMMA detector probes at an effective height of 1 m above ground, without obstacles in the surroundings. The team suggests using the same unit for displaying the measurement values.*

5.2 CAMPANIA

In Campania, automatic gamma dose rate monitoring stations of the national GAMMA system are located at Airola, Castel Volturno, Pisciotta and Polla. There are no REMRAD stations in this region.

The team verified the GAMMA stations at Airola and Castel Volturno, both located within the fenced domains of the *Corpo Forestale dello Stato*.

The Airola gamma measurement station was operational at the time of the visit (the display read: 13.9.2011 08:24:38 / 08:24 133 nGy/h). Full maintenance records were available within the housing. The detector is in a level garden, securely fenced and free from any obstacles. Data are sent every 6 hours.

The Castel Volturno gamma measurement station was operational at the time of the visit and full maintenance records were available within the housing. The detector is in a level garden which has some trees nearby. At present these do not greatly obstruct the probe but attention should be paid to this aspect in the future.

> *The verification team encourages all efforts to find solutions for placing the equipment in locations that are technically well suited and easily manageable in the long-term.*

5.3 MOLISE

In Molise, automatic gamma dose rate monitoring stations of the national GAMMA system are located at Casacalenda and Petacciato Scalo. There are no REMRAD stations in this region.

The team verified the GAMMA station (N° 31 of the 56 stations currently in operation in the national system) at Petacciato Scalo Ferroviario, located in the area of the *Corpo Forestale dello Stato (Comando Stazione Petaccciato)*. The whole area is fenced. The overall location is very good in a flat area, close to the sea shore. However, the situation is not ideal: The gamma dose rate probe is mounted on a building of about 4 m in height, some trees are situated about 15 m away and some buildings also at about 15 m. The effective probe height is about 4 m above ground, just below the roof of an auxiliary building with a flat roof.

The team verified the presence of the gamma dose rate monitor. The device was operating and at the time of the visit the display showed the median measurement value (85 nSv/h) for terrestrial and cosmic radiation. The data sheet for the equipment was available locally (original 'equipment covering sheet' from 1999 containing also servicing information, e.g. date of last service by *Hörmann* - '04.08.04', names of technicians, action performed).

A technician from ISPRA was available to give explanations about the device.

The verification team recommends having the GAMMA probe at an effective height of 1 m above ground in an area without obstacles.

5.4 ABRUZZO

In Abruzzo, automatic gamma dose rate monitoring stations of the national GAMMA system are located at Castel del Monte, Magliano dei Marsi and Pescara. There are no REMRAD stations in this region.

The team verified the GAMMA station No°28 at Pescara,located at the *Corpo Forestale dello Stato* premises. The cabin housing the electronic components was locked. The location is very good, in a flat area near the sea shore. However the location is not ideal: The probe (serial no 0028) is mounted on a building, the effective probe height being about 3 m above ground. Some trees are situated about 10 m away and buildings at ca 50 m. The probe is mounted at the side of the building just over the steps of an open-air staircase and just below the roof of an auxiliary building with a flat roof.

At the time of the visit, the device was operating. The data sheet for the equipment was available locally (original 'equipment covering sheet' from 1999 containing also servicing information, e.g. date of last service by *Hörmann* - '19.07.2005', names of technicians, action performed).

Again, a technician from ISPRA was available to give explanations about the device.

The verification team recommends having the GAMMA probe at an effective height of 1 m above ground in an area without obstacles.

5.5 MARCHE

In Marche, automatic gamma dose rate monitoring stations of the national GAMMA system are located at Fiuminata, Villa Potenza, and Monsampolo. There are no REMRAD stations in this region.

The team verified the GAMMA station at Villa Potenza-Macerata, Via Federico II, no 41, installed on the fenced site of the *Agenzia Regionale Per la Protezione Ambientale delle Marche (ARPAM)-dipartimento provinciale di Macerata*. The gamma probe (serial no 0695) together with a rain sensor and its electronics cabinet are located near the fence of the premises. The general location of the installation is very good, in a flat area with soft hills starting to rise at a distance of about 70 metres. There are trees of about 10 m in height at a distance of some 15 m; a one storey building is about 20 m and a car park some 2 m from the device. The probe is mounted at an effective height of about one metre.

The data sheet for the equipment and the measurement information was not accessible since the device was locked and the key was with the technicians. A reserve key is available at the headquarters of ARPAM in Ancona.

The verification does not give rise to any specific remarks.

5.6 UMBRIA

In Umbria, automatic gamma dose rate monitoring stations of the national GAMMA system are located at Cascia and Amelia. There are no REMRAD stations in this region.

Due to time constraints, the team did not verify a GAMMA station in Umbria.

5.7 LAZIO

In Lazio, automatic gamma dose rate monitoring stations of the national GAMMA system are located at Priverno, Cittareale, Poggio Moiano and Tuscania. A REMRAD automatic station (currently not working) is located in Rome.

The team verified the GAMMA station No 70 (with rain sensor) at Tuscania, situated at *Corpo Forestale dello Stato* since 5 March 2008; formerly the station was located at Vetralla.

The area is fenced and has an motorised entrance gate operated by a staff member.

The location is very good (wide, flat) and the gamma dose rate probe and the cabinet are mounted in a separate fenced zone (locked) within an area of 10 m x 50 m, near the meteorological mast of the station. At some 20 m, there are some high trees, the nearest building is 50 m distant. The effective probe height is 1 m above ground.

At the time of the verification a logbook was available at the location. The Telecom manual for data transfer description was available locally. While 'normal' data transmission in the GAMMA system is once per hour, at this location data are transmitted every six hours to the control room.

At the time of the visit the team witnessed an elevated background of 221 nGy/h. It was explained that this is due to the fact that the station is situated in a volcanic area and that the soil is very permeable (leading to high Rn-220 – thoron – levels).

The team was also shown graphics with time trends for gamma dose rate that are increasing in an oscillating manner after each rain fall. The reason for this behaviour is under study.

The team had also foreseen to verify the GAMMA station at Priverno (Latina), but due to a training course for the concerned staff at another location, this visit could not be performed.

The verification encourages all efforts to explain the unusual time behaviour of the station at Tuscania.

5.8 SARDEGNA (NOT INCLUDED IN THE PRESENT VERIFICATION)

In Sardegna, automatic gamma dose rate monitoring stations of the national GAMMA system are located at Cagliari-Poetto, La Maddalena, and Abbasanta. A REMRAD automatic station (currently not working) is located in Capocaccia (Alghero-Sardegna).

5.9 TOSCANA (NOT INCLUDED IN THE PRESENT VERIFICATION)

In Toscana, automatic gamma dose rate monitoring stations of the national GAMMA system are located at Montevarchi, Ansedonia, Massa Marittima, Cecina Marina and Bagni di Lucca. There are no REMRAD stations in this region.

6 REGIONAL/PROVINCIAL ENVIRONMENTAL RADIOACTIVITY MONITORING IN CENTRAL AND SOUTHERN ITALY (DESCRIPTION OF THE SITUATION AND VERIFICATION)

6.1 CAMPANIA (ARPA CAMPANIA NETWORK)

Due to lack of time during the May 2010 mission, the verification of the environmental radioactivity monitoring in the region of Campania could only be performed through an analysis of the submitted written documents and the oral presentation of the proposed monitoring plan at the opening meeting of the verification mission in Palermo. The team decided to use the 2010 information as a basis, together with that received in 2011 to verify the implementation of the monitoring plan proposed at the May 2010 opening meeting.

6.1.1 Regional legislative acts regulating environmental radioactivity monitoring

The Regional Agency for the Environmental Protection of Campania – ARPAC, established under the regional Law n. 10 of 29 July 1998, is the technical reference institution for the environmental monitoring of the Region. Among his institutional duties there is the environmental surveillance in the matter of radioactivity.

The ARPAC resolution n. 193 of 26 July 2001 established the Regional Reference Centre for Radioactivity (*Centro Regionale Radioattivitá*, *CRR*) of the National network for the surveillance of the environmental radioactivity.

The *CRR* carries out radioactivity measurements on foodstuffs and beverages in accordance with the Regional Department (Assessorato) of Health and with the local sanitary departments of the Regional Public Health Service (ASL). Environmental radioactivity monitoring has not been carried out on the basis of a defined plan. A few environmental measurements have been performed, but mainly on request.

Within the Regional Operative Programme 2000 – 2006 approved with the Regional Decree n. 788 of 30 March 2004 the Region of Campania has allocated 840 490.81 € to implement the regional monitoring of environmental radioactivity. This financing has been used mainly for the acquisition of new instrumentation and equipment for the Salerno laboratory.

The team was informed that in June 2011 the maintenance of the instrumentation has been performed, the renovation of the laboratory has been started and is still ongoing. Furthermore since June 2011, sampling and measurements are carried out according to the monitoring plan.

6.1.2 Radioactivity monitoring – organisation in Campania

The analytical laboratory involved in the radioactivity monitoring is:

- Regional Reference Centre for Radioactivity (*CRR*) – ARPAC – Via Lanzalone 54/56

The team was informed at the last verification (May 2010) that the Regional Reference Centre for Radioactivity Laboratory was not operative because it was moving to new buildings, which were planned to be ready in June 2010. At its verification visit on 12 September 2011, the team noted that all equipment had been transferred to the new building and was fully operational.

In table 4 the measurement techniques used in 2011 and those programmed for the future are shown.

Table 4: measurement techniques used in 2011 and those programmed for the future

Available measurement techniques	In 2011	Programmed
Gamma Spectrometry	x	x
Gamma dose rate	-	x
Liquid scintillation	x	x
Gross beta	x	x
Sr-90	-	x
H-3	-	x
Gross alpha	x	x
Alpha spectrometry	-	x

The personnel currently involved in the authority's radioactivity monitoring activity is shown in table 5.

Table 5: Personnel involved in radioactivity monitoring in Campania

Personnel	Units	Man months/year
Responsible	1	12
Graduate	4(1)	48 (1)
Technician	-	-
Support	1	6

(1) 3 physicists, 1 chemist

In table 6, details for the foodstuff samples analysed by ARPAC in the year 2008 are given. This information was received prior to the May 2010 verification in southern Italy. No environmental samples have been analysed in that year.

Table 6: Sampling locations, matrices and radionuclides analysed by ARPAC in foodstuff samples in the year 2008

Sampling location	Matrix	Radionuclides	N. of samples
SALERNO	Apples	Cs-(134+137), K-40	1
CAPUA	Aubergine	Cs-(134+137), K-40	2
FISCIANO	Aubergine	Cs-(134+137), K-40	1
CASERTA	Beans	Cs-(134+137), K-40	1
SALERNO	Beans	Cs-(134+137), K-40	1
MARCIANISE	Biscuits	Cs-(134+137), K-40	1
PIANA DI MONTE VERNA	Biscuits	Cs-(134+137), K-40	1
SALERNO	Blueberry	Cs-(134+137), K-40	
CAIAZZO	Blueberry jam	Cs-(134+137), K-40	
CAPODRISE	Blueberry jam	Cs-(134+137), K-40	
CASERTA	Blueberry jam	Cs-(134+137), K-40	
MARCIANISE	Blueberry jam	Cs-(134+137), K-40	
PIEDIMONTE MATESE	Bread	Cs-(134+137), K-40	
CASERTA	Carrots	Cs-(134+137), K-40	1
BRACIGLIANO	Cherries	Cs-(134+137), K-40	1
SALERNO	Cherries	Cs-(134+137), K-40	2
SALERNO	Chestnut	Cs-(134+137), K-40	1
MERCATO SAN SEVERINO	Coffee	Cs-(134+137), K-40	1
CASERTA	Carrots	Cs-(134+137), K-40	1
BAIA E LATINA	Corn	Cs-(134+137), K-40	1
CASERTA	Courgette	Cs-(134+137), K-40	1
FISCIANO	Courgette	Cs-(134+137), K-40	1
MADDALONI	Cranberry juice	Cs-(134+137), K-40	1
NAPOLI	Vodka (Ukraine)	Cs-(134+137), K-40	1
SANTA MARIA CAPUA VETERE	Endives	Cs-(134+137), K-40	1
CAIAZZO	Breakfast cereals	Cs-(134+137), K-40	1
CASERTA	Fennel	Cs-(134+137), K-40	1
NUSCO	Hay	Cs-(134+137), K-40	1
SPERONE	Hazelnut paste	Cs-(134+137), K-40	1
BARONISSI	Homogenized fruit	Cs-(134+137), K-40	2
BRACIGLIANO	Homogenized fruit	Cs-(134+137), K-40	2
CAPODRISE	Homogenized fruit	Cs-(134+137), K-40	1
SANTA MARIA CAPUA VETERE	Endives	Cs-(134+137), K-40	1
CAIAZZO	Breakfast cereals	Cs-(134+137), K-40	1
CASERTA	Homogenised fruit	Cs-(134+137), K-40	1
CASERTA	Homogenised fruit	Cs-(134+137), K-40	1
SANTA MARIA A VICO	Homogenised fruit	Cs-(134+137), K-40	1
MADDALONI	Honey	Cs-(134+137), K-40	1
MARCIANISE	Honey	Cs-(134+137), K-40	1
SALERNO	Kiwi	Cs-(134+137), K-40	1
SANTA MARIA A VICO	Lentils	Cs-(134+137), K-40	1
SALERNO	Lupin	Cs-(134+137), K-40	1

Sampling location	Matrix	Radionuclides	N. of samples
AGROPOLI	Mollusc (*Ensis siliqua*)	Cs-(134+137), K-40	1
CASERTA	Homogenized fruit	Cs-(134+137), K-40	1
CASERTA	Homogenized fruit	Cs-(134+137), K-40	1
CAPACCIO	Mollusc (*Ensis siliqua*)	Cs-(134+137), K-40	3
GIOIA TAURO	Mushrooms (*Agaricus bisporus*)	Cs-(134+137), K-40	1
SALERNO	Mushrooms (*Agaricus bisporus*)	Cs-(134+137), K-40	1
CAPODRISE	Mussels	Cs-(134+137), K-40	1
BACOLI	Mussels	Cs-(134+137), K-40	9
BATTIPAGLIA	Mussels	Cs-(134+137), K-40	1
GIUGLIANO IN CAMPANIA	Mussels	Cs-(134+137), K-40	3
POZZUOLI	Mussels	Cs-(134+137), K-40	6
CASAGIOVE	Sunflower seed oil	Cs-(134+137), K-40	1
CAPACCIO	Mollusc (*Ensis siliqua*)	Cs-(134+137), K-40	3
GIOIA TAURO	Mushrooms (*Agaricus bisporus*)	Cs-(134+137), K-40	1
SALERNO	Mushrooms (*Agaricus bisporus*)	Cs-(134+137), K-40	1
CAPACCIO	Mollusc (*Ensis siliqua*)	Cs-(134+137), K-40	3
GIOIA TAURO	Mushrooms (*Agaricus bisporus*)	Cs-(134+137), K-40	1
SALERNO	Mushrooms (*Agaricus bisporus*)	Cs-(134+137), K-40	1
CAPODRISE	Mussels	Cs-(134+137), K-40	1
BACOLI	Mussels	Cs-(134+137), K-40	9
BATTIPAGLIA	Mussels	Cs-(134+137), K-40	1
GIUGLIANO IN CAMPANIA	Mussels	Cs-(134+137), K-40	3
POZZUOLI	Mussels	Cs-(134+137), K-40	6
CASAGIOVE	Sunflower seed oil	Cs-(134+137), K-40	1
MONTESARCHIO	Sunflower seed oil	Cs-(134+137), K-40	2
CASAGIOVE	Corn seed oil	Cs-(134+137), K-40	1
CASAGIOVE	Olive oil	Cs-(134+137), K-40	1
SALERNO	Olives	Cs-(134+137), K-40	1
SALERNO	Olives (Argentina)	Cs-(134+137), K-40	1
CAIAZZO	Pasta	Cs-(134+137), K-40	1
CASERTA	Pasta	Cs-(134+137), K-40	3
SANTA MARIA A VICO	Pasta	Cs-(134+137), K-40	1
MARCIANISE	Peach nectar	Cs-(134+137), K-40	1
CASAGIOVE	Peanut seed oil	Cs-(134+137), K-40	1
CAPUA	Peppers	Cs-(134+137), K-40	1

Sampling location	Matrix	Radionuclides	N. of samples
MONTESARCHIO	Sunflower seed oil	Cs-(134+137), K-40	2
CASAGIOVE	Corn seed oil	Cs-(134+137), K-40	1
CASAGIOVE	Olive oil	Cs-(134+137), K-40	1
SALERNO	Plums	Cs-(134+137), K-40	2
NAPOLI	Poplar chips	Cs-(134+137), K-40	1
CAPODRISE	Rice flour	Cs-(134+137), K-40	2
MADDALONI	Rice flour	Cs-(134+137), K-40	1
SANTA MARIA A VICO	Strawberry jam	Cs-(134+137), K-40	1
CASERTA	Tomatoes	Cs-(134+137), K-40	1
SANTA MARIA CAPUA VETERE	Tomatoes	Cs-(134+137), K-40	1
CAIAZZO	Vegetable soup	Cs-(134+137), K-40	1
CASERTA	Vegetable soup	Cs-(134+137), K-40	1
PIEDIMONTE MATESE	Wheat flour	Cs-(134+137), K-40	2
NAPOLI	Wheat, hard	Cs-(134+137), K-40	1
NAPOLI	Wheat, soft	Cs-(134+137), K-40	18
MADDALONI	Whole cow's milk UHT	Cs-(134+137), K-40	1
CASAGIOVE	Wine	Cs-(134+137), K-40	1
MADDALONI	Wine	Cs-(134+137), K-40	1
SALERNO	Plums	Cs-(134+137), K-40	2
NAPOLI	Poplar chips	Cs-(134+137), K-40	1
CAPODRISE	Rice flour	Cs-(134+137), K-40	2
MADDALONI	Rice flour	Cs-(134+137), K-40	1
SANTA MARIA A VICO	Strawberry jam	Cs-(134+137), K-40	1

In table 7 an overview of samples analysed by ARPAC in the years 2009 to 2011 is given.

Table 7: Foodstuff samples analysed by ARPAC in the years 2009, 2010 and 2011

Sampling media	Radionuclides	N. of samples 2009	N. of samples 2010	N. of samples 2011
Milk	Cs-137, Cs-134, K-40	2	-	-
Other foodstuffs	Cs-137, Cs-134, K-40	55	-	-

The sampling locations fixed for sampling in 2011 are reported in table 8.

Table 8: Sampling locations fixed by ARPA Campania for 2011 (information given in preparation of the 2011 verification)

Fixed location	Sampling media	Radionuclides
Cancello Arnone (CE), Volturno River, Garibaldi Bridge (Ponte Garibaldi), (41°04’29”N 14°01’42”E)	River water	Cs-137
Melizzano (BN), Calore River, Torello Bridge (Ponte Torello), (41°11’01”N 14°28’32”E)	River water	Cs-137
Capaccio (SA), Sele River, Barizzo Bridge (Ponte Barizzo), (40°39’39”N 15°14’07”E)	River water	Cs-137
Buccino (SA), *I.B.G. sud Industry*, 40°38’05” N 15°22’48” E	Drinking water	Cs-137
Contrada Pezzapiana (BN), 41°08’40” N 14°46’27” E	Drinking water	Cs-137
Maddaloni, Contrada Lima, 41°01’08” N 14°24’02” E	Drinking water	Cs-137
Salerno/Via Fuorni, 86 – 84131, diary	Milk	Cs-137, I-131, K-40

Salerno/ via Lanzalone, 54/56 84100	Airborne particulate	Cs-137, I-131, Be-7
Benevento/via San Pasquale 36/B 82100	Airborne particulate	Cs-137, I-131, Be-7
Napoli, via Don Bosco, 4/F 80141	Airborne particulate	Cs-137, I-131, Be-7
Salerno/ via Lanzalone, 54/56 84100	Fallout (wet)	Cs-137, I-131
Benevento/via San Pasquale 36/B 82100	Fallout (wet)	Cs-137, I-131
Napoli, via Don Bosco, 4/F 80141	Fallout (wet)	Cs-137, I-131

The verification team acknowledges that moving the laboratory lead to a momentary reduction in the monitoring programme.

6.1.3 Planned Regional programme for radioactivity monitoring

Region Campania in a letter dated 23 April 2010 has transmitted to the Ministry of Environment and Protection of Land and Sea a proposal to implement the regional network for the surveillance of the radioactivity in the environment and in foodstuffs developed by ARPAC.

In table 9, the regional monitoring programme proposed by ARPAC (May 2010) is shown.

In table 10 the planned regional programme as foreseen for 2011 is reported as a summary.

Table 9: Regional monitoring programme for environment and foodstuffs as proposed by ARPAC (information received by the team for the verification in 2010)

Matrix	**Sampling locations**	**Radionuclides**	**Sampling frequency**	**Measurement frequency**
Air	Variable points of the Region	Gamma dose rate	Continuous/ Daily	Continuous/ Daily
Soil	Grid network	Artificial radionuclides	Three-year	Three-year
Airborne particulate	One point per province	Artificial radionuclides; gross alpha and beta	Daily	Continuous/Weekly/ Monthly
Fallout	One point per province	Artificial radionuclides	Monthly	Monthly
SMOD	Main rivers	Artificial radionuclides	Quarterly	Quarterly
Sea water	At least one point	Artificial radionuclides	Half-yearly	Half-yearly
River water	Main rivers	Artificial radionuclides, radon	Half-yearly	Half-yearly
Sludge (treatment plants)	Main plants	Artificial radionuclides	Half-yearly	Half-yearly
Waste water (treatment plants)	Main plants	Artificial radionuclides	Half-yearly	Half-yearly
Drinking water	Main aqueducts	Artificial radionuclides	Daily	Monthly
Main aqueducts and aquifers	Gross alpha, gross beta and radon	Half-yearly	Half-yearly	
Cow's milk	Main centres of production/distribution	Artificial radionuclides	Weekly	Monthly

Matrix	Sampling locations	Radionuclides	Sampling frequency	Measurement frequency
Buffalo milk	Main centres of production/distribution	Artificial radionuclides	Weekly	Monthly
Dairy	Main centres of production/distribution	Artificial radionuclides	Monthly	Monthly
Buffalo Dairy	Main centres of production/distribution	Artificial radionuclides	Monthly	Monthly
Beef	Main centres of production/distribution	Artificial radionuclides	Monthly	Quarterly
Pork	Main centres of production/distribution	Artificial radionuclides	Monthly	Quarterly
Poultry meat	Main centres of production/distribution	Artificial radionuclides	Monthly	Quarterly
Wheat	Main centres of production/distribution	Artificial radionuclides	Quarterly	Quarterly
Rice	Main centres of production/distribution	Artificial radionuclides	Quarterly	Quarterly
Pasta	Main centres of production/distribution	Artificial radionuclides	Quarterly	Quarterly
Flour	Main centres of production/distribution	Artificial radionuclides	Seasonal	Seasonal
Fruit	Main centres of production/distribution	Artificial radionuclides	Weekly	Monthly
Green salad	Main centres of production/distribution	Artificial radionuclides	Weekly	Monthly
Vegetables	Main centres of production/distribution	Artificial radionuclides	Weekly	Monthly
Mushrooms	Main centres of production/distribution	Artificial radionuclides	Seasonal	Seasonal
Berries	Main centres of production/distribution	Artificial radionuclides	Quarterly	Quarterly
Wine	Main centres of production/distribution	Artificial radionuclides	Monthly	Monthly
Olive oil	Main centres of production/distribution	Artificial radionuclides	Monthly	Monthly
Fish and mollusc	Main centres of production/distribution	Artificial radionuclides	Quarterly	Quarterly
Baby products	Main centres of production/distribution	Artificial radionuclides	Monthly	Monthly
Animal feed	Main centres of production/distribution	Artificial radionuclides	Seasonal	Seasonal

Matrix	Sampling locations	Radionuclides	Sampling frequency	Measurement frequency
Products from food industry	Main centres of production/distribution	Artificial radionuclides	Quarterly	Quarterly
Moss	All provinces	Artificial radionuclides	Seasonal	Seasonal

Table 10: Summary of planned regional programme as foreseen for 2011 (information received in preparation of the 2011 verification)

Sampling media	Measurement	Measurement frequency	Measurements/year
Airborne particulate	Cs-137, I-131, Be-7	Weekly	156
Fallout	Cs-137, I-131	Monthly	36
River water	Cs-137	Monthly	36
Drinking water	Cs-137	Monthly	36
Milk	Cs-137, I-131, K-40	Monthly	12
Other foodstuffs	Cs-137	Monthly	48

The verification team endorses the full implementation of the programme and encourages its perpetuation in the future.

6.1.4 ARPA Campania laboratory

The verification team visited the radiological laboratory (CRR) of ARPA Campania, which is situated at Via Lanzalone 54/56, Salerno, within the city limits.

On the roof of the laboratory the team were shown the air sampler using a dual silicon detector for the measurement of alpha, beta and gamma radiation and of radon (*ABPM 203M Mobile Alpha Beta Particulate Monitor*, *Mirion Technologies*) which was placed under a hard plastic roof still allowing air to circulate freely around the instrument. The instrument was calibrated by the manufacturer in May 2011 whilst measurements started in June 2011. The measurement characteristics are given in table 11.

Table 11: Measurement characteristics of the air monitor located at ARPA Campania

Parameters	Measurement units	Energy range	Measurement range
Alpha activity	Bq/m^3	2 MeV – 10 MeV	10^{-2} – 3.7 10^{+6} Bq/m^3
Beta activity	Bq/m^3	80 keV – 2.5 MeV	1 – 3.7 10^{+6} Bq/m^3
Gamma dose rate	μGy/h	80 keV – 2.5 MeV	

In the event of a mains power failure a battery backup exists. The continuous cellulose filter has an autonomy of 6 months.

Near the air monitor was a small meteorological station which serves for the adjustment of radon concentration calculations. Additionally two plastic trays for the collection of rainwater were placed.

For gamma spectrometry, the laboratory uses two HPGe detectors (60% n-type and 80% p-type, *Ortec*). Spectrum acquisition is done by *DSpec* (*Ortec*), spectrum evaluation with *GammaVision* (*Ortec*).

A liquid scintillation counter (*Quantulus*, *Perkin Elmer*) has been installed in August 2011 and will be used for H-3, alpha and beta measurements for water samples.

In addition to equipment in the laboratories there are three mobile gamma detectors (*Ortec Detective*) available which feature electric cooling and a Cs-137 source for auto-calibration. These are principally deployed at the request of the police or customs authorities, or to measure building materials.

A lab register is entered in a LIMS (*Apricots 201101013*) which is considered the "official" record. However, data are also maintained in paper form.

Currently in case of power failures the capacity of the available UPS is only one hour if all equipment is operating. It is planned to increase the battery power to enable equipment to remain in operation for a longer period.

Milk samples are stored for six months and food for one year whilst water is stored for as long as possible taking into account the space available etc.

The verification team were presented with a certificate for one of the gamma calibration sources used, a 70 mm diameter mixed radionuclide source purchased from *Eckert & Ziegler Nuclitec GmbH* in May 2011 (certified by *Deutscher Kalibrierdienst*, *DKD*). Other certificates were not readily available as parts of the archives had not yet been transferred to the new building.

ISO 17025 accreditation procedure was initiated for the measurements shown in table 12.

Table 12: Measurements for which an ISO 17025 accreditation procedure was initiated on 7 September 2011

Product	Measurement
Food	Sr-90 gamma emitters
Milk	Cs-137 Cs-134 I-131
Water	Total alpha & beta (H-3 and C-14)

In addition to the programme of analysis which forms part of the regulatory control the laboratory also performs analysis for external clients, chiefly related to foodstuff exports.

> *The verification team supports the move to obtain ISO 17025 certification and would appreciate being informed when this has been obtained. It is suggested to increase the UPS capacity to enable greater autonomy in the event of a mains power failure.*
>
> *The verification team suggest to replace the plastic trays used for collection of rainwater by a dedicated sampling device (see e.g. IAEA technical report series No.295, p.29ff) and to establish a written procedure for processing the samples for subsequent measurement.*

6.2 MOLISE (ARPA MOLISE NETWORK)

6.2.1 Regional legislative acts regulating environmental radioactivity monitoring and funding

The team was informed that the Regional Agency for Environmental Protection of Molise established under the regional Law n.38, of 13 December 1998, is the technical reference institution for the environmental monitoring included radioactivity. With the *"Determinazione Dirigenziale" n. 22* of 17 May 2011 the new monitoring programme for foodstuff is established.

6.2.2 Radioactivity monitoring – organisation at Molise

The analytical laboratory involved in the monitoring of ionizing radiation in Molise is:

- Regional Centre for Reference environmental radioactivity (*CRR*-Molise), Contrada Selva Piana, 86100 Campobasso.

The verification team was informed that *CRR* Molise soon will move to a new laboratory building.

Table 13 shows the measurement techniques used in 2011 and those which are currently under implementation.

Table 13: Measurement techniques used in 2011 and those programmed for the near future

Measurement technique	In 2011	Under implementation
Gamma Spectrometry	x	x
Gamma dose rate	x	x
Liquid scintillation		x
Gross beta		x
Sr-90		x
H-3		x
Gross alpha		x
Alpha spectrometry		x

The current personnel situation for the radioactivity monitoring activity is reported in table 14.

Table 14: Personnel involved in radioactivity monitoring in *CRR* Molise

Personnel	Units	Man-Months/Year
Responsible	1	9
Graduate	-	-
Technician	1	6
Support	1	4

Details with regard to the fixed locations radioactivity monitoring are reported in table 15.

Table 16 gives details on samples analysed by ARPA Molise in 2009, 2010 and 2011.

The verification team acknowledges the monitoring for the years 2009 to 2011.

6.2.3 Planned regional programme for radioactivity monitoring in Molise

The team was informed that the Molise Region approved with the Regional Deliberation n°894 of the 08/11/2010 the regional radioactivity monitoring programme for the estimation of ingested Cs-137.

Moreover, the Region Molise has communicated a further programme regarding other environmental sampling media.

In tables 17 and 18 the planned regional programmes are reported.

The verification team endorses the full implementation of the programme and encourages its perpetuation in the future.

Table 15: Fixed sampling locations, matrices and the radionuclides analysed in 2009, 2010 and 2011 by ARPA Molise

Fixed location	Samples/media	Measurement
Campobasso/Via Ugo Petrella 1	Air/deposition	Gamma dose rate
Termoli/Via Corsica 99	Air/deposition	Gamma dose rate
Isernia/Largo Cappuccini 1	Air/deposition	Gamma dose rate
Campobasso/Via Ugo Petrella 1	Airborne particulates	Cs-137
Campobasso/Via Ugo Petrella 1	Fallout	Cs-137
Campobasso/C. da S. Piero	Waste sediment	I-131, Tc-99m
Campobasso/C. da Scarafone	Waste sediment	I-131, Tc-99m
Termoli/Porto	Waste sediment	I-131, Tc-99m
Termoli/ Zona industriale	Waste sediment	I-131, Tc-99m
Isernia/C. da Tavenna	Waste sediment	I-131, Tc-99m
Fiume Biferno – Bivio Morrone	River Sediment	Artificial radionuclides
Fiume Biferno – Bivio Fossalto	River Sediment	Artificial radionuclides
Fiume Biferno – Bivio Colle d'Anchise	River Sediment	Artificial radionuclides

Table 16: Sampling locations, matrices and radionuclides analysed in 2009, 2010 and 2011 by ARPA Molise for environmental and food samples

Media/Samples	Measurement	N. of samples 2009	N. of samples 2010	N. of samples 2011
Air/deposition	Gamma dose rate	36	36	36
Fallout	Gamma spectrometry	0	0	6
Sewage purification plant	Gamma spectrometry	0	5	0
Milk	Gamma spectrometry	0	0	8
Drinking water	Gamma spectrometry	4	0	0
Other foodstuffs	Gamma spectrometry	0	0	16

Table 17: Regional foodstuff monitoring programme

Sampling media	Measurement	Frequency of measurement	Measurements / year
Cereals	Cs-137	Monthly	12
Flour	Cs-137	Monthly	4
Mushrooms	Cs-137	Monthly	6
Milk	Cs-137	Monthly	20
Honey	Cs-137	Monthly	4

Table 18: Regional environmental monitoring programme

Samples/media	Measurement	Measurement frequency	Measurements / year
Air/deposition	Gamma dose rate	Continuous	12
Airborne particulate	Cs-137	Continuous	12
Sewage sludge	Cs-137	Quarterly	12

6.2.4 ARPA Molise laboratory Campobasso

First the team visited the new building at Contrada Selva Piana di Campobasso, which will house the ARPA Molise laboratory in the near future (the laboratory was said to be moving two weeks later). ARPA Molise received 2.6 M€ from the European structural funds for this construction and installation project. The new building has about 2500 m^2 distributed over three storeys. The radiological laboratory (*laboratorio radiazioni ionizzanti*) currently has 35 m^2. At the time of the verification the building was finished but empty, electric circuits were installed. The initial funding was allocated to the laboratory part of the building, thus only the labs are 'ready' to move equipment in. The administrative part will be finalised in 2012.

The radiological part comprises an office for the head of the laboratory and the main laboratory room (ca. 5.5x5.5 m). The laboratory has a secure power supply, gamma spectrometry, an ionisation chamber, balances, etc.. A table is provided that will hold equipment for the 'control' of non-ionising radiation and the control for gamma dose rate measurements (linked to an external antenna). Auxiliary rooms can also be used together with the other laboratories in the premises. On the roof of the building, a fall-out sampler, a gamma dose rate monitor and an air-sampler will be installed.

The team also verified the 'old' ARPA Molise laboratory located at Via Ugo Petrella, Campobasso. The building is also used by other bodies, e.g. the health CRR. The laboratory is not accredited to ISO 17025.

Personnel situation

ARPA Molise as a whole has about 200 employees, of which about 50 are working in the administration. A responsible for the Regional Network for monitoring environmental radioactivity is employed as well as an Environmental Protection Technician.

Sample registration and preparation

ARPA Molise has a common sample registration office serving all laboratories.

At the time of the visit due to the move to the new laboratory no sample preparation activities were performed. The chemical hood for any radiochemical activities currently installed at the 'old' laboratory premises will be moved to the new location.

In situ gamma spectrometry

A new *Canberra InSpector 2000* device is available for in situ gamma spectrometry. Calibration is performed with the help of a technician from Milano.

Gamma spectrometry

A room is dedicated to gamma spectrometry.

The team witnessed an *Ortec* HPGe detector, electrically cooled (*Ortec-X Cooler II*) with a cylindrical lead shield with copper liner. An *Ortec DISPEC jr 2.0* serves for digital signal management; *Ortec GammaVision* is used as spectrum analysis software. Manuals etc. were to hand.

For measurements the detector end caps are protected against contamination with cling film.

The laboratory routinely uses one litre and 0.5 litre Marinelli geometries for sample measurements; *Amersham* mixed radionuclide sources are used for calibration.

Once per month, a Co-60 point source with a 25 cm cylindrical spacer is used for checking the relative efficiency.

Background is determined once per month in an overnight measurement.

On average, seven to eight foodstuff samples are handled per week (each sample is accompanied by a sample description sheet).

The team was shown a rough flow chart showing the analytical process.

Summing corrections and density corrections are not applied. A density of one is assumed for all samples handled (meat, milk, flour).

Every 6 months a spectrum backup is performed on CD-ROM.

Tracing of a historical sample

For tracing purposes the verification team chose a milk sample from S. Giorgio (internal No 2308 and 2277; reference date = day of analysis: 28 May 2011). The team was told that the two sample numbers were due to an error by sample administration; the impression was given that such errors appear quite frequently. Due to the 'double' registration it was not easy to quickly find all relevant documents. Using the day of measurement (instead of the sampling day or another relevant date) as reference date for long-lived radionuclides does not give large discrepancies in the analysis results. However, for short lived radionuclides such as iodine-131 (that may be detected in environmental or in foodstuff samples, e.g. after a nuclear power event, even if from a large distance) a significant error may be made when using a badly chosen reference date.

The team analysed the spectrum and found for K-40 that the peak form was ok, however the energy information was not correct thus, the analysis printout for K-40 showed '<LLD'; manually a value of 58.2 Bq/l was introduced. The team was shown the sample description sheet with all raw values (signed) and the analysis results sheet containing the same K-40 value. The original of the result certificate goes to the Health Inspector. With regard to the observed peak shift the team was told that the "spectra are more stable now".

At the time of the visit all radiological measurement related work was done by the head of the lab.

During the verification visit there were two electric power failures. Lights went out, however gamma spectrometry continued to operate (including the printer). For cases of power failure, the laboratory has a *Powertronix* UPS guaranteeing electrical power supply for up to 20 hours.

Gamma dose rate – central data system

In the laboratory the (regional) data centre for ambient gamma dose rate is set up. The system uses *Thermo Electron* devices with natural background reduction; the probes are located at Campobasso, Termoli and Isernia and connected to the centre. The central data management and display software was developed using *NetView*.. The team noticed that the display for the results did not function correctly. The team was informed that this was due to a problem with an electronic contact.

The team witnessed also one portable detector set *BTI* (*Bubble Technology Ind.*, Chalk River, Ontario, CDN) with a phoswich beta detector and a NaI(Tl) gamma detector.

Other devices

During the visit of the laboratory, the team witnessed some equipment for field surveys: an 'intelligent' ionisation chamber *Thermo Eberline FHT191T (tritium)* together with an *FHT 6020* display unit; display on a notebook using *NetView* software (also used for displaying temperature and gamma dose rate data); and an *Automess* plastic scintillator device. Calibration of this equipment is performed every 6 months by a technician from Milan, using a Cs-137 source. At the time of the verification, no labels indicating calibration details were on the devices

The team witnessed an *Endecotts Octagon 200* test sieve shaker with several 200 mm diameter sieves, e.g. 2 mm mesh size, which together with a *Retsch SR2* (Haan, DE) mill were said to be used for the preparation of rigid samples such as noodles, beans, chickpea.

Two balances were available in the laboratory, an *A&D Company FR Mark II* and a *Sartorius Gold*. The team witnessed also a *SEA 373C* measurement system with external beta probe *SEA 300 PMS* in a cylindrical lead shield, which was said to be no longer in operation.

Reference sources and certificates

Radioactive sources were stored in a separate locked room which had several signs (*'accesso controllato'*) on the door.

Data storage and Quality management

A separate informatics office was used for housing the network with servers and for storage of backups. Archiving will be improved in the new location since this is at the moment an issue for all ARPA Molise laboratories. It is also foreseen to improve traceability. The laboratory already has a LIMS which at the moment is used only for drinking water. This shall in future be used for all laboratories.

Measurement equipment on the roof of the laboratory building

Several sampling and monitoring devices are installed on the roof of the building. The team was not informed which devices will be moved to the new premises. The building itself is situated in a wide plain amidst soft hills, at about 600 m a.s.l.. The roof is very large and flat, thus well suited for placing monitoring equipment.

The team witnessed and verified the following devices:

1) A gamma dose rate probe (*Thermo FHZ621 G-L2-10*) with NEMP (nuclear electro-magnetic pulse) filter. The probe was locked in a cabin. The probe is situated at an effective height of about 1.7 m and is connected by cable to a data PC.

2) A fallout sampler for wet and dry deposition (old system). At the time of the verification the device was defective: only the wet sampling functioned. The laboratory will soon buy a new device.

3) A *Zambelli* aerosol sampler powered by a *Zambelli Explorer* pump. Maintenance is performed by *Zambelli*. The pump and the electronics were last checked in June 2011. The device performs sampling at 8 positions (allowing daily sampling) 'face down', with a diameter of about 5-6 cm. All filters are changed once a week. The team was told that the device worked perfectly well during the Fukushima accident. It will be replaced by the system also used at other ARPAs (e.g. ARPACAL / Reggio di Calabria; verified in 2010).

The verification team recommends accreditation of the laboratory to ISO 17025.

The team suggests thoroughly checking the sample registration procedure(s) used and adapt/correct them if needed. It encourages applying the Laboratory Information Management System (LIMS) for all measuring activities.

The team also suggests checking and fixing the electronic contacts at the ambient gamma dose rate display centre. In particular such problems should be avoided at the new laboratory premises to guarantee reliable information.

Furthermore, the team suggests putting labels on all measuring devices indicating calibration details such as 'last calibration performed on …'.

With regard to radionuclide specific (e.g. gamma spectrometric) analyses the team recommends using the sampling date (day and hour) as reference date rather than the date of measurement.

6.2.5 ARPA Molise, Termoli

The Termoli unit of ARPA Molise is situated at *Via Corsica 99*, Termoli, close to the sea.

With regard to monitoring of environmental radioactivity ARPA operates dose rate equipment which is installed on the large, flat roof of the building, at about 20 m above sea level, well placed. The access to the roof is locked. The roof is made of tin covered with varnish. The dose rate probe is mounted in a locked cabin at an effective measuring height (marked on the probe) of about 165 cm above ground. The probe is connected to the data centre in Campobasso via GSM.

The verification does not give rise to specific remarks.

6.3 ABRUZZO (ARTA ABRUZZO NETWORK)

6.3.1 Regional legislative acts regulating environmental radioactivity monitoring and funding

ARTA Abruzzo, the *Agenzia Regionale per la Tutela dell'Ambiente* (Regional Agency for the Environmental Tutelage) Abruzzo, established under the regional Law n.64 of 1998, is the technical reference institution for the environmental monitoring in the Abruzzo Region.

The ARTA physical laboratory of Pescara performs the radioactivity monitoring in the environment; foodstuff monitoring is carried out by the Experimental Zoo-prophylactic Institute of Abruzzo and Molise, located in Teramo.

6.3.2 Radioactivity monitoring – organisation at Abruzzo

The analytical laboratories involved in the monitoring are:

- Regional Reference Centre for Radioactivity - Physical Laboratory (*CRRRA – Settore Fisico*) - ARTA Abruzzo - Viale Marconi 51, Pescara;
- Foodstuffs of Animal Origin Laboratory - Experimental Zoo-prophylactic Institute of Abruzzo and Molise - Via Campo Boario, Teramo.

In table 19, the measurement techniques used in 2011 and those programmed for the future are shown.

Table 19: Measurement techniques used in 2011 and those programmed for the near future

Measurement techniques	In 2011	Programmed
Gamma Spectrometry	x	x
Gamma dose rate		x
Liquid scintillation		x
Gross beta		x
Sr-90		
H-3		x
Gross alpha		x
Alpha spectrometry		

The personnel currently involved in the authority's radioactivity monitoring activity is shown in table 20.

Table 20: Personnel involved in radioactivity monitoring in Abruzzo

Personnel type	Units	Man months/year
Responsible	1	1
Graduate	3	12
Technician	1	6
Support	0	0

The fixed sampling locations for radioactivity monitoring are reported in table 21.

Table 21: Fixed sampling locations for radioactivity monitoring in Abruzzo

Fixed location	Sampling media	Radionuclides
Pescara / Viale Marconi 51	Airborne particulate	Cs-137; Be-7; I-131
Pescara / Viale Marconi 51	Fallout wet and dry	Cs-137; Be-7; I-131

In table 22, details for the sampling in 2009 to 2011 in Abruzzo for radiological analyses are listed.

Table 22: Sampling media and radionuclides analysed in 2009 and 2010, as well as the numbers foreseen for 2011, for ARTA Abruzzo and the Experimental Zoo-prophylactic Institute of Abruzzo and Molise; environmental and foodstuff samples.

Sampling media	Radionuclides	Samples 2009	Samples 2010	Samples 2011
Milk	Cs-137; I-131; Be-7	-	-	15
Other foodstuffs	Cs-137; Be-7; I-131	31	34	3
Airborne particulate	Cs-137; Be-7; I-131	-	144	86
Fallout	Cs-137; Be-7; I-131	-	11	6

The verification team acknowledges the monitoring for the years 2009 to 2011.

The verification team encourages the implementation of the foreseen (new) analysis techniques

6.3.3 Planned Regional programme for radioactivity monitoring

The regional radioactivity monitoring programme in foodstuffs, planned from 2008 to 2010, is published it in the *Bollettino Ufficiale della Regione Abruzzo, N°44 Speciale*, 23/05/2008. Foodstuffs are sampled by the local Public Health Authority (AUSL) and analysed by the Experimental Zoo-prophylactic Institute. The environmental monitoring programme is carried out by ARTA in agreement with the Region.

In table 23, the planned regional programme is reported.

Table 23: Planned regional programme for environment and foodstuff monitoring for Abruzzo

Sampling media	Measurement	Measurement frequency	Measurements /year
Air particulates	Gamma Spectrometry (Cs-137)	5 measurement/week	300
Dry/wet deposition	Gamma Spectrometry (Cs-137)	Monthly	12
Drinking water	Cs-137	Half-yearly	2
Milk and other foodstuffs	Gamma Spectrometry (Cs-134; Cs-137; K-40)	Variable	58

The verification team endorses the full implementation of the programme and encourages its perpetuation in the future.

6.3.4 ARTA Abruzzo laboratory - Pescara

The team verified the ARTA Abruzzo laboratory located at Viale Marconi 51, Pescara.

The laboratory is not accredited to ISO 17025.

Personnel situation

ARTA Abruzzo as a whole has 231 employees, of which 41 are working in the administration. In the radiological laboratory in Pescara four persons are working, however, the team was informed that they also have tasks in other areas.

Sample receipt and registration

ARTA Abruzzo has a LIMS system in which all incoming samples are registered. For the radiological laboratory, only the results for radon are registered in this LIMS; in future, all results will be included.

Gamma spectrometry

The team witnessed an old gamma spectrometer (*Eurisys*), which was not in operation, as well as a new gamma spectrometer from *Ortec* (HPGe detector originally ca. 28% relative efficiency and 1.85 keV resolution; several repairs changed the detector specifications to 28.5% and 1.76 keV, then to 27% and 1.73 keV, finally to 25% and 1.72 keV). The data sheet and the device manual were available. The *Ortec* device has a cylindrical 10 cm Pb shield with Cu liner. In the laboratory end cap protection e.g. by a cling foil is not applied. NIM electronics come from *Ortec* spectrum acquisition and analysis are done with *Ortec GammaVision* software.

Routinely the laboratory uses three geometries for measurements: the 1 l-Marinelli geometry is used for foodstuffs and water measurements (calibration with a - MRNS - from *Eckert&Ziegler Nuclitec GmbH*, no. *TU 254*); for air filters a 40 mm diameter source MRNS *TU 255* is available. Fallout samples are counted on planchettes (using 4 g substance); for calibration an *Isotrek* MRNS standard (*TU253*) is used.

The team was shown the calibration certificates supplied by *AMETEK*, Milano. This company checks the devices and their calibration once per year with mixed radionuclide sources (MRNS) and Am-241. The MRNS standards come from *Eckert&Ziegler Nuclitec GmbH* (no. *TU 254* for Marinelli and *TU 255* for 40 mm diameter) and from *Isotrek* for the planchette geometry.

The *Eckert&Ziegler* standards had calibration certificates from *DKD* (*Deutscher Kalibrierdienst*), dated 1.8.2011.

Energy checks are performed almost daily using a Marinelli geometry source.

Background (without blank sample) is measured once every half year; once per month a short background check is performed.

Once per week the peak centroid position and FWHM are determined using a Co-60 source (1332 keV line). For the registration of such measurements a standard form exists. The results are signed by the operator.

Once per year the radionuclide library used is checked.

Backing-up and archiving of gamma spectra on a common server is automatically done daily via the IT network.

On an experimental basis the laboratory performs density corrections (for soil samples, with Marinelli geometry), using a database included in the GammaVision software. No summing corrections are applied yet.

For cooling the detector in use the laboratory has installed a fixed LN_2 supply system with manual valve handling.

Other measuring devices

The team was informed that 2000 Rn measurements had been done using CR-39 foils, using an image analyser for the tracks caused by radon.

Tracing

For tracking purposes the team performed a comparison with values in the RADIA database (from ISPRA).

The team chose a sample of wood pellets from 11.8.2009 (sample 4505-1PE09). The values in the RADIA (accessed on-line), in a printout from the ARTA database and in the official report showed good agreement. The team noticed that it took quite some time to find the original report in the laboratory.

Roof of the building

On the roof of the building several devices are installed. From a 'large scale' point of view the location is well suited, on a quite large flat roof.

The team witnessed an aerosol sampler *T&CR TECORA ECHO PM*, with a nominal air flow of 60 m^3/d. The device is programmable and equipped with a self-check routine.

For fallout sampling, the old wet-and-dry sampler has been replaced by a 2 m^2 fallout sampler (consisting of 8 plastic trays, covered with a net to protect it against debris and birds bathing in it). If weather is dry, staff fill some acidified water (37% HCl, pH=1) into it to collect the sample.

A small meteorological station is installed as well.

The verification team recommends accreditation of the laboratory to ISO 17025.

The verification team suggest to replace the plastic trays used for collection of rainwater by a dedicated sampling device (see e.g. IAEA technical report series No.295, p.29ff) and to establish a written procedure for processing the samples for subsequent measurement.

6.4 MARCHE (ARPA MARCHE NETWORK)

6.4.1 Regional legislative acts regulating environmental radioactivity monitoring and funding

Following the Circular Letter of the Ministry of Health n. 2/1987 a Regional Reference Centre for the monitoring of environmental radioactivity (CRR) was established by the Region. In 1997 the Regional Agency for the Environmental Protection of Marche – ARPA Marche – was established under regional Law n.60/97. In accordance with this law, among other duties, ARPA Marche takes care of the organization and management of the regional networks for the radiological monitoring of foodstuffs and of the environment. The Region has enacted the sampling plan for the foodstuffs radioactivity monitoring for 2011 with decree n. 43 of the 15/04/2011 and ARPA Marche has implemented this regional plan comprising also environmental radioactivity monitoring (airborne particulates, river waters and molluscs, etc.).

6.4.2 Radioactivity monitoring – organisation in Marche

The analytical laboratory currently involved in the monitoring is:

- ARPA Marche (ARPAM) - Servizio Radiazioni/Rumore – U.O. Radioattività Ambientale (CRR). Via Cristoforo Colombo 106, 60127 Ancona.

Table 24 gives information about measurement techniques, table 25 about the personnel situation.

Table 24: measurement techniques used in 2011 in Marche and those programmed for the future

Measurement techniques	In 2011	Programmed
Gamma Spectrometry	X	X
Gamma dose rate	X	X
Liquid scintillation	X	X
Gross beta	X	X
Sr-90	-	X
H-3	-	-
Gross alpha	X	X
Alpha spectrometry	-	-

Table 25: Personnel currently involved in radioactivity monitoring activities in Marche

Personnel	Units	Man months/year
Responsible	1	11
Graduate	1	4
Technician	2	20
Support	0	0

The fixed sampling locations are reported in table 26.

Table 26: Fixed sampling locations for radioactivity monitoring in Marche

Location	Sampling media	Radionuclides
Ancona/Via Cristoforo Colombo 106, 60127 Ancona	Airborne particulates	Cs-137, Cs-134, I-131, Be-7, gross alpha, gross beta

In table 27, details of the samples analysed by ARPA Marche are listed. ARPA Marche renovated it's laboratory during 2009 and 2010, thus the numbers of samples in 2009 and 2010 were less than in previous years.

Table 27: Sample media and radionuclides analysed by ARPA Marche in 2009, 2010 and 2011 (until May 31); environmental and foodstuff samples

Sample media	Radionuclides	Samples 2009	Samples 2010	Samples 2011
Airborne particulate	Cs-137, Cs-134, I-131, Be-7, gross alpha, gross beta	112	71	118
Milk	Cs-137, Cs-134, I-131, K-40	-	-	2
Other foodstuffs	Cs-137, Cs-134, I-131, K-40	1	-	31

The verification team acknowledges the monitoring programme for 2009 to 2011. With regard to the personnel situation the team points out that for the foreseen new methods (e.g. Sr-90 analysis) adequate staffing is necessary.

6.4.3 Planned Regional programme for radioactivity monitoring

Since 2003 the Marche Region, in cooperation with ARPA Marche, has established a plan for foodstuffs radioactivity monitoring (decree n. 21 of the 28/04/2003). In subsequent years, until 2007, the plan has been renewed through the decrees n. 139 (06/07/2004), n. 96 (18/05/2005), n. 178 (09/06/2006) and n. 125 (07/09/2007). The last plan for the radioactivity monitoring of foodstuffs has been enacted further to the regional decree n. 43 (15/04/2011) and the ARPA Marche has implemented the regional plan comprising the environmental radioactivity monitoring (airborne particulates, river waters and molluscs, etc.).

In table 28 the planned regional programme is reported.

The verification team endorses the full implementation of the programme and encourages its perpetuation for the future.

Table 28: Marche's planned regional programme for environmental and foodstuff samples

Sampling media	Measurement	Measur. frequency	Measurement /year
Airborne particulate	Gamma spectrometry (Cs-137, Cs-134, I-131, Be-7), Gross alpha, gross beta	Daily	300 300 300
River water	Gamma spectrometry (Cs-137, Cs-134, I-131, K-40)	Quarterly	2
Mollusc	Gamma spectrometry (Cs-137, Cs-134, I-131,K-40)	Half-yearly	2
Milk	Gamma spectrometry (Cs-137, Cs-134, I-131, K-40)	*	8
Bovine meat	Gamma spectrometry (Cs-137, Cs-134, I-131, K-40)	*	12
Poultry meat	Gamma spectrometry (Cs-137, Cs-134, I-131, K-40)	*	6
Cereals	Gamma spectrometry (Cs-137, Cs-134, I-131, K-40)	*	5
Pasta and bread	Gamma spectrometry (Cs-137, Cs-134, I-131, K-40)	*	18
Vegetables	Gamma spectrometry (Cs-137, Cs-134, I-131, K-40)	*	36
Fruit	Gamma spectrometry (Cs-137, Cs-134, I-131, K-40)	*	36
Mushrooms	Gamma spectrometry (Cs-137, Cs-134, I-131, K-40)	*	4
Sea fish	Gamma spectrometry (Cs-137, Cs-134, I-131, K-40)	*	12
Honey	Gamma spectrometry (Cs-137, Cs-134, I-131, K-40)	*	3
Infant foods	Gamma spectrometry (Cs-137, Cs-134, I-131, K-40)	*	6

* Measuring frequencies are defined by a regional decree from 2011.

6.4.4 ARPA Marche laboratory

The team verified the ARPA Marche laboratory, *Dipartimento Provinciale di Ancona, Servizio Radiazioni/Rumore*, located at Via Cristoforo Colombo 106, Ancona.

ARPA Marche as a whole has 243 employees, of which 37 are working in the administration. The radiometric laboratory in Ancona is staffed with four persons.

Sample receipt and registration

Upon arrival, samples come to the sample receipt room. To register the samples, the laboratory uses a self-developed registration software, *AC_FRONT_END_ARPAM* and *IM_FRONT_END_ARPAM*, that includes sample and analysis details. Data input and reporting is still manual. The system performs a printout of sample labels. For the data transfer to the central data base at ISPRA the laboratory operates direct transmission of data (no report necessary).

Generally, food samples are taken by Health Service inspectors and environmental samples by their own staff.

Sample preparation / Radiochemical facilities

The team witnessed a refrigerator (+2°C) and a freezer (-17°C) in the foodstuff sample preparation room. In the environmental sample preparation room, the team noticed a muffle furnace, which, at the time of the visit was not in use, a dryer for mussels (using a temperature of 65°C) and a *Fumex* ventilation system (to protect staff).

Gamma spectrometry

The laboratory is equipped with three HPGe detectors (two *Ortec*, one *DSG*). NIM electronics is from *Ortec*, *Silena* and *Ascom*. For calculations *Ortec GammaVision* software is used.

The lab also has a mobile system available (25% rel. eff., 2 keV resolution *Canberra* HPGe detector, with *Canberra ISOCS™* data evaluation).

A 100 MHz oscilloscope (*HP 54645A*) is used for fine tuning pulse shapes in the gamma spectrometry system.

Calibration is done once per year. Calibration instructions were to hand. The team witnessed the presence of two certified MRNS standards (Italian National Institute of Metrology; ENEA INMRI), produced Dec 2010/Jan 2011, in liquid form in 450 ml and 1000 ml Marinelli geometries. All radioactive standards are kept in a locked steel bin in the same room for easier control.

Background determinations are performed once per year and checked once per week.

For quality assurance, system checks are performed every week (Monday) by measuring a 450 ml Marinelli MRNS certified standard (*GT 492* from *AEA Technology QSA GmbH*, Braunschweig, Germany), in particular by scrutinising energy and peak shape information for Am-241, Cs-137 and Co-60. The team was shown the sheet accompanying such measurements.

Gross alpha/beta measurements and Liquid scintillation counting

The team witnessed a *Berthold LB770 10 channel low-level counter* with *Berthold LB 530 PC low radioactivity data system* that is used for gross alpha and gross beta measurements and a *Wallac 1220 Quantulus ultra low level liquid scintillation spectrometer* that will be used for drinking water measurements (gross alpha, gross beta).

A pressurised ionisation chamber *SEA SMP 01/T* was also available. It is only used when needed.

Quality control and management

Overall, the laboratory is very spacious and gives a well organised impression.

The laboratory currently is in the process of ISO 17025 accreditation for the 1 l and 0.45 l Marinelli geometries whereas cylindrical geometries will not be accredited. The verification team was told that the laboratory will receive an accreditation visit by the Italian authority ACCREDIA on 26 September 2011. Accreditation for gamma spectrometry of milk and foodstuff samples is already in place.

With regard to maintaining quality the laboratory participates in inter-comparisons exercises (e.g. wild bilberries by the European Commission) or those organised by ARPA Lombardy (Milan) or IAEA.

The balances of the laboratory are partly calibrated by an official service (e.g. for food); the analytical balance is calibrated at longer intervals.

Tracing

For tracing purposes the verification team chose the measurement of an aerosol filter taken on 10 May 2008. At that time paper filter were used, now glass fibre filters. The team found that the spectral shape for Be-7 was good, and the activity concentration value matched very well with the one taken online from the ISPRA RADIA database.

Sampling equipment on the roof of the building

The team verified sampling equipment installed on the roof terrace of the building. The location is rather protected by the building construction and trees and only in a limited way reflects the meteorological conditions in the Ancona area.

Aerosols are sampled with a *Zambelli* pump (situated inside of the building, flow rate 140 m^3/d). The 55 mm diameter glass fibre filters (*Ederol*) are held by a slightly protected filter holder mounted on a tripod outside on the small upper roof terrace.

Fallout is sampled with 14 large plastic cylinders, altogether covering a surface of 2.1 m^2, covered by a net for protection against birds and falling leaves, located on the lower roof terrace (medium size, but rather well protected by the building walls and a large *AERMEC* air conditioning unit). The laboratory uses acidified water to improve (dry) fallout sampling.

The verification team encourages the ongoing ISO 17025 accreditation activities.

The team suggests finding a location for the sampling devices that better reflects the meteorological conditions of the area.

Furthermore, the verification team suggest to replace the plastic cylinders used for collection of rainwater by a dedicated sampling device (see e.g. IAEA technical report series No.295, p.29ff) and to establish a written procedure for processing the samples for subsequent measurement.

6.5 UMBRIA (ARPA UMBRIA NETWORK)

6.5.1 Regional legislative acts regulating environmental radioactivity monitoring and funding

The Regional Agency for the Environmental Protection of Umbria – ARPA Umbria, established under the regional Law n.9 of 1998 (annex 19) (amended by Regional Law N. 29 of 2007, annex 20), is the technical reference institution for the environmental monitoring.

6.5.2 Radioactivity monitoring – organisation in Umbria

The analytical laboratory involved in the monitoring in Umbria is:

- ARPA Umbria – Water Chemistry Section – Physics – Ionizing Radiation Physics Service – Via Pievaiola 207 B-3 – 06132 – Perugia.

Table 31 gives information about measurement techniques, table 32 about the personnel situation.

The fixed sampling locations are reported in table 33.

In table 34, details on the samples analysed by ARPA Umbria in 2009, 2010 and 2011 are listed.

Table 31: Measurement techniques used in 2011 and those programmed for the near future for ARPA Umbria

Available measurement techniques	In 2011	Programmed
Gamma Spectrometry	X	X
Gamma dose rate	X	X
Liquid scintillation	-	X
Gross beta	X	X
Sr-90	-	X
H-3	-	X
Gross alpha	-	X
Alpha spectrometry	-	-

Table 32: Personnel involved in radioactivity monitoring in Umbria

Personnel	Units	Man months/year
Responsible	1	2.4
Graduate	1	11
Technician	1	11
Support	1 10	7 0.5

Table 33: Fixed sampling locations for radioactivity monitoring in Umbria

Fixed location	Samples/media	Parameter
Perugia/Via Pievaiola 207 B-3, 06132	Air/deposition	Gamma dose rate
Perugia/Via Pievaiola 207 B-3, 06132	Airborne particulates	Cs-137, Be-7
Terni/Via F.Cesi 24, 05100 (from July 2011 onwards: Terni/ Via C.A. Dalla Chiesa 05100)	Airborne particulates	Cs-137, Be-7
Perugia/Via Pievaiola 207 B-3, 06132	Fallout	Cs-137, Be-7
Terni/Via F.Cesi 24, 05100 (from July 2011 onwards: Terni/ Via C.A. Dalla Chiesa 05100)	Fallout	Cs-137, Be-7
Terni/Loc. Prisciano (industrial area)	Fallout	Cs-137, Be-7
Terni/Loc. Maratta (industrial area)	Fallout	Cs-137, Be-7
Pontenuovo di Torgiano (PG)/ Tevere River	SMOD	Cs-137, artificial gamma-emitting radionuclides
Nera Montoro (TR)/ chemical industry, Nera River	River water	Cs-137, artificial gamma-emitting radionuclide
Trasimeno Lake: Passignano sul Trasimeno/ Spiaggia Comunale La Darsena Isola Polvese/Spiaggia Nuova Tuoro sul Trasimeno/Spiaggia Lido Comunale Castiglion del Lago/Spiaggia Lido Arezzo	Lake sediment	Cs-137, artificial gamma-emitting radionuclides

Table 34: Sample media and radionuclides analysed by ARPA Umbria in 2009, 2010 and 2011; environmental and foodstuff samples

Samples/media	Parameter	Samples 2009	Samples 2010	Samples 2011
Airborne particulates	Cs-137, Be-7, gross beta	505	527	301
Fallout	Cs-137, Be-7	43	48	20
Air/deposition	Gamma dose rate	12	12	5
Waste water	I-131, In-111, Tc-99m	57	71	37
Lake sediment	Cs-137	4	8	-
Soil	Cs-137, K-40	29	22	-
Drinking water	H-3, Ra-226, U-234, U-238, gross alpha, gross beta	40	20	-
Milk	Cs-137, K-40	14	13	11
Other foodstuffs	Cs-137	53	47	33

The verification team acknowledges the current monitoring programme and recommends taking the experience gained in its implementation into account when revising future programmes.

6.5.2.1 Water sampling station at Pontenuovo

The verification team visited a surface water sampling site that is operated by ARPA Umbria.

The location is on the left bank of the Tevere River, some 10 km downstream of the inflow from Perugia. A pipe leads from the water surface to a locked container (*'stazione automatica controllo ambientale*') in a fenced area that houses the sampling equipment and devices for non-radiological purposes. The site is used for radiological sampling since 2011. Perugia hospital has a nuclear medical facility, thus the laboratory analysing the samples 'always' detects I-131. (The team was told that the laboratory also takes waste water samples from the Perugia sewage purification plant and verifies the measurements by comparing with data from the hospital).

For sampling, water is pumped every 20 minutes to the container for various (non-radiological) analyses also performed by ARPA Umbria. The site is connected by telecommunication to the centre.

Twice per year samples of 25 l are taken at a tap on the water inflow line in the container for radioactivity measurements. Although the river water carries a lot of sediments no problems with clogging of pipes have been reported yet.

At the opposite side of the river the team was shown the place for sediment/mineral organic detritus sampling (twice per year; sampling location 'DMOS') used since 1991.

A similar station is operated on the Nera River near Terni, where also a hospital with a nuclear medical department is located. At this location only water is sampled, no sediments.

The verification does not lead to any specific remarks.

6.5.3 Planned Regional programme for radioactivity monitoring

The Umbria Region approved with the Regional decree December 20th 2010 n.1919 and the Managerial Determination March 15th 2011 n.1649, the regional radioactivity monitoring programme. Table 35 lists this programme.

The verification team endorses the full implementation of the programme and encourages its perpetuation for the future.

Table 35: Umbria's planned regional programme for environmental samples and foodstuffs

Samples/media	Measurement	Measurement frequency	Measurements /year
Air/deposition	Gamma dose rate	Daily Monthly	365 12
Airborne particulate	Artificial gamma-emitting radionuclides, gross beta	Daily Monthly	730 24
Fallout	Artificial gamma-emitting radionuclides	Monthly	48
Freshwater sampling media	Artificial gamma-emitting radionuclides	Half-yearly	10
Drinking water	Gamma-emitting radionuclides, gross alpha, gross beta, H-3	Yearly	40
Milk	Artificial gamma-emitting radionuclides	Monthly	20
Meat	Artificial gamma-emitting radionuclides	Yearly	6
Cereal	Artificial gamma-emitting radionuclides	Yearly	4
Pasta	Artificial gamma-emitting radionuclides	Half-yearly	6
Vegetables, fruit	Artificial gamma-emitting radionuclides	Seasonal	18
Soft fruits	Artificial gamma-emitting radionuclides	Yearly	4
Game meat	Artificial gamma-emitting radionuclides	Yearly	4
Baby food	Artificial gamma-emitting radionuclides	Yearly	4
Other foodstuffs	Artificial gamma-emitting radionuclides	Variable	13

6.5.4 ARPA Umbria laboratory

The team verified the ARPA Umbria laboratory (Water Chemistry Section – Physics – Ionizing Radiation Physics Service) located at Via Pievaiola 207 B-3, 06132 – Perugia. A second laboratory belonging to ARPA Umbria is in Terni.

Personnel situation

ARPA Umbria as a whole has some 150 employees in Perugia and some 60 in Terni. The radiological laboratory in Perugia has three to four persons. The building is quite large and spacious.

The laboratory has ISO 17025 accreditation for food and soil; it participates regularly in intercomparison exercises organised by IAEA and the EC.

The laboratory handles all environmental samples (also waste water) and food samples (for the Health Department), incl. samples from ARPA Umbria Terni.

Sample receipt and registration

The laboratory runs a home-made LIMS, based on *Microsoft Access*. The sample ID number comprises the year, and a consecutive number and is allocated to sections (ie.: B … biological; C … chemistry; F … physics).

Sample preparation

In the sample preparation room, the team noted a chemical hood, a *FALC Jolly 1* heater for water evaporation, a *Retsch SM2000* mill, a *Retsch* cutter for pellets, a *HMHF* homogeniser, a *Retsch PM400* agate grinder and a *Heraeus* muffle furnace.

Liquid scintillation counting

Since three months a *Perkin Elmer Quantulus* LSC device is available for drinking water measurements. A graduate from the university has a contract for one year to set up the method. The installation of an automatic data transfer interface is planned.

Gamma spectrometry

The laboratory has three HPGe detectors, the last one has been received in February. This device showed problems and was returned to the manufacturer. Only recently it was sent back; at the time of the visit it was not yet fully in service.

All detectors are from *Ortec* (30%, 30%, 50% low energy); several *Ortec DSPEC* devices are used for digital pulse handling.

The detectors are shielded by commercially available 10 cm Pb shields with Cu liners. On a new *ITECO* shield the team noted end cap protection by cling film and a support/spacer for samples. Maintenance sheets on the shields (and in a maintenance book) were available.

For spectrum analysis the laboratory uses *Ortec GammaVision 6*.

Efficiency calibrations are performed once every two years, energy calibrations once per month. The laboratory uses calibration sources from *Deutscher Kalibrierdienst* (*DKD*; 2008) bought from *QSA Global GmbH*, Braunschweig, Germany.

Routinely, 1 l and 0.5 l Marinelli beaker as well as disk geometries are used. Based on an agreement with the university, a 100 ml source and a composite filters source are available for measurement of small volume samples and of monthly composite air filter packs.

The team also noted a Cs-137 source (*Amersham*, 1990) that is used for tests.

Checks of energy, efficiency, background and resolution are performed every 10 days (after LN_2 filling) using a Eu-152 point source.

Other measuring devices

The team witnessed an *Ortec* (*AMTEK*) *Detective-EX-100* device with HPGe detector to be used for mobile measurements.

The team also saw a *Berthold LB770 10 channel low-level counter* that is used for gross beta measurements (only for filters). Gross alpha and gross beta measurements are usually performed in the laboratory using the *Perkin Elmer Quantulus* LSC device.

Furthermore an ionisation chamber *SEA* SMP 01/T was noted (electronics inside of the laboratory; ionisation chamber on roof terrace outside of the building)

Tracing

For tracing a detritus (SMOD) sample collected on 31.5.2007 was chosen. For analysis the laboratory used the middle of the sampling period as reference date. For the I-131 value the gamma spectrometry printout, the LIMS report, and ISPRA's RADIA database (accessed online) showed very good agreement. The team noted that corrections on the spectrum analysis printout were signed.

Other equipment

A UPS for gamma spectrometry (*SOCOMEC SICON Modulys* with two battery packs provides electricity backup for most measuring devices for up to 45 minutes, before a diesel generator starts in. A second UPS is available for the *Quantulus* device.

Archiving (backup)

Once every month all gamma spectra are automatically archived. In addition, once per month back-ups are run by the informatics unit on the ARPA file server.

Devices on the roof of the laboratory building

The team verified the radiological equipment installed on the roof of the laboratory building. The building is quite high and situated in a wide area between soft hills. The large, flat roof has a cover with asphalt paper. The location is well chosen.

The team verified a *SEA* ionisation chamber on a tripod (secured on the railing and mounted at about 140 cm above ground). Additionally there was also a high volume air sampler (*Analitica strumenti*, Pesaro, IT, model *AirHVS* flow, with PM10 head model *Testa PM10 HVS*®) and a programmable low volume air sampler type *Zambelli Explorer*, with eight sampling heads (lockable).

The team was informed that during the Fukushima accident and currently (Marcoule 'event') the laboratory used the HiVol sampler from ARPA's 'air' unit. To allow for fast reaction in case of need, the laboratory asked for two HiVol samplers (one for the Perugia site, one for Terni).

For fallout sampling a stainless steel basin (2 m^2 surface) has been set up. For protection it is covered by a perforated grid.

The verification team recommends accreditation of the laboratory to ISO 17025 for the other analytical methods applied.

6.6 LAZIO (LAZIO NETWORK)

6.6.1 Regional legislative acts regulating environmental radioactivity monitoring and funding

The Regional Agency for Environmental Protection of Lazio was established under the Regional Law n° 45 (06. October 1998). In accordance with this law, ARPA Lazio is the technical reference body for the environmental monitoring of the Region, among its institutional duties there are the surveillance of the physical, chemical and biological factors of the environmental pollution as well as the surveillance of ionising- and non-ionising radiation.

The Regional Department (*Assessorato*) of Environmental Politics and Sustainable Development, with the Regional Deliberation n°109 of the 25/03/2011, approved the regional radioactivity monitoring programme, elaborated by the Environmental Regional Direction in collaboration with ARPA Lazio.

6.6.2 Radioactivity monitoring – organisation in Lazio

The analytical laboratories involved in the radioactivity monitoring are:

- Physics Laboratory – Provincial Department of Viterbo – ARPA Lazio, Via Maresciallo M. Romiti, 50 – 01100 Viterbo (VT);
- Physics Laboratory – Provincial Department of Latina – ARPA Lazio, Via Arrigo Serpieri, 3 – 04100 Latina (LT);
- Central Laboratory of the Croce Rossa Italiana (Italian Red Cross), Via B. Ramazzini, 15 – 0151 Roma (RM);
- Laboratory NBCR-VV.F Roma – Ministero degli Interni CNVVF, Via Genova, 3a – 01194 Roma (RM).

At present, the main regional reference centre is the Physics Laboratory of Viterbo.

Table 36 gives information about measurement techniques, table 37 about the personnel situation.

Table 36: measurement techniques used in 2011 in Lazio and those programmed for the near future

Available measurement techniques	**In 2011**	**Programmed**
Gamma Spectrometry	X	X
Gamma dose rate	X	X
Liquid scintillation	-	X
Gross beta	X	X
Sr-90	-	X
H-3	-	X
Gross alpha	-	X
Alpha spectrometry	-	-

Table 37: Personnel situation of the laboratories in Lazio

Personnel	ARPA Viterbo		ARPA Latina		CRI Rome		NBCR-VV.F Rome	
	Units	Man-Months/ Year	Units	Man-Months/ Year	Units	Man-Months/ Year	Units	Man-Months/ Year
Responsible	1	6	1	1	1	12	1	2
Graduate	2	12	3	6	1	6	-	-
Technician	-	-	-	-	-	-	3	12
Support	-	-	-	-	20	12	-	-

The fixed sampling locations are reported in table 38.

In table 39, details on the samples analysed by ARPA Lazio in 2009, 2010 and 2011 are listed.

The verification team acknowledges the current monitoring programme and recommends taking the experience gained in its implementation into account when revising future programmes.

Table 38: Fixed sampling locations for radioactivity monitoring in Lazio

Fixed location	Sampling media	Radionuclide
Rome/Via Boncompagni 101	Airborne particulate	Cs137
Viterbo/ViaMaresciallo M.Romiti 50	Airborne particulate	Cs137
Rome/via Genova 3 / VVF	Airborne particulate	Gross Beta
Rome, via Saredo 52 lat.41,862 long.12,573	Fallout	Cs137
Castel Giubileo lat.41,987 long.12,496	Surface water, SMOD, Sediment, Aquatic Plant	Cs137
Rome lat.41,906 long.12,474	Surface water, SMOD, Sediment, Aquatic Plant	Cs137
Rome lat.41,745 long.12,257	Surface water, SMOD, Sediment, Aquatic Plant	Cs137
Arce lat.41,453 long.13,666	Surface water, SMOD, Sediment, Aquatic Plant	Cs137
Anguillara Sabazia lat.42,091 long.12,265	Surface water, , Sediment, Aquatic Plant	Cs137
Marta lat.41,453 long.13,666	Surface water, , Sediment, Aquatic Plant	Cs137
Castel Gandolfo lat.41,756 long.12,652	Surface water, , Sediment, Aquatic Plant	Cs137
Tarquinia lat.42,166 long.11,731	Sea water, Sea Sediment	Cs137
Pomezia lat.41,365 long.12,882	Sea water, Sea Sediment	Cs137
Latina lat.41,365 long.12,882	Sea water, Sea Sediment, Aquatic Plant	Cs137
Viterbo lat.42,423 long. 12,009	Soil	Cs137
Rome lat.42,156 long.12,596	Soil	Cs137
Latina lat.41,484 long.12,883	Soil	Cs137

Table 39: Sample media and radionuclides analysed by ARPA Lazio in 2009, 2010 and 2011; environmental and foodstuff samples

Sampling media	Radionuclide	N. of samples 2009	N. of samples 2010	N. of samples 2011
Airborne particulate	Cs-137; Pb-214; K-40; Bi-214	-	10	-
Airborne particulate	Cs-137	-	8	52
Airborne particulate	Gross beta	-	31	39

Sampling media	Radionuclide	N. of samples 2009	N. of samples 2010	N. of samples 2011
Fallout	Cs-137	-	4	4
Soil, sand	Cs-137; Pb-214; K-40; Bi-214	-	6	-
River, lake sediment	Cs-137	-	14	-
Sea sediment	Cs-137	-	2	-
River, lake water	Cs-137	-	16	-
SMOD	Cs-137	-	12	-
Milk	Cs-137; Pb-214; K-40	23	51	23
Other foodstuffs	Cs-137; Pb-214; K-40, I-131	53	-	14
Mixed diet	Cs-137; Pb-214; K-40; Bi-214	-	16	3
Aquatic Vegetables	Cs-137	-	7	12

6.6.3 Regional programme for radioactivity monitoring

The Regional Department (*Assessorato*) of Environmental Politics and Sustainable Development approved with the Regional Deliberation n°109 of the 25/03/2011 the regional radioactivity monitoring programme elaborated by the Environmental Regional Direction in collaboration with ARPA Lazio. Table 40 lists this programme.

Table 40: Lazio's planned regional programme for environmental samples and foodstuffs

Samples/media	Measurement	Frequency of measurement	Measurements /year
Air/deposition	Ambient gamma dose rate	Monthly	36
Airborne particulate	Cs-137	Monthly	24
Airborne particulate	Gross beta	Monthly	12
Fallout	Cs-137	Quarterly	4
SMOD	Cs-137	Quarterly	12
Surface water	Cs-137	Quarterly	24
Lake and river sediments	Cs-137	Quarterly	28
Freshwater aquatic plant	Cs-137	Quarterly	28
Sea water	Cs-137	Half-yearly	6
Sea sediment	Cs-137	Half-yearly	6
Seawater aquatic plant	Cs-137	Half-yearly	6
Mollusc	Cs-137	Half-yearly	2
Soil	Cs-137	Half-yearly	6
Drinking water	Gross beta	Quarterly	12
Milk	Cs-137	Quarterly	12
Mixed diet (daily meals)	Cs-137	Quarterly	12
Other foodstuffs	Cs-137	Yearly	24

The verification team endorses the full implementation of the programme and encourages its perpetuation for the future.

6.6.4 ARPA Lazio – Viterbo

The team verified the ARPA Lazio laboratory (Physics Laboratory – Provincial Department of Viterbo *Sezione Provinciale di Viterbo*), situated at Via Maresciallo M. Romiti, 50 – 01100 Viterbo (VT).

Personnel Situation

ARPA Lazio as a whole has 400 employees, of which 59 are at the Provincial Department of Viterbo. The radiological laboratory in Viterbo (*laboratorio di fisica*, *CRR – Centro Regionale di Riferimento per il controllo della Radioattivitá Ambientale Lazio*) has 3 employees.

Sample receipt and registration

The laboratory uses new software for the registration of all incoming samples. All samples are also registered on paper with numbers starting with "1" each year.

Samples (environmental samples and food) are taken by ARPA staff.

Sample preparation / Radiochemical facilities

The sample preparation room was found to be very spacious. Food samples are stored in a fridge at 4°C until preparation. For this, they are cooked for 2h 40min at 200°C using a programmable *MMM* dryer, homogenised in a *Kenwood* kitchen machine and then transferred to Marinelli beakers. The procedure could be printed out, but was not directly available at the work place.

Surface water samples are evaporated at 80°C (slow evaporation) in order to reduce losses of more volatile substances.

Soil samples are air dried before being processed through a *Retsch SR2* mill. For rigid foods (e.g. pasta) there is a second such mill available.

Gamma spectrometry

The team witnessed *Ortec* HPGe detectors and *Ortec* NIM (amplifier etc.). An *Ortec 419* pulse generator is available for pulse shape fine tuning. *Ortec 919 SpectrumMaster* is used for spectrum management. The shields are made of 10 cm Pb with Cu liner; no cling film end cap protection is applied.

For calculation, the laboratory utilises the *Ortec GammaVision* software.

The geometries used are 1 l and 450 ml Marinelli beakers and a small cylindric form for air filters.

Calibration is performed once per year and background measurements once every three months. Energy and peak shape checks are done before each measurement. Density correction is not needed since 'all' samples are of ca. 1 kg, in 1 l Marinelli beakers. Summing corrections are not applied.

The team was informed that for Marinelli calibrations the laboratory utilises mixed nuclide certified calibration sources (*NW336* respectively *NW337* from *DKD – Deutscher Kalibrierdienst* / *QSA Global GmbH*, Braunschweig, Germany), dating 1 February 2006.

Measuring times are 10000 sec for all food and environmental samples.

A UPS with a reserve of two days of electrical power reserve is available.

Other measuring devices

For alpha spectrometry a NIM spectrometer *Ortec Soloist* with one chamber is available. Spectrum management is performed using an *Ortec 919 Spectrum Master* device. At the time of the visit there was no vacuum pump connected and the device was obviously not in operation.

The team witnessed a new *HIDEX 300 SL* liquid scintillation counter that the laboratory received four months ago and which will be put into operation next year. The device will be used for gross beta determination in surface water (next year's programme).

For radon measurements the laboratory had a *RadOsys Radometer 2000* device available; *CR-39* films were used. At the time of the visit the device was out of order. The team was told that two years ago a study on Rn indoor, covering the whole region, has been performed.

At the time of the visit, all radioactive sources were stored in a locked bin (e.g. a Rn-222 standard - Ra-226 in a sealed canister; production date 1.1.1989; from *Isotope Products Laboratories*, Burbank, CA, USA). The bin also contained all certification sheets.

Archiving/backups

The team witnessed a vast sample archive containing e.g. many food samples in Marinelli beakers).

With regard to a backup or archive, in particular of gamma spectra, the team was told that no specific procedure is used, the spectra 'just stay on the computer'.

Tracing

For result tracing the team chose the measurement of the combined local air filters for May 2010 with the registration number *NRG 3370*. A printout of the spectrum could be made available very quickly. The verification of the spectrum showed good peak shape for the Be-7 peak and a reasonable value. Since the RADIA database does not contain Be-7, the team changed its choice to Cs-137, which on the spectrum analysis printout had a value of <2.6497E-4. In the report, this value was given as 2.6x20^-4MAR (*'minima attivitá rilevabile'*). The team was told that the report did not show '<' because the utilised software 'does not allow this', however 'MAR' signifies that the value is the minimal detectable activity. The team noted that '20' should read '10' to demonstrate the correct power; apparently there is a bug in the software. The team was told that the values are transferred to an *Excel* table, which correctly showed <2.6E-4. From here data are transferred to ISPRA to the RADIA database. The RADIA database (accessed online) gave the correct value: .00026MAR.

Devices on the roof of the laboratory building

The team witnessed several sampling and measuring devices installed on the flat roof of the laboratory building. The location of the site is globally very good (wide, relatively plane area), however due to the fact that the roof is on first floor level there may be some influence from the higher storeys of the building. This could be compensated by the reasonably large size of the roof.

The team witnessed a new programmable low volume aerosol sampler (*Zambelli*) with display and the possibility of connecting a USB device.. Up to 16 filters can be used (*Controller16*); nominal air flow rate is 50 m^3/d.

For fallout sampling a wet and dry sampler (*mtx*, Bologna, IT) is placed that closes and opens the respective sampling trays.

A pressurised ionisation chamber (*SEA*) mounted on a tripod is installed as well. The laboratory expected to receive a new system with data interface a few weeks after the visit.

> *With regard to sample preparation the verification team recommends having the relevant procedures also available at the work place.*
>
> *With regard to reporting the team suggests correcting the apparent software bug that – at least for values lower than the minimum detectable activity – on the internal report presents '20' as marker for '10 to the power of …'.*
>
> *The team further recommends installing a structured backup and archiving system to keep data – in particular spectra in case of hardware problems with a measuring system.*
>
> *The verification team recommends accreditation of the laboratory to ISO 17025.*

6.6.5 ARPA Lazio – Latina

The team verified the Physics Laboratory – Provincial Department of Latina – ARPA Lazio, Via Arrigo Serpieri, 3 – 04100 Latina (LT).

Currently the only equipment is an electrically cooled *Ortec* HPGe detector with 50% efficiency with a *DSpec Junior2* (*Ortec*) device for data acquisition and *GammaVision* (*Ortec*) software for spectra evaluation. Measurements on milk from Rome, Latina and a farm situated close to the Latina NPP are carried out monthly. In 1998 measurements on fruit & vegetables were started with around 30 samples and currently about 60-80 samples are analysed and this is expected to increase.

Efficiency calibration is carried out yearly and energy calibration is done after each measurement. A mixed nuclide source (*OW918A*) with a reference date of 1 March 2007 from *QSA Global GmbH* (*DKD* certified) is used.

Samples are recorded on arrival in a register and also input to the national database.

This could be traced with a 2 L milk sample from 6.9.2011: Sample receipt form, spectrum (A11_09_11_3761.An1), internal report and external report were readily available.

It is planned to move to a new building in 2012, the administrative procedures for the purchase were nearly completed at the time of the visit. Additional equipment is envisaged, including a second gamma detector and a liquid scintillation counter.

The verification team were also shown an air particulate sampler (*TCR TECORA* model *Sentimel PM*) on the roof of the building which has been in operation since June 2011 though out of operation in August 2011 due to technical problems. At the time of the visit a flow rate of 38.33 l/min was observed. Calibration is automatic. Filters are changed every two days and sent to the ARPA Lazio laboratory at Viterbo for analysis.

The verification team recommends the purchase of a new calibration source when the move to the new laboratory is complete.

The verification team recommends accreditation of the laboratory to ISO 17025.

6.6.6 Central Laboratory of the Italian Red Cross

The team verified the Central Laboratory of the Italian Red Cross (*Croce Rossa Italiana*, *CRI*), Via B. Ramazzini, 15 – 0151 Roma (RM).

The Environmental Radioactivity Measurement Service at the Central Laboratory of the Italian Red Cross (*SMRA/LC/CRI*), is the only structure within the association that carries out activities of monitoring, research, and development within the field of measurement and methods for environmental, food, and biological matrix.

The *SMRA/LC/CRI* Service, was instituted in 1986 in response to the Chernobyl accident, and has been part of the Environmental Radioactivity Surveillance Network in Italy - "*RETE RESORAD*"- since 1991.

It currently comprises a laboratory for gamma spectrometric analysis of natural and artificial radionuclides, a laboratory for sample preparation and treatment and a laboratory for indoor radon measurement. It is staffed by specialised personnel and Italian Red Cross volunteers (in particular for sample taking).

Activities in the local area comprise:
- semi-annual/quarterly monitoring campaigns
- monthly, quarterly and semi-annual indoor radon monitoring campaigns (active and passive measurements).

Quality controls include calibration and intercomparison campaigns with secondary standards laboratories. National Institute of Ionizing Radiation Metrology—ENEA-INMRI (*Istituto Nazionale di Metrologia delle Radiazioni Ionizzanti*), Casaccia and the UK Health Protection Agency.

The Red Cross also organise educational activities in the areas of: environmental radioactivity, nuclear emergency risk, health consequences, etc. namely the organisation of continuing-education courses, Enterprise Content Management courses, seminars, conventions, conferences, and internships with students from American universities at their laboratories.

River and lake waters are sampled quarterly at the following points respectively, the river Tevere in central Rome, to the North and the South, and lakes Albano, Bracciano and Bolsena. In addition sediment is sampled at each point using a weighted double bag which has been slashed to allow through flow of water and collection of sediment in the bottom. Typically sampling is undertaken by a team of trained volunteers and a sampling protocol accompanies all samples.

For water samples the typical sample size is 30 litres which upon return to the laboratory is concentrated on resin and normally measured the following day.

Additional sample media include aquatic vegetation (typically 60-80 g) which is dried before being passed through a mixer. Furthermore since 1991 monthly milk samples from a cooperative near the Lazio NPP and since 2008 six monthly samples of mixed diet have been analysed. Samples since 2007 are still in storage.

The current laboratory dates from 2000 and is equipped with an *Ortec GEM series* HPGe detector having a relative efficiency of 25% at the 1.33 MeV Co-60 line which was purchased in August 2001. The last test of the detector was in July 2011, however a problem with the electronics in early September forced its return to *Amtek* for maintenance, with an expected return date at the end of the month.

Ortec GammaVision version 6.1 is used for analysis though the laboratory procedures in place (*Procedura di Laboratorio Gamma Vision (5.1) Servizio misure Radioaktivita Ambientale LC-CRI*) spoke of version 5. This will be updated.

Background measurements are done every two weeks and have been found to be invariable over the years. However it was observed that the background file used for evaluation of samples was from 16 November 2007

A mixed nuclide gamma calibration source (*Amersham MO952*, 1 L Marinelli, density = 1 kg/L) with a reference date of 1 July 2004 was available. It was already envisaged to acquire a new source in late 2011 or early 2012.

The verification team supports to acquire a new gamma calibration source and suggests to update the gamma measurement procedure for the current software version and the use of the most recent background measurement for sample evaluation..

The verification team recommends accreditation of the laboratory to ISO 17025.

6.7 SARDEGNA (ARPA SARDEGNA NETWORK)

Due to lack of time, the verification of the environmental radioactivity monitoring in the region of Sardegna by the verification team could only be performed by a verification of the submitted written documents and the oral presentation of the situation at the opening meeting.

6.7.1 Regional legislative acts regulating environmental radioactivity monitoring and funding

The Regional Agency for Environmental Protection of Sardegna established under the regional Decree September 30th 2002 n.323, is the technical reference institution for the environmental monitoring confirmed in 2006 by the Regional Act May 18th 2006 n.6.

6.7.2 Radioactivity monitoring – organisation in Sardegna

The analytical laboratories involved in the monitoring are:

- Reference Regional Centre for the environmental radioactivity (CRR-Sardegna). Via F. Ciusa 6-09100 Cagliari;
- Environmental radioactivity laboratory – Sassari Department. Via Rockfeller, 58-60 – 07100 Sassari.

The available measurement techniques are reported in table 41, the personnel situation is shown in table 42.

Details for the fixed sampling locations are reported in table 43.

Table 41: Measurement techniques available in Sardegna

Available measurement techniques	In 2011	Programmed
Gamma Spectrometry	X	X
Gamma dose rate	X	X
Liquid scintillation	-	X
Gross beta	X	X
Sr-90	-	X
H-3	-	X
Gross alpha	X	X
Alpha spectrometry	-	-

Table 42: Personnel actually involved in radioactivity monitoring in Sardegna

Personnel	Units	Man-Months/Year
Responsible	1	4
Graduate	2	12
Technician	4	26
Support	-	-

Table 43: Fixed sampling, locations, media, and radionuclides analysed, for Sardegna

Fixed location	Samples/media	Parameter
Cagliari/Via F. Ciusa 6	Airborne particulate	Gross alpha, gross beta, Cs-137, Be-7
Sassari/ Via Rockfeller, 58-60	Airborne particulate	Gross alpha, gross beta, Cs-137
Sassari/ Via Rockfeller, 58-60	Fallout	Cs-137
Cagliari/Via F. Ciusa 6	Fallout	Cs-137, Sr-90
Cagliari/Via F. Ciusa 6	Air/deposition	Gamma dose rate
Sassari/ Via Rockfeller, 58-60	Air/deposition	Gamma dose rate

In table 44, details for the sampling in 2009 to 2011 in Sardegna for radiological analyses are listed.

Table 44: Sampling media and radionuclides analysed in 2009, 2010, and 2011, by ARPA Sardegna; environmental and foodstuff samples.

Sampling media	Radionuclide	N. of samples 2009	N. of samples 2010	N. of samples 2011
Fallout	Gamma spectrometry	7	4	13
Airborne particulate	Gamma spectrometry	-	-	58
Waste water	Gamma spectrometry	121	20	41

Sampling media	Radionuclide	N. of samples 2009	N. of samples 2010	N. of samples 2011
Sea water	Gamma spectrometry	27	20	20
Mussel (environmental sample)	Gamma spectrometry	13	38	12
Sewage purification plant	Gamma spectrometry	57	10	32
River sediment	Gamma spectrometry	11	-	-
Cow's milk	Gamma spectrometry	61	67	2
Food (excluding milk)	Gamma spectrometry	210	200	25

6.7.3 Regional programme for radioactivity monitoring

The document "*Controllo della radioattività ambientale - Stato della Rete Regionale di rilevamento della radioattività ambientale*", published in May 2011 by Sardegna Region, contains the Laws, the regional monitoring network of the environmental radioactivity and the environmental and foodstuffs monitoring plan. The environmental radioactivity monitoring and the collaboration with the RESORAD network is established in the Agency general programme of activity 2011-2013 approved with Regional Deliberation April 5th 2011 n. 18/14. Table 45 lists this programme.

Table 45: Sardegna's planned regional programme for environmental samples and foodstuffs

Samples/media	Measurement	Frequency of measurement	Measurements/year
Airborne particulate	Cs-137, I-131, K-40, Be-7 gross alpha, gross beta	Daily Monthly	250 (gamma) 250 (gross alpha/beta) 24 (only gamma)
Fallout	Cs-137, I-131, Be-7	Monthly	12
Air/deposition	Ambient gamma dose rate	Monthly	12
Drinking water	Cs-137, Sr-90, H-3 gross alpha, gross beta,	Half -yearly	20
Sea water	Cs-137, Sr-90	Half- yearly	4
Waste water	I-131, In-111, Tc-99m, Cs-137	Half -monthly	50
Mud depuration plant	I-131, In-111, Tc-99m, Cs-137	Half -monthly	50
Cereals	Cs-137, I-131	Monthly	30
Milk	Cs-137, I-131, Sr-90	Monthly	30
Dairy product s	Cs-137, I-131	Monthly	28
Fruit	Cs-137, I-131	Monthly	30
Vegetables	Cs-137, I-131, Sr-90	Monthly	50
Meat (bovine, pork, ovine)	Cs-137, I-131	Monthly	30
Fish	Cs-137, I-131	Monthly	20

6.8 TOSCANA (ARPA TOSCANA NETWORK)

Due to lack of time, the verification of the environmental radioactivity monitoring in the region of Toscana could only be performed by a verification of the submitted written documents and the oral presentation of the situation at the opening meeting.

6.8.1 Regional legislative acts regulating environmental radioactivity monitoring and funding

The regional Law July 7th 2003 n.32 "*Disciplina dell'impiego di sorgenti di radiazioni ionizzanti*" assigns to the Reference Regional Centre for radioactivity of the Agency for Environmental Protection of Toscana the regional network management of the environmental radioactivity. This attribution was confirmed with the regional Law "*Nuova disciplina dell`Agenzia regionale per la protezione ambientale della Toscana*", that includes environmental radioactivity control among the duties of ARPAT.

6.8.2 Radioactivity monitoring – organisation in Toscana

The analytical laboratories involved in the monitoring are:

- ARPAT - Provincial Department of Firenze, Via Ponte alle Mosse 221 - 50144 Firenze.

The available measurement techniques are given in table 46, the personnel situation in table 47.

Table 46: Measurement techniques available at ARPAT

Available measurement techniques	In 2011	Programmed
Gamma Spectrometry	X	X
Gamma dose rate	X	X
Liquid scintillation	X	X
Gross beta	X	X
Sr-90	-	X
H-3	-	X
Gross alpha	-	X
Alpha spectrometry	-	-

Table 47: Personnel involved in the radioactivity monitoring at ARPAT

Personnel	Units	Man-Months/Year
Responsible	2	12
Graduated	3	30
Technician	4	46
Support	3	6

Details for the fixed sampling locations are given in table 48.

In table 49, details for the radiological monitoring in 2009 to 2011 in Toscana are listed.

Table 48: Fixed sampling, locations, media, and radionuclides analysed, for Toscana

Location	Samples/media	Measurement
Firenze/Via Ponte alle Mosse 211	Airborne particulates	Cs-137, Cs-134
Firenze/Via Ponte alle Mosse 211	Fallout	Cs-137, Cs-134, Be-7, Co-60
Firenze/Via Ponte alle Mosse 211	Air/deposition	Gamma dose rate
Livorno/Via Marradi 114 - 57126	Air/deposition	Gamma dose rate
Grosseto/Via Unione Sovietica 43°31'08,20"N 10°19'14,90"E	Air/deposition	Gamma dose rate
Livorno/Piazza L. Cappiello, (43°31'08,20"N 10°19'14,90"E)	Air/deposition	Gamma dose rate
Massa/Via Galvani, 10 (44°02'14,030"N 10°08'07,80"E)	Air/deposition	Gamma dose rate
Prato/Via Roma, 101 (43°52'24,30"N 11°05'32,50"E)	Air/deposition	Gamma dose rate
Firenzuola/Passo del Giogo, (FI) (44°02'50,30"N 11°23'20,60"E)	Air/deposition	Gamma dose rate
Pisa/Piazza Del Rosso (42°46'40,00"N 11°07'05,60"E)	Air/deposition	Gamma dose rate
Settignano (FI)/Via Desiderio da Settignano (43°47'17,30"N 11°19'23,20"E)	Air/deposition	Gamma dose rate
Stia/Papiano Alto (43°49'54,00"N 11°42'04,20"E)	Air/deposition	Gamma dose rate
Firenze/Lungarno Ferrucci, Circolo Canottieri di Firenze	SMOD	Cs-137, Cs-134, I-131, Co-60
Calcinaia/Circolo Canottieri di Calcinaia (43°40'59"N 10°36'56"E)	SMOD	Cs-137, Cs-134, I-131, Co-60
Firenze/Via Ponte alle Mosse, 211 - 50144 (43°46'38"N 11°14'55"E)	Drinking water	Cs-137, Cs-134, I-131, Co-60
Grosseto/Via Scansanese 150. *Consorzio Produttori latte Maremma*	Milk	Cs-137, Cs-134, K-40
Firenze/Via dell'Olmatello 20. *Centrale del latte di FI, PT e LI*	Milk	Cs-137, Cs-134, K-40
Capannori/Via Circonvallazione Colognora di Compito 1/3. *C.A.P.LA.C. Soc. Coop. Ar.l.*	Milk	Cs-137, Cs-134, K-40
Grosseto/*loc. Stiacciole snc. ICAM*	Meat, bovine	Cs-137, Cs-134

Table 49: Radiological monitoring in 2009, 2010, and 2011, by ARPAT; environment and foodstuffs

Samples/media	Parameter	N. of samples 2009	N. of samples 2010	N. of samples 2011
Airborne particulate	Gamma spectrometry	12	12	5
Fallout	Gamma spectrometry	12	12	11 (7 Fukushima incident)
Air/deposition	Gamma dose rate	12	12	5
River water	Gamma spectrometry	8	4	3
Ground water	Gamma spectrometry, gross alpha, gross beta	4	3	-
Spring water	Gamma spectrometry	3	-	-
SMOD	Gamma spectrometry	5	4	3
Sea sand	Gamma spectrometry	1	-	-
Sea water	Gamma spectrometry	1	-	-
Soil	Gamma spectrometry	13	5	-
Mud depuration plant	Gamma spectrometry	-	10	3
Waste water	Gamma spectrometry	-	19	7
Fume dust, bottom ash of municipal waste treatment plants and sanitary	Gamma spectrometry	-	18	-
Geothermal fluids	Rn-222	22	12	-
Milk	Gamma spectrometry	36	43	19
Drinking water	Gamma spectrometry, gross alpha, gross beta and Rn-222	42	29	10
Mushrooms	Gamma spectrometry	25	60	11
Other foodstuffs	Gamma spectrometry	24	21	24 (17 Fukushima incident)

6.8.3 Regional programme for radioactivity monitoring

In table 50, the planned programme for Toscana for radiological analyses is listed.

Table 50: Toscana's planned regional programme for environmental samples and foodstuffs

Samples/media	Measurement	Frequency of measurement	Measurements /year
Airborne particulates	Cs-137	Daily	262 (temporary)
Air/deposition	Ambient gamma dose rate	Daily	2920 (8 stations)
Fallout	Cs-137	Monthly	12
Surface water, SMOD	Cs-137	Quarterly	8, 16
Drinking water	Cs-137, Rn-222 gross alpha, gross beta,	Variable	52
Sea water	Cs-137	Half-yearly	2
Sea sediment	Cs-137	Half-yearly	4
Sewage purification plant	I-131, In-111, Tc-99m, Cs-137	Half-yearly	15
Waste water	I-131, In-111, Tc-99m	Half-yearly	15
Fume dust, bottom ash of municipal waste treatment plants and sanitary	I-131, In-111, Tc-99m, Cs-137, Ra-226	Yearly	16
Geothermal fluids	Rn-222	Three-year	10
Other environmental sampling media	Gamma spectrometry	Variable	30 (temporary)
Mushrooms	Cs-134, Cs-137, K-40	Variable	40
Foodstuffs	Cs-134, Cs-137, K-40	Variable	60

6.9 GENERAL RECOMMENDATIONS BY THE VERIFICATION TEAM FOR ALL VERIFIED REGIONS

Staffing should allow that each work task can be performed by at least two persons in order to allow operating a routine programme also during holiday times and in case of sickness of a staff member. The verification team recommends finding a stable solution to achieve this with trained personnel.

In particular with regard to highly specific tasks involving radiochemical sample preparation such as alpha spectrometry and analysis of Sr-90 the team recommends co-operation between the ARPAs/APPAs. Such co-operation should achieve that not each laboratory has to perform each of these complex analyses. For some tasks (e.g. with regard to mass spectrometry) other units of the local ARPA/APPA could be involved. Necessary training for such tasks could be organised and given by ISPRA. The team points out that in particular radiochemical work should be performed as a routine task to guarantee continuity and to reach a reasonably high qualitative standard.

7 GARIGLIANO NUCLEAR POWER PLANT (DESCRIPTION AND VERIFICATION FINDINGS)

7.1 HISTORY OF NUCLEAR INDUSTRY IN ITALY

In the mid-1960s Italy completed its first three nuclear power plants – each one equipped with one reactor –Latina in 1964, Garigliano in 1964 and Trino Vercellese in 1965 for a total installed capacity of 500 MW. Still in 1977 the national energy planning considered the need to build 20 more nuclear power plants. In 1978 the fourth Italian NPP located at Caorso was connected to the grid.

Latina NPP was the first Italian nuclear reactor to enter into operation: a Magnox reactor of 200 MW. Garigliano NPP (160 MW) faced unexpected structural problems and thus stopped electricity production in 1982. In December 1987 all radioactive fuel was transferred to the nuclear manufacturing ENEA plant "Avogadro" at Saluggia. Trino Vercellese NPP has an installed capacity of 250 MW and it has not produced electricity since March 1987, when it was stopped for re-powering activities.

The Italian nuclear power programme was stopped after the Chernobyl reactor accident in 1986. By popular referendum on 8 November 1987 the Italian people voted in favour of a ban on the use of nuclear reactors in Italy. Formally, the referendum called for the restriction and stand-by of the nuclear programme. Soon afterwards the Italian government decided to put a five years moratorium on all nuclear activities, including projects, power plants and research reactors.

Following the results of the referendum, on 12 December 1987 the House of Deputies of the Italian Parliament passed a motion calling for the final shut down of Latina and Garigliano NPPs, and stopping any construction work at Trino II, as well as a stand-by for operations at Trino I and Caorso and construction works at Montalto di Castro.

In August 1988 the Italian government decided to convert the Alto Lazio plant into a conventional thermal power plant, which was completed after ten years.

During the 80s spent fuel from the Italian NPPs was sent to Sellafield, UK, for reprocessing.

On 12 June 1990 the House of Deputies agreed to shut down Caorso and Trino NPPs as well.

Finally, the government decided to definitively ban nuclear power generation in existing plants in Italy. On 26 July 1990 the Interministerial Committee on Economic Planning (CIPE) decided to shut down Caorso and Trino NPPs, specifying that the electric power company ENEL was in charge to put the two plants under a passive safety regime, and the Industry Minister had to elaborate decommissioning plans for both.

In October 1998 the first phase of safety operations at Caorso started, including the transfer of about 200 tonnes of nuclear fuel from the core of the nuclear reactor into "pools".

SoGIN Co. was established in July 1999 to take care of the decommissioning of the four Italian NPPs. In January 2000, the only nuclear reactor of the Caorso NPP was definitively deactivated. In August 2000 SoGIN started officially decommissioning operations on the four NPPs, to be completed in 2020.

In 2000 the Parliamentary Committee on waste adopted a resolution for the establishment of the "Agengir" agency in charge with the construction and management of the national nuclear waste storage centre and the co-ordination of nuclear decommissioning operations in Italy.

7.2 GARIGLIANO NUCLEAR POWER PLANT

7.2.1 Historical context

Garigliano Nuclear Power Plant was a nuclear power plant located at Sessa Aurunca (Campania), in southern Italy and was named after the river Garigliano.

Consisting of one BWR with a thermal power of 506 MW corresponding to an electrical power of 160 MWe, it operated from April 1964 until August 1978 producing a total of 12.5 x 10^9 kWh. Final shutdown was on 4 March 1982.

The Garigliano NPP site is managed by SoGIN and counts a total of 46 employees. The organisation chart was approved by ISPRA in November 2010 as is required by law.

7.2.2 Decommissioning work

Three trenches were dug on the site during the 1960's and 70's for the disposal of low activity technological waste. Currently it is foreseen to start remediation of trenches 2 and 3 with number 1 foreseen for 2013. In 1987 the removal of irradiated fuel from the plant was completed, a part of which was transferred to UK for reprocessing and the other part put into storage at Avogadro di Saluggia. The transport of fuel from the Avogadro storage to France for reprocessing has been initiated in February 2011.

After stopping the reactor operation, all the hydraulic circuits of the reactor have been drained and after the fuel was removed the fuel storage pool has been emptied.

Treatment of accumulated waste has been completed in 1998.

In December 2000 the working activities were finalised to achieve a condition of passive protective custody where the residual radioactivity is confined in a safe condition inside the structure.

In 2007, activities were completed for the removal of asbestos from the turbine building.

In 2008 electrical installations, ventilation, fluids drainage and radiological monitoring were renovated for asbestos removal.

In 2009, hot and cold chemical laboratories were built.

In 2010 cleaning of the reactor building insulation containing asbestos was finished.

The plans for 2011 – 2013 are:

- D1 new temporary storage until Dec 2011, storage from 2012 onwards only for waste from on site;
- Adaption of ex diesel building for storage of 700 radioactive waste drums and asbestos;
- Demolition of old chimney and construction of new chimney;
- 3 trenches: preliminary activities for remediation of low activity technological waste from the 1960's and 70's.

Currently decommissioning activities are 'on hold'; the elaboration of the decommissioning procedure is at an advanced stage and discharge limits will be modified with new criteria, based on an estimated dose to the public of 10 microsieverts/year per person.

7.2.2.1 Control room

The team visited the control room housed within the turbine building. In addition to environmental monitoring data, meteorological information and water levels of the Garigliano River are displayed in the control room.

The verification team was shown the software for the central surveillance of the environmental dose rate which consists of four measurement points located around the site. (*Sistema di monitoraggio* 5700 *sMON*, *ELSE*). The measurement point located 134958.12E, 411504.86N is also used for reporting to ISPRA.

The verification team was shown the software for monitoring of meteorological data (*ARTS Versione 2.0*). Pressure, temperature, humidity, solar power, wind velocity and direction are displayed online for 2 measurement points (Torre Faro and Traliccio). Additionally, the river water level is displayed.

The verification team was shown the monitoring software for gaseous and aqueous discharges. Both discharge paths are monitored by NaI(Tl) detectors which are checked weekly with a calibration source for quality control. Alarm levels are set to 1% of daily discharge limit. The pre-alarm and alarm level is set at 400 and 500 cpm for gaseous discharges and to 150 and 250 cps for liquid discharges respectively.

The verification does not give rise to specific recommendations.

7.2.2.2 Environmental radioactivity monitoring as performed by the responsible operator (on site and off site)

On-site monitoring

The verification team witnessed the procedure for underground water sampling at sampling point P8 located on the east side of the site. The sampling well is covered with a pit cover, a sampling container is lowered down on a string, the water is then filled into a Marinelli beaker which is labelled "Falda 8".

Several TLD & film badge dosimeters located on the site boundary are changed monthly.

The gamma station operates with solar power due to high cost of drawing electricity.

The verification does not give rise to specific recommendations.

Off-site monitoring

There are 4 air sampling stations in close proximity to the site each equipped with an *Eolo model 3001* particulate air sampler. The verification visited one such station and the procedure for changing the filter was demonstrated. Additionally 2 meteorological stations (on and off site) record the principal climatological date (temperature, wind direction and speed etc.).
The following matrices are measured as part of the environmental monitoring network:

Sample matrix	N° of samples	Frequency of sample	Radionuclides analyzed	Frequency of measure
Air	1	Continuous	Total beta, gamma emitters	weekly , monthly
Superficial water	3	Continuous, weekly, six-monthly	H-3 and gamma emitters	Monthly- six monthly
River fish	1	six-monthly	gamma emitters	six monthly
Sand	2	Annual	gamma emitters	Annual
Sediments	10	six-monthly	gamma emitters	six monthly

Sample matrix	N° of samples	Frequency of sample	Radionuclides analyzed	Frequency of measure
Groundwater	11	Quarterly/ six-monthly	H-3 and gamma emitters	Quarterly/ six-monthly
Fall-out	1	monthly	gamma emitters + beta total	monthly

Though not part of the environmental monitoring network the following additional matrices are measured:

Sample matrix	N° of samples	Frequency of sample	Radionuclides analyzed
Mussels	1	Six monthly	^{3}H e γ-emitters
Clams	1	Six monthly	^{3}H e γ-emitters
Vegetables	5	Six monthly	^{3}H e γ-emitters
Fruits	6	Six monthly	^{3}H e γ-emitters

All samples are analysed at the on-site laboratory, the functioning of which is described in detail elsewhere in the report.
A number of procedures cover the environmental monitoring network, notably:
- *Istruzione Operativa* "Sampling and pretreatment of the matrices provided by the Network of Environmental Monitoring" GR RS 0126
- C.I. Prot. 0004653 del 30/01/2001 "The Environmental Monitoring Network for the Nuclear Garigliano"
- I. Prot. 0010747 del 25/03/2001 "Environmental monitoring of Tritio"
- *Istruzione operativa* "Measures of gamma spectrometry with software gamma vision v.6.07" - Doc Sogin GR RS 00258
- *Procedura operativa* "Efficiency calibration for germanium detectors" doc Sogin GR RS 0031 (under review)

Outside of the routine environmental sampling the University of Naples performed two special monitoring surveys, in 2001 and the latest in 2009.

7.2.2.3 Discharge monitoring

Gaseous discharges

The verification team inspected the sampling station for gaseous discharges. In this sampling station, particulates present in exhaust gases are sampled with the chimney isokinetic probe placed at a height of 30 m in the chimney. Exhaust air is pumped from the probe and passed through a filter which is exchanged daily. The filter sampling procedure was demonstrated to the verification team (filter: *C/11/FA/481*, marked *filtro stack gas 14/09/2011*). Vents for operation of the filter change were well marked, checklist and sampling procedure (*GR RS 0068 Rev.1 30/4/2005*) were readily available on site.

Determination of H-3 discharge data is done by quarterly sampling. Exhaust gas is taken from a pipe within the stack with a valve and a pump; H-3 (H_2O) collected with a molecular sieve, the water is then evaporated from the molecular sieve by heating and collected, distilled and measured by LSC.

Continuous monitoring of stack gas is performed by a NaI(Tl) detector located in the stack which is checked weekly with a calibration source for quality control. Count rate is displayed by the discharge monitoring software on-line in the control room.

The verification team suggests to ensure isokinetic sampling for the planned new exhaust stack and to consider on-line H-3 monitoring for the new stack.

Liquid discharges

There are 2 tanks for aqueous waste which are homogenised for 30 minutes from the control room prior to sampling. Activity concentration is determined by gamma spectrometry prior to release. A monthly integral sample is prepared by daily automatic sampling of waste water and measured by gamma spectrometry, for Sr-90 by beta counting of separated Y-90, for H-3 by LSC after distillation and for alpha emitters.

The verification team inspected the NaI(Tl) detector located in a tube at the discharge point. The control unit showed 28.91 cps and is connected to the control room where the data are displayed by the discharge monitoring software. In case of an alert, the discharge pump can be stopped from the control room. The detector can be pulled up from the tube and can be placed to a nearby lead shield for calibration.

The verification does not give rise to specific recommendations.

7.2.2.4 Environmental radiology monitoring laboratory

The verification team inspected the on-site laboratory for environmental radiology monitoring which comprises five technicians and a manager. The laboratory does not have ISO 17025 certification but an internal quality maintenance programme is implemented.

Gamma spectrometry

For gamma spectrometry, five HPGe detectors (*Ortec*) with liquid nitrogen cooling are available for laboratory measurement; spectrum acquisition is done by *DSPEC* or *DSPEC Junior* (*Ortec*). Detectors are calibrated for efficiency every 2 years. At the time of the verification, the date of the last calibration and the date of the next calibration was stated on the detector lead shield. Spectrum evaluation is done by *GammaVision 6.07* software (*Ortec*). Calibration samples for the measurement geometries are prepared in the laboratory from certified standards for different densities in 0.1 density steps from 0.5 (glass wool) to 1.5 (KCl solution).

Although the laboratory has no formal accreditation, an internal Quality Assurance System is in place and seems to work well, all operational instructions were readily available in the laboratory.

The verification team was presented the operating instruction for gamma spectrometry (*Instruzione operativa GS RS 0258 Rev.00* 23.06.2009) and the procedure for instrumentation management (*Procedura Gestionale GR Q 0008 Rev.02* 10-11-06).

Alpha/beta measurements

For alpha/beta measurement, a *Berthold LB 770* proportional counter with 10 chambers is available. Calibration dates are marked directly on the instruments.

Liquid scintillation counting

For LSC measurements, a *Quantulus* (*PerkinElmer*) LSC counter is available which is used for H-3 measurements.

Sample preparation

For sample preparation, a chemical laboratory is available with a deep freezer, balance, grinder, fume hood, oven and drying cabinet.

Sample pre-treatment for the different matrices is described in a separate operation instruction (*GR RS 0126, Prelievo e pretrattamento delle matrici previste dalla Rete di Sorveglianza Ambientale, Rev.01*, 25.7.2008).

Reporting

The verification team was presented the 2010 annual report on environmental monitoring (*GR RS 00443 ETQ-00010566, Rev.0*, 31.3.2011) where the results of the environmental measurement programme and discharge data are summarized. This report is also submitted to ISPRA.

The following matrices were measured in 2010: Air (total beta and gamma), surface water (gamma and H-3), fish, sand and sediments from Garigliano River (gamma), underground water (gamma and H-3), fall out (total beta and gamma) and well water (gamma and H-3).

Tracing

The verification team verified the gamma measurement of a fish sample from the 2010 report. The sample was from 2nd semester 2010, the corresponding measurement file *C10AN00_Carpe_2 sem_2010.An1*, values found there corresponded to the value given in the yearly report on page 21. Both efficiency and energy calibration were current at the time of measurement, data were readily available.

Archiving

Samples are generally stored for one year, data are stored on a computer system with a network drive, 1 copy is kept as hardcopy and a monthly backup is done.

Electrical power backup

A UPS is available for HPGe detectors and *Quantulus* LSC for two hours and emergency diesel power supply exists.

The verification team notes that the laboratory is adequately equipped and working with good quality assurance.

> *The verification team suggests participation in intercomparison exercises with a view to ensure a high level of analytical quality.*

7.2.2.5 "Hot" laboratory

The "hot" laboratory comprises an *Ortec Octète* alpha spectrometer with 8 measurement chambers. The two HPGe detectors presently cooled with liquid nitrogen will be switched to electric cooling. One detector is primarily dedicated to the daily analysis of the stack gas filter and has a notice attached requiring it to be available at a specified time each day. All (calibration) sources were supplied by leading international suppliers and a full list was available.

Samples arising from decontamination of non- or lightly contaminated areas can be handled on site, however for samples coming from the reactor area their analysis will be subcontracted to laboratories qualified to receive such material.

> *The verification does not give rise to specific recommendations.*

7.3 ENVIRONMENTAL RADIOACTIVITY MONITORING; CONTROL BY THE REGULATOR

At the time of the verification the monitoring situation was that ISPRA oversees the operator's radiological monitoring programme without performing their own measurements. ISPRA informed the verification team that it foresees to implement an independent radiological monitoring programme when decommissioning will be restarted. There is a plan to ensure independent monitoring by involving ARPA Campania in performing re-measurements for both environmental monitoring and discharge monitoring. As done in other regions where nuclear installations are present this will done in thr near future in the context of specific agreements between ISPRA and ARPA. When these agreements are in place ISPRA does not conduct re-measurements in its laboratories, with the only exception of specific cases (such as extraordinary monitoring campaigns).

The verification team recommends ISPRA setting up an independent control programme for the monitoring by the operator, as a minimum to select a few samples every year which were measured by SoGIN and to do re-measurement of these samples in ISPRA's own lab and to compare results. The region of Campania as regulator should be involved in this task.

8 CONCLUSIONS

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

(1) The verification activities that were performed demonstrated that the facilities necessary to carry out continuous monitoring of levels of radioactivity in the air, water and soil in Central and Southern Italy (Campania, Molise, Abruzzo, Marche, Umbria and Lazio are adequate. The Commission services could verify the operation and efficiency of these facilities in these six regions and was informed of the situation in Sardegna and Toscana.

(2) Under the co-ordination of ISPRA a detailed monitoring programme for environmental radioactivity has been elaborated and proposed for the whole of Italy. As far as concerns the implementation of the regional/provincial programmes they are under the responsibility of the regional/provincial authorities. The verification noted that the facilities for monitoring environmental radioactivity on a regional scale on the territory of the regions of Campania, Molise, Abruzzo, Marche, Umbria and Lazio are present and that each of these regions are currently implementing a specific programme for the monitoring of environmental radioactivity. The Commission services were also informed about the situation in Sardegna and Toscana. On the basis of the verification findings the Commission services request the Italian authorities to fully implement the said monitoring programmes as a matter of high priority as projected for 2011 and 2012. The Commission services might conduct in due time a re-verification in the central and southern regions of Italy to verify the state of implementation of these programmes. This observation is valid as well for other regions that may not yet have implemented this programme to its full extent.

(3) A number of topical recommendations are formulated. These recommendations aim at improving some aspects of the surveillance of environmental radioactivity in Central and Southern Italy. The recommendations do not discredit the fact that this environmental monitoring – after its full implementation – is in conformity with the provisions laid down under Article 35 of the Euratom Treaty.

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

(5) The Commission services will closely follow up the progress made by the Italian authorities with respect to point (2) concerning the full implementation of the concerned monitoring programmes in all five regions.

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

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APPENDIX 1

Verification Programme

Art. 35 verification IT – 12 to 16 September 2011
Central Italy
Environmental radioactivity monitoring networks
Garigliano NPP

PROGRAMME

	Team 1	Team 2
Date	Travel/Visits	Travel/Visits
Sun 11.9.	Travel to Salerno	
Mon 12.9.	Salerno (ARPA Campania): Opening Meeting	
	Travel to Campobasso	Campania: regional laboratory (Salerno)
	Regional laboratory (Molise)	
Tue 13.9.	Travel to Pescara	Garigliano NPP site
	Regional laboratory (Abruzzo)	
	Travel to Ancona	
Wed 14.9.	Regional laboratory (Marche)	
	Travel to Perugia	
	Regional laboratory (Umbria)	
Thu 15.9.	Travel to Viterbo	Travel to Latina
		Provincial laboratory (ARPA Lazio Latina)
	Provincial laboratory (ARPA Lazio Viterbo)	Travel to Rome
	Travel to Rome	Red Cross laboratory
Fri 16.9.	Rome/ISPRA HQ: Closing Meeting	
	Return	

On route: visit of stations of the national GAMMA system and of regional monitoring networks

APPENDIX 2

Documentation received and consulted

1. Main Legislation

- Legislative Government Decree Nr 230 of 17 March 1995 transposing the European Directives 89/618/Euratom, 90/641/Euratom, 92/3/Euratom and 96/29/Euratom.
- Legislative Decree Nr 241 of 26 May 2000, amending Government Decree Nr 230.
- Legislative Decree Nr 257 of 9 May 2001, amending Government Decree Nr 230.
- Legislative Decree Nr 151 of 26 March 2001, amending Government Decree Nr 230.

2 Legislative acts regulating environmental radioactivity monitoring

- Treaty of Rome (1957) establishing the European Atomic Energy Community.
- Circular n. 2 of 3 February 1987 of the Health Ministry "Directives to the Regions for the execution of the controls on the environmental radioactivity".
- Legislative Decree 230/1995 modified to: Legislative Decree187/2000, Legislative Decree241/2000, D.Lgs 257/2001, Legislative Decree151/2001 "Implementation of EC Directives EURATOM 89/618, 90/641, 92/3/ and 96/29 on ionising radiation" Ordinary Supplement OJ, 13 June 1995, n.136.
- Commission Recommendation 2000/473/Euratom of 8 June 2000 on the application of Art. 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 (Official Journal L 191, 27 July 2000, pg 0037 – 0046).

3 Legislative acts regulating the radiological surveillance of foodstuffs

- Treaty of Rome (1957) establishing the European Atomic Energy Community.
- Council Regulation EURATOM 3954/87 of 22 December 1987 laying down maximum permitted levels of radioactive contamination of foodstuffs and of feeding stuffs following a nuclear accident or any other case of radiological emergency (OJ L371, 30 December 1987, pg 11). Amended by: Council Regulation EURATOM 2218/89 of 18 July 1989 (OJ L211, 22 July 1989, pg 1).
- Council Regulation EEC 737/90 of 22 March 1990 on the conditions governing imports of agricultural products originating in third countries following the accident at the Chernobyl nuclear power station (OJ L82, 29 March 1990, pg 1ff). Amended by: Council Regulation EEC 616/2000 of 20 March 2000 (OJ L75, 24 March 2000, pg 1).
- Council Regulation EURATOM 944/89 of 12 April 1989 laying down maximum permitted levels of radioactive contamination in minor foodstuffs following a nuclear accident or any other case of radiological activity (OJ L101, 13 April 1998, pg 17).
- Commission Regulation (ECC) 2219/89 of 18 July 1989 on the special conditions for exporting foodstuffs and feeding stuffs following a nuclear accident or any other case of radiological activity (OJ L211, 22 July 1989, pg 4).
- Commission Regulation (EC) 1661/99 of 27 July 1999 laying down detailed rules for the application of Council Regulation 737/90/EEC on the conditions governing imports of agricultural products originating in third countries following the accident at the Chernobyl nuclear power-station (OJ L197, 29 July 1999, pg 17). Amended by: Commission Regulation (EC) n° 1621/2001 of 8 August 2001 (OJ L215, 9 August 2001, pg 18); Commission Regulation (EC) n° 1608/2002 of 10 September 2002 (OJ L243, 11 September 2002, pg 7).
- Commission Recommendation 2000/473/Euratom of 8 June 2000 on the application of Art. 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. Official Journal L 191, 27 July 2000, pg 0037 – 0046).

- Commission Regulation (EC)1609/2000 establishing a list of products excluded from the application of Council Regulation 737/90/EEC the conditions governing imports of agricultural products originating in third countries following the accident at the Chernobyl power station (OJ L185, 25 July 2000, pg 27).
- Legislative Decree 31/2001, "Implementation of EC Directive 98/83 on the quality of water intended for human consumption" (Ordinary Supplement OJ, 3 March 2001, n. 52).
- 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 (OJ L99, 17 April 2003, pg 55f and OJ L109, 1 May 2003, pg 27).

4 Main national guidance documents

- *"Raccolta dei risultati dell'attività dei Gruppi di Lavoro delle Reti Nazionali"*, ANPA, May 1995.
- CTN_AGF (AGF-T-RAP-99-13) *"Rassegna di Bioindicatori per la Radioattività Ambientale"*, 2000.
- CTN_AGF (AGF-T-RAP-00-13) *"Criteri per l'adeguamento degli insiemi di dati sulla radioattività ambientale"*, 2000.
- CTN_AGF (AGF-T-RAP-01-12) *"Assistenza all'ANPA per la revisione delle reti nazionali di controllo della radioattività ambientale"*, 2001.
- CTN_AGF (RTI CTN_AGF 2/2002) *"Guida tecnica sulle misure di radioattività ambientale"*, 2002.
- CTN_AGF (AGF-T-SFW-01-05) *"Sviluppo della banca dati delle reti nazionali di monitoraggio della radioattività ambientale"*, 2001.
- CTN_AGF (AGF-T-GTE-03-01) *"Guida tecnica sulle misure di radioatività ambientale: H-3 α e β totale in acque potabili, α e β emettitori artificiali e naturali in matrici ambientali"*, 2004.
- CTN_AGF (AGF-T-RAP-03-15) *"Adeguamento della rete nazionale della radioattività ambientale: completamento della proposta operativa e integrazione con la rete d'allarme"*, 2005.
- CTN_AGF (AGF-T-RAP-04-04) *"Definizione di standard informativi per la gestione del flusso di dati sulla radioattività ambientale"*, 2005.

5 Main international guidance documents

- IAEA (1985), "Survey of currently available Reference Materials for use in Connection with the determination of Trace Elements in Biological and Environmental materials", IAEA/RL/128 REP-1, IAEA, Vienna.
- IAEA (1989) "Measurement of radionuclides in food and the environment. A guidebook" Technical Report Series N° STI/DOC/010/295 TRS 295. IAEA, Vienna
- IAEA (1998) "Analytical Quality Control Services, AQCS Programme 1998, Intercomparison Runs, Reference Materials", IAEA, Vienna.
- National Council on Radiation Protection and Measurements (1978), "A Handbook of Radioactivity Measurements Procedures", Report n° 58, Washington D.C.
- WHO, (2004) "Guidelines for Drinking-water Quality", 3rd edition

6. Documents received:

- Report on the environmental monitoring facilities and monitoring programmes in central Italy and Campania region with 25 annexes 21/07/2011
- Doc. Sogin - " Informazioni per la verifica della Commissione Europea ex. Art. 35 del Trattato Euratom"

- Doc. ISPRA - "Euratom Treaty Art. 35 - Verification visit at Garigliano NPP - Background Information on Regulatory Control Activities.
- ISPRA: Descriptive report with annexes, April 2010
- Power Point presentation by MATTM
- Power Point presentations by all concerned regions

7 Web sites consulted

Environment Ministry (MATTM)	http://www.minambiente.it/home_it/index.html?lang=it
Health Ministry (MH)	http://www.salute.gov.it/
Legislation	http://www.parlamento.it/elenchileggi/87088/gencopertina.htm
ISPRA	http://www.isprambiente.it/site/it-IT
ARTA Abruzzo	http://www.artaabruzzo.it/
ARPA Campania	http://www.arpacampania.it/index.asp
ARPA Lazio	http://www.arpalazio.net/index.php
ARPA Marche	http://www.arpa.marche.it/doc/htm/center_flash.asp
ARPA Molise	http://www.arpamolise.it/
ARPA Sardegna	http://www.sardegnaambiente.it/arpas/
ARPA Toscana	http://www.arpat.toscana.it/
ARPA Umbria	http://www.arpa.umbria.it/canale.asp
SOGIN	http://www.sogin.it/

APPENDIX 3

Provincial and Regional Environmental Protection Agencies – APPA/ARPA Network

1. Provincial Agency for Environmental Protection – Bolzano
2. Provincial Agency for Environmental Protection – Trento
3. Regional Agency for Environmental Protection of Emilia-Romagna
4. Regional Agency for Environmental Protection of Veneto
5. Regional Agency for Environmental Protection of Calabria
6. Regional Agency for Environmental Protection of Campania
7. Regional Agency for Environmental Protection of Lazio
8. Regional Agency for Environmental Protection of Marche
9. Regional Agency for Environmental Protection of Molise
10. Regional Agency for Environmental Protection of Piemonte
11. Regional Agency for Environmental Protection of Puglia
12. Regional Agency for Environmental Protection of Toscana
13. Regional Agency for Environmental Protection of Umbria
14. Regional Agency for Environmental Protection of Basilicata
15. Regional Agency for Environmental Protection of Friuli Venezia Giulia
16. Regional Agency for Environmental Protection of Liguria
17. Regional Agency for Environmental Protection of Lombardia
18. Regional Agency for Environmental Protection of Sicilia
19. Regional Agency for Environmental Protection of Valle d'Aosta
20. Regional Agency for Environmental Protection of Abruzzo
21. Regional Agency for Environmental Protection of Sardegna