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Radiation Protection

TECHNICAL REPORT

VERIFICATIONS UNDER THE TERMS OF ARTICLE 35 OF THE EURATOM TREATY

CAORSO NPP

EMILIA ROMAGNA
ITALY

15 to 19 May 2006

Reference: IT-06/4A

VERIFICATIONS UNDER THE TERMS OF ARTICLE 35
OF THE EURATOM TREATY

FACILITIES:	Installations for monitoring and controlling radioactive discharges and for surveillance of the environment in the region of Emilia Romagna during normal operations of the Caorso nuclear power plant.
SITE:	Caorso NPP, Piacenza province, region of Emilia Romagna, Italy.
DATE:	14 to 19 May 2006
REFERENCE:	IT-06/4A
VERIFICATION TEAM:	Mr S. Van der Stricht (Head of team) Mr P. Vallet
DATE OF REPORT:	January 2008.

SIGNATURES:

[signed]

S. Van der Stricht

[signed]

P. Vallet

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1 ABBREVIATIONS

APAT	Agency for Environmental Protection and Technical Services (at national level) [formerly ANPA: the National Environmental Protection Agency]
ARPA	Regional Agency for Environmental Protection
APPA	Provincial Agency for Environmental Protection
ARPA-ER	Regional Agency for Environmental Prevention for the region of Emilia Romagna (regional network of laboratories)
ARPA-PC	Local Districts of the ARPA-ER, located at Piacenza (PC); and regional Centre of Excellence "Area Eccellenza Isotopia e Radioattività ambientale", High Level Laboratory of the environmental radioactivity monitoring
ASL	"Azienda sanitaria locale" (the local sanitary departments of the Regional Public Health Service)
BWR	Boiling water reactor
CESI	"Centro Elettrotecnico Sperimentale Italiano" Italian experimental electrotechnique centre
DG TREN	Directorate general Transport and Energy (of the EC)
EC	European Commission
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 detector
ISS	National Health Institute
LLD	Lower level of detection
METP	Ministry of Environment and Territorial Protection
MH	Ministry of Health
MHA	Ministry of Home Affairs
MPA	Ministry of Productive Activities (former Ministry of Industry)
NPP	Nuclear power plant
REMRAD	Automated national network for the on-line monitoring of airborne radioactivity (part of the national early warning system)
RESORAD	Laboratory-based national network for radiological surveillance of the environment
SINAL	"Sistema nazionale per l'accreditamento dei laboratori", the Italian accreditation board
SOGIN	"Società Gestione Impianti Nucleari", the operator of the Caorso NPP
TREN H4	The Radiation Protection Unit (of the EC)

2 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 Transport and Energy (DG TREN) and more in particular its Radiation Protection Unit (TREN H4) 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.

A verification team from DG TREN visited (15 to 19 May 2006) the site of the Caorso nuclear power plant located on the banks of the river Po in the region of Emilia Romagna. The site is operated by SOGIN ([2]).

The visit also included meetings with representatives of various national authorities having competence in the field of radiation protection. A closing meeting was held, with all parties involved during the visit, on the premises of Central laboratory of the ARPA (the Regional Agency for Environmental Prevention) of Emilia Romagna located at Piacenza.

The present report contains the results of the verification team's review of relevant aspects of the radiological environmental surveillance on and around the site of the Caorso nuclear power plant, as well as the regional radiological surveillance in the region of Emilia Romagna.

The present report is also based on information collected from documents received and from discussions with various persons met during the visit.

3 PREPARATION AND CONDUCT OF THE VERIFICATION

3.1 Preamble

The Commission's decision to request the conduct of an Article 35 verification was notified to the Italian Permanent Representation to the European Union by letter TREN.H4 CG/ab D(2006) 202557 dated 20 February 2006.

It was decided to split the verification activities over two independently operating teams. One team would visit the Latina nuclear power plant (in the Lazio region), the other would focus on the Caorso nuclear power plant (in the Emilia Romagna region). It should be noted here that both nuclear power plants were shut down in 1980s.

Subsequently, practical arrangements for the implementation of both verifications were made with the Italian competent authorities.

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

2 Società Gestione Impianti Nucleari ("nuclear sites management company").

The findings of the verification activities conducted at the Latina nuclear power plant are subject to a separate report (reference IT-06/4B).

3.2 Programme of the visit in Emilia Romagna

On 15 May an opening meeting was held at the Caorso site where, in conjunction with the Italian competent authorities and the operator of the Caorso NPP, the programme of verification activities was discussed and finalized.

The agreed programme comprised:

- The verification of liquid and gaseous radioactive discharges from the Caorso NPP (sampling and monitoring systems, analytical methods, quality assurance and control aspects, reporting).
- The verification of the Caorso site-related environmental radiological monitoring programmes as implemented by:
  i. The operator of the Caorso NPP.
  ii. The Regional Centre of Excellence "Area Eccellenza Isotopia e Radioattività ambientale", laboratory of the ARPA-ER laboratory network located at Piacenza (hereafter ARPA-PC).

  At these locations the verification addressed technical aspects of monitoring and sampling activities, analytical methods used, quality assurance and control, archiving and reporting.
- Verification activities at the ARPA-PC laboratory, 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 the REMRAD ([3]) national surveillance network station located at Monte Cimone (Emilia Romagna region, district of Modena), system operated by the APAT (the Agency for Environmental Protection and Technical Services – body operating at national level).

A summary overview of the programme of verification activities is provided in Appendix 1 to this report.

The verifications were carried out in accordance with the programme.

3.3 Documentation

In order to facilitate the work of the verification team, a package of information 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 to this report. The verification team notes the comprehensiveness of the documentation provided.

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

3.4 Representatives of the competent authorities and the operator

During the verification visit, the following representatives of the national authorities and the operator were met:

[3] Autonomous on-line sampling and monitoring network for airborne radioactivity.

APAT

Mr.	Leandro MAGRO	Art.35 Euratom expert for Italy
Ms.	Sonia FONTANI	National monitoring networks department
Mr.	Pietro PETRI	Head of the radiation protection department (nuclear sites)
Mr.	Andrea ORAZI	Engineer, responsible for "Ufficio progetto centrale di Caorso"

ARPA-PC

Mr.	Sandro FABBRI	Director of the local Districts of Piacenza (PC)
Mr.	Roberto SOGNI	Head of the Regional Centre of Excellence "Area Eccellenza Isotopia e Radioattività ambientale"
Others:		Radioactivity laboratory staff

SOGIN - staff of the Caorso NPP:

Ms.	Sabrina ROMANI	Head of the department for health physics, radiochemistry and environmental protection
Ms.	Laura CATTANEO	Qualified expert in radiation protection
Mr.	Roberto BELLINTANI	Head of the unit for radiochemistry and environmental matters
Mr.	Gualtiero PUERARI	Head of the unit for health physics
Mr.	Renzo GUERZONI	Plant supervisor
Mr.	Gilberto FAELLI	Head of operations department
Mr.	Ezio BANDERALI	Plant manager

4 COMPETENT AUTHORITIES AND NUCLEAR LEGISLATION

4.1 The 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 actuating 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 degree 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 Territorial Protection (hereafter METP).
- The responsibility for the radiological surveillance of foodstuffs and feedingstuffs 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 METP 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.
- The national radiological emergency network, under the responsibility of the Ministry of Home Affairs (hereafter MHA), shall also contribute to the national radiological surveillance (transmission of collected data).

4.2 The Agency for Environmental Protection and Technical Services (APAT)

4.2.1 Introduction

ANPA (the former National Environmental Protection Agency) was established by Art. 38 of Legislative Decree Nr. 300 of 30 July 1999.

The APAT was created in 2002 by merging the 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 APAT operates at national level.

The APAT is technically, scientifically and financially autonomous and reports directly to the METP. The APAT operates in three-year programmes which are annually updated. These programmes aim at the implementation of directives issued by METP, by setting objectives, defining priorities and allocating resources.

4.2.2 Environmental responsibilities

The Department of Nuclear, Technological and Industrial Risk of the APAT is involved in environmental radioactivity monitoring.

Legislative Government Decree Nr. 230 (as amended) specifies in its Art. 104 that:

- The national monitoring networks shall be operated under the supervision of ANPA (since 2002 APAT). These networks are:
  - -- The National Environmental Radioactivity Network RESORAD. RESORAD is a laboratory-based network (of regional laboratories) that surveys the pattern of environmental and dietary contamination in the various regions in Italy. The data obtained are used to assess the exposure of the population.
  - -- The two National Early Warning Networks: REMRAD (airborne particulate monitoring) and GAMMA (doserate monitoring).
- ANPA (since 2002 APAT) shall also manage the technical co-ordination between the various national actors, so as to ensure standardisation and comparability of methods and techniques for sampling and sample analysis ([4]).
- ANPA (since 2002 APAT) is responsible for the implementation of the Euratom Treaty, in particular where it concerns Art.35 (data collection) and Art.36 (data transmission to the EC).

[4] The APAT, as a national body, has supervisory and co-ordinatory responsibilities in the field of radiological environmental surveillance. In order to discharge itself from this statutory duty APAT has signed memoranda of understanding (co-operation agreements) with the various regional actors in RESORAD. These memoranda define the terms of reference of co-operation between both the regional and national levels.

4.2.3 Other statutory responsibilities

The main duties and statutory responsibilities of the APAT as 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 ([5]).
- 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 (see section 4.4.3 below).
- 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, APAT has also to:

- Support the national administrations (environment, health, home affairs, industry) to issue decrees that implement primary nuclear legislation.
- To issue specific technical guidance documents.
- Maintain a national database on all nuclear applications.

APAT responsibilities for the licensing process of nuclear installations include:

- Assessment of the safety analysis carried out by the operating organisation.
- Inspection of equipment and materials during the design, construction and operational phases (systematic operational safety verification).
- Enforcement of actions to remedy any failure to meet the licensing conditions and/or operational safety criteria.

4.3 The Regional Agency for Environmental Prevention (ARPA-ER)

4.3.1 Introduction

Every administrative region and two autonoumus provinces in Italy have their own environmental protection agency, ARPA/APPA, established by special regional/provincial laws and responding to the local government. The ARPA/APPA are environmental control and technical support bodies for the regional/provincal, district and local authorities. Allthough sponsored by their Region/Provinces the ARPA/APPA are administratively and technically independent.

The ARPA-ER (Emilia Romagna region) was established under Regional Law Nr. 44 of 19 April 1995 (and subsequent amendments).

The ARPA-ER is a network organisation structure, with nine operational District Laboratories located throughout the region. The ARPA-PC, located at Piacenza, operates the regional Centre of Excellence "Area Eccellenza Isotopia e Radioattività ambientale": a High Level Laboratory for environmental radioactivity monitoring.

[5] In addition to having operational and administrative autonomy under the METP, the APAT, for all nuclear activities, acts as the technical body of the Ministry of Productive Activities, the licensing authority.

4.3.2 Statutory responsibilities

ARPA statutory responsibilities cover all aspects of environmental surveillance, including:

- Monitoring of environmental components (regional environmental radioactivity monitoring).
- Management and surveillance of human activities and their territorial impact (in this case: site-related environmental radioactivity monitoring and impact assessment around the Caorso NPP).

ARPA-PC as leading laboratory is responsible for the establishment and implementation of these programmes. To that effect co-operation agreements are in place with the APAT (for both the site-related and RESORAD programmes) and the Regional Public Health Service. The latter, within the context of RESORAD, performs sampling activities on behalf of the ARPA-PC.

In addition to these duties, ARPA-ER (ARPA-PC) has also:

- To support the regional administrations (environment, health) to issue decrees that improve regional radioprotection legislation and to support them in case of environmental emergency.
- To provide support for technical guidance documents.

Note: sections 8.2 and 8.3 below provide further detail.

4.4 Other radiation protection actors

In addition to the bodies described above, it is worth mentioning the National Health Institute (ISS) and National Institute for Occupational Prevention and Safety as national organisations involved in radiation protection.

4.4.1 The National Health Institute

The Istituto Superiore di Sanità (ISS) is the leading technical and scientific public body of the Italian National Health Service. Its main activities are research and advising the Minister of Health. Within the ISS the Department of Technology and Health has responsibilities in the field of radiation protection. The main areas of research are: evaluation and reduction of the health risks associated with exposure to ionising and non-ionising radiation of environmental and medical origin. The other main duty is providing scientific support and drafting of guidelines for radiation protection regulations.

4.4.2 The National Institute for Occupational Prevention and Safety

The National Institute for Occupational Prevention and Safety is a technical and scientific public body of the Italian National Health Service. Concerning radiation protection the institute has, between others, the following duties:

- Protection of the workers against the risks coming from exposure to chemical, physical and biological agents.
- Certification for occupational prevention and safety.

4.4.3 The Civil Protection Department – Ministry of Home Affairs

Italian law entrusts the Prefect of a provincial administrative district where a nuclear facility is present with the responsibility for planning and managing regional off-site emergency responses. The Prefects are appointed by the Minister of Home Affairs.

At national level the Civil Protection Department is the competent authority responsible for managing the response to a nuclear emergency, more in particular the activation and implementation of the "National Plan for Nuclear and Radiological Emergency".

In the context of the National Plan, APAT is entrusted by Decree Nr. 230 (as amended) with the operational co-ordination and with the technical and logistic support of the Data Processing and Evaluation Centre (CEVaD in Italian). The staff of the CEVaD Emergency Committee in turn provides technical support to the Civil Protection Department in the decision making processes (e.g. evaluation of the accident scenario and its evolution, estimation of the radioactive contamination trends on the basis of radiometric data provided to the APAT by the regional laboratories and radiation monitoring networks, assessment of the related health impact, countermeasures to be taken).

The Emergency Committee of CEVaD is composed by members of the following administrations: the APAT, the National Institute of Health, the Fire Brigades of the MHA, the National Meteorological Service, the National Institute for Occupational Prevention and Safety as well as regional representatives (usually from regional agencies for environmental protection ARPA/APPA).

5 THE CAORSO NPP

The Caorso NPP is located on the right bank of the River Po; locality of Mezzanone di Zerbio, municipality of Caorso, province of Piacenza (PC).

The NPP is a General Electric type BWR-4 MkII boiling water reactor, having a nominal thermal power of 2590 MWth and a net electrical output of 860 MWe. The plant came into commercial service on 01/12/81 and was shut down on 25/10/86.

Definitive closure of the Coarso NPP was decided by the Interministerial Commission for Economic Planning on 26/07/90. Subsequent to this decision the plant was put in a "passive protective custody" condition.

The former Ministry of Industry (now the MPA), in its Decree of 04/08/2000 (pursuant to Art.55 and Art.56 of Decree Nr. 230 of 1995) authorised SOGIN to carry out specific decommissioning activities, subject to approval by ANPA (since 2002 APAT) of the Operating Plans for the intended decommissioning work.

Decommissioning started in 2001 with the removal of insulating materials from the turbine systems, followed by decontamination (mainly by sandblasting) and dismantling of the main turbine. Early in 2004 the chemical decontamination of the primary circuit was performed. In the meantime, parts of the plant were characterized both by destructive and non destructive methods.

It should be noted that the core has been completely defuelled and that all the irradiated/spent fuel elements have been transferred to the spent fuel pond, waiting for future reprocessing.

6 CONTROL OF RADIOACTIVE DISCHARGES

6.1 Introduction

The MPA is the authority that issues the operating licence for all nuclear and radioactive installations. Such licences are issued after a positive technical advice given by the APAT.

The cold shutdown condition in which the Caorso NPP is maintained involves the production and consequent controlled release into the environment of liquid and gaseous discharges. These discharges derive mainly from ongoing maintenance activities such as ventilation and cleaning. Decontamination and decommissioning activities also contribute to the discharge of activity. The

discharged activity is however significantly lower than that produced during normal operation of the NPP.

Discharges of activity into the environment are statutorily limited in terms of annual, quarterly (13 consecutive weeks) and daily limits. The quarterly limit and daily limit are set at one half and one tenth of the yearly limit respectively.

These limits, that were applicable to the NPP under normal operating conditions, remain in force for the shut-down plant.

Discharge limits and all operations relative to liquid and airborne discharge control, discharge quantification, bookkeeping and reporting are described in a statutory, quality controlled, Operations Manual. On-line monitoring systems are in place for a real-time surveillance of the levels of discharge. Sampling systems are in place that allow for a retrospective accountancy of discharged radioactivity, based on the analytical results of the samples taken (liquid discharges; airborne discharges of particulate matter and iodines). The discharge accountancy for noble gases is calculated on basis of the data acquired and stored by the on-line monitoring system.

6.2 Provisions for monitoring/sampling of liquid discharges

6.2.1 Discharge limits

Liquid discharge limit formula: $^{3}H/10 + 10(\beta) + (\beta\gamma) + 10\alpha \leq 2.22\ 10^{11}$ Bq/year

where:

- ^{3}H = total discharged activity of tritium
- (β) = total discharged activity of β emitters (^{32}P equivalent)
- $(\beta\gamma)$ = total discharged activity of $\beta\gamma$ emitters (^{134}Cs equivalent)
- α = total discharged activity of α emitters (^{239}Pu equivalent)

6.2.2 Sampling provisions

Potentially radioactive liquid effluents are collected in two sentencing tank (each of app. 37 m³ - plant items G11AA015 A and -B), the contents of which must be quantified (representative sampling and subsequent analysis of the sample taken by gamma spectrometry) and the results obtained checked against the discharge limitations before a release into the discharge pipeline may be authorised. The pipeline leads to the discharge canal, the latter being in connection with the river Po. The authorisation to discharge is issued (signed) by both the health physics officer and the shift manager.

Furthermore trimestrial and semestrial composite samples are prepared from aliquots taken from each discharge tank sample during the period under scrutiny. The aliquots must be proportional to the volumes discharged.

Trimestrial samples are analysed as follows:

- Gamma spectrometry (HPGe detector).
- ^{90}Sr (total beta measurement with a proportional gas counter after chemical separation).
- Tritium (liquid scintillation counter).

Semestrial samples are analysed as follows:

- Gamma spectrometry (HPGe detector).
- ^{55}Fe (liquid scintillation counter after chemical separation).

6.2.3 Monitoring provisions

The discharge pipeline is equipped with a continuously operating NaI Tl scintillation detector (plant item D11-N007). Efficiency: 345 cps per Bq/ml for ^{60}Co. LLD: 0.4 Bq/ml. Detection range: 0.4 to 400 Bq/ml. Alarm threshold: 370 Bq/ml. Functionality alarm: < 1 cps.

This on-line system transmits measurement data, functionality status and alarms to the plant operations control room where all data are stored. In case of an alarm the discharge cannot be automatically interrupted.

6.3 Provisions for monitoring/sampling of airborne discharges

6.3.1 Discharge limits

The discharge limits are applicable to the sum of releases from all discharge points on site.

- Noble gases: $Q_T + 0.2Q_R + 0.1Q_O \leq$ 7.4 E+14 Bq/year (^{138}Xe equivalent)
- Iodines: $Q_T + 0.2Q_R + 0.1Q_O \leq$ 7.4 E+09 Bq/year (^{131}I equivalent)
- Particulates: $Q_T + 0.2Q_R + 0.1Q_O \leq$ 2.59 E+08 Bq/year (^{90}Sr equivalent)

where:

Q_T = activity realeased from the turbine buiding
Q_R = activity realeased from the reactor building and its ancillaries
Q_O = activity released from other sources

6.3.2 Monitoring and sampling provisions

All systems described below are subjected to daily checks by health physics personnel. Results (readings of all displayed acquisition data) are written on dedicated quality controlled working papers.

- <u>The reactor building and its ancillaries including the spent fuel pond</u>

  A single stack of a height of 60 metres collects air from two distinct ventilation systems:

  - The reactor building (1.8 E+05 Nm³/h).
  - The controlled zones within the ancillaries (1.2 E+05 Nm³/h).

  The reactor building ventilation system is redundant: in case of need an emergency ventilation system takes over. This system is equipped with HEPA filters, located upstream from the stack.

  Air extracted from controlled zones is passed through various filter banks (e.g. HEPA filters) before being fed to the stack.

  The stack sampling line that feeds the monitoring and the sampling devices is equipped with 6 isokinetic sampling nozzles.

  <u>On-line monitoring of particulates</u>

  The sampling line feeds (11 Nm³/h) a plastic scintillation detector (plant item D11-PP011A) that continuously measures particulate activity (beta) impacted on a stepped filter system (fibre glass filter). Integration time: 3000 sec. Efficiency: 0.20 cps/Bq for ^{90}Sr. LLD: 16 Bq. Detection range: 0.5 to 5.0 E-05 Bq. Alarm threshold: 50% of the regulatory daily discharge limit. Functionality checks and related alarms are performed by measuring the pressure differential over the filter.

This online system transmits measurement data (real-time and integrated values), functionality status and discharge alarms to the plant operations control room where the data are stored.

On-line monitoring of noble gases

The sampling line feeds (60 l/min) a continuously operating Geiger-Müller counter (plant item D11-PP011B). A particulate filter and an iodine filter (plant item D11-PP002) are mounted upstream of the shielded measurement geometry, the latter with a capacity of 500 dm³. Integration time: 60 minutes. Efficiency: 1.6 E-09 (imp/h)/(Bq/m³) for ^{137}Cs. LLD: 5.0 E-07 Bq/m³. Detection range: 6.0 E-10 to 6.0 E-04 Bq/m³. Alarm threshold: 1/365th of the regulatory annual discharge limit. Functionality assessed by pressure differential over the filters: the value is displayed on a local control panel but not relayed into the plant operations control room.

This online system only transmits measurement data (real-time and integrated values) to the plant operations control room where the data are stored.

Sampling provisions for particulates and iodines

The sampling line continuously feeds (60 l/min) a filtering device (plant item D11-PP002), the fibre glass filter of which is exchanged weekly for measurement in the laboratory: assessments of total beta activity and, after a 5-day decay time, total alpha activity. A gamma spectrometric analysis is conducted monthly.

- The turbine building

Ventilation of the turbine building is split into two separate systems:

- Extraction of the steam/feedwater cycle off-gas systems and ventilation of their containment (3.2 E+05 Nm³/h).
- Ventilation of the other (non-controlled) parts of the building (2.2 E+05 Nm³/h).

Both systems discharge into the environment via extraction turrets (4 turrets for the former, 12 turrets for the latter) located on the roof of the building.

▪ *Controlled zones*

On-line monitoring of particulates

The extraction turrets' sampling lines are equipped with isokinetic sampling nozzles. The four lines merge into one single line feeding the monitoring and sampling devices.

The sampling line feeds a plastic scintillation detector (plant item D11-PP012A) that continuously measures particulate activity (beta) impacted on a stepped filter system. Technical characteristics are identical to the system in place in the reactor building stack (D-11-PP011A).

Sampling provisions for particulates and iodines

The sampling line continuously feeds (60 l/min) a filtering device (plant item D11-PP012B), the filters of which are exchanged weekly for measurement in the laboratory: assessments of total beta activity and, after a 5-day decay time, total alpha activity and gamma spectrometry are conducted.

▪ *Non-controlled zones*

Sampling provisions for particulates and iodines

Twelve extractor fans are located on the roof of the building. Each extraction duct is equipped with an isokinetic sampling line upstream from the fan. Each sampling line continuously feeds (60 l/min) a filtering device (D11-PP015), the filters of which are exchanged weekly for measurement in the laboratory: assessments of total beta activity and, after a 5-day decay time, total alpha activity and gamma spectrometry are conducted.

6.3.3 Maintenance of the monitoring systems

All aspects of maintenance and calibration of the various monitoring systems and reporting thereof are laid down in quality assured procedures and working instruction. These documents are integral part of the Operations Manual.

- The particulate monitors

  Monthly: functionality checks of the detector and electronic systems with a reference source.
  Semestrial: calibration verification with a reference source.
  Every 18 months: full calibration of the monitoring device.

- The noble gas monitor

  Semestrial: calibration of the electronic systems with a pulse generator.
  Every 18 months: full calibration of the monitoring device using a reference source.

6.4 The analytical laboratory for discharge samples

The laboratory equipment characteristics are:

Measurement type	Efficiency	Lower limit of detection
Gamma spectrometry	30% ^{60}Co	^{60}Co 6,0 E-02 Bq
Liquid scintillation counting	27% ^{3}H 26% ^{55}Fe 75% ^{14}C 52% ^{63}Ni	^{3}H 0,28 Bq ^{55}Fe 0,16 Bq
Gas proportional counting - total beta	53% ^{90}Y 44% ^{90}Sr	^{90}Sr 1,9 E-01 Bq
Gas proportional counting - total alpha	35% ^{241}Am	^{241}Am 2,4 E-02 Bq

The quality controlled Operations Manual, in its relevant sections, describes the procedures for:

- Use, maintenance and calibration of the various instruments.
- Analytical methodologies that are used.
- Data management (recording, reporting, archiving).

6.5 Independent monitoring of discharges

The regulatory authority issuing the licence to operate is the MPA. The licence includes an authorisation to discharge radioactivity and imposes limits on such discharges. The operator is responsible for his radioactive discharge accountancy and shall report these to the authority, thus providing proof that the limits are abided by. These declarations are transmitted to the APAT on a semestrial basis.

The APAT, in its quality as representative for the MPA, does not implement any programme of independent confirmation of the data provided (for detail, see section 7.6 below).

7 VERIFICATION ACTIVITIES - RADIOACTIVE DISCHARGES

7.1 Introduction

The verification team visited:

- The monitoring/sampling devices for airborne discharges.
- The discharge sentencing tanks and related monitoring/sampling devices for liquid discharges.
- The NPP operations control room.
- The analytical laboratory for discharge samples.

7.2 Verification findings - airborne discharges

The verification team confirmed the existence and functionality of the monitoring and sampling provisions as described in section 6.3 above.

Upon request the operator submitted technical drawings attesting the provisions for isocynetic sampling at the main stack.

The verification team noted that:

(1) The continuity of monitoring and sampling is guaranteed. Back-up power supply (a diesel generator) is available for the monitoring and sampling systems as well as for the extraction systems.

(2) The monitoring/sampling equipment for the main stack is subjected to routine on-the-spot checks by staff. Such operational checks, depending on the type of device, are performed daily if not during every shift. The results of these checks are noted down on quality controlled working papers.

(3) The availibilty of a comprehensive quality controlled operations manual for all systems is in place, including the maintenance and calibration thereof.

(4) All parts of the various systems are clearly and unequivocally identified with tags. Where appropriate, information on maintenance and calibration intervals is also attached.

> *The verification activities performed do not give rise to particular remarks; the monitoring and sampling systems in place are operational and adequate.*

7.3 Verification findings - liquid discharges

The verification team confirmed the existence and functionality of the monitoring and sampling provisions as described in section 6.2 above.

The verification team noted that:

(1) The continuity of monitoring is guaranteed through a back-up power supply (a diesel generator).

(2) Redundancy of the on-line monitoring device controlling the discharge is ensured through a second (identical) system.

(3) The representativeness of the samples taken is achieved through homogenisation of the content of the sentencing tank to be sampled (30 minutes circulation) and drainage of the sampling line (for 15 minutes). A sample of 1 dm^3 is taken for analysis in the laboratory.

(4) In case the analytical result would indicate that the activity concentration of the sentencing tank is above the defined limit, the contents of the tank are recycled towards to water treatment plant for additional processing.

(5) The availibilty of a comprehensive quality controlled operations manual for all systems in place, including the maintenance and calibration thereof.

The verification activities performed do not give rise to particular remarks; the monitoring and sampling systems in place are operational and adequate.

7.4 Verification findings - operations control room

The verification team noted that:

(1) Light indicators associated with normal operating conditions as well as alert and alarm level transgressions (for airborne and liquid discharges) are installed in the reactor's operations control room.

The verification activities performed do not give rise to particular remarks.

7.5 Verification findings - analytical laboratory

The verification team visited the laboratory where it verified the adequacy of the analytical systems in place, including various aspects of quality assurance and control (working instructions, methodologies, calibration, maintenance, bookkeeping of results, reporting etc.).

The verification team noted that:

(1) The laboratory is adequately equipped and staffed for the assessment of effluent samples.

(2) A comprehensive quality controlled operations manual for all systems is in place and readily available. The manual also includes maintenance and calibration procedures.

(3) Analytical procedures and methodologies are described in quality controlled documents.

(4) Reporting and archiving of analytical results is well managed; the chain of custody is clearly defined; the traceability of data is accurately maintained.

The verification activities performed do not give rise to particular remarks; the analytical laboratory for discharge samples is satisfactorily equipped and managed.

(5) Current practice at the Caorso NPP requires that results below the detection limit are reported as "< 'value of the detection limit' ".

It is reminded that the European Commission issued Recommendation 2004/2/Euratom ([6]) wherein substitution rules for values below the detection limit are presented. Such rules are proposed to avoid unnecessary over- or underestimation of discharged activities. These substitution rules are in line with ISO standard 11929-7:2005.

The verification team suggests that the competent regulatory authority consider the benefits of revising its regulatory requirements for substitutions of analytical results below detection limits by bringing these requirements in line with Commission Recommendation 2004/2/Euratom and ISO standard 11929-7.

6 Official Journal L 002, 06/01/2004 P. 0036 - 0046

7.6 Verification findings - independent monitoring by the regulator

The MPA is the licensing authority for nuclear power plants in Italy.

The operator of the Caorso NPP informs its licensing authority (through APAT) about the quantities of discharged radioactivity (also in terms of % of the regulatory discharge limit) on a semestrial basis. This information is also taken up in a yearly activity report.

In order to fulfil the obligations laid down in Decree Nr. 230 (as amended), the APAT shall, (in its quality as representative for the MPA), amongst others:

- Control and inspect existing nuclear installations.
- Control and inspect the management of radioactive wastes.

The verification team noted that:

(1) The APAT only performs a paper-based verification of the submitted discharge reports: verification is restricted to checking (at headquarters) whether the declared values do not breach the statutory limits.

(2) The APAT does not perform a formal validation of the operator's declarations.

(3) The APAT does not implement an independent sampling and analysis programme so as to satisfy itself that the operator's discharge declarations are reliable.

(4) The APAT has not established a system of inspection.

> *While it is understood that controls and inspections by APAT should be commensurate with the shut down status of the Caorso NPP and its future decommissioning, the verification team suggests that the Ministry of Productive Activities provides the necessary means to the APAT so as to allow the latter to fully discharge itself from its responsibilities as laid down in Decree Nr 230 of 17 March 1995 (as amended), especially with regard to control and inspection of nuclear facilities and the waste these generate.*

8 THE ENVIRONMENTAL RADIOACTIVITY MONITORING PROGRAMMES

This section provides a summary description of the radiological monitoring programmes that are implemented in the region of Emilia Romagna:

- Caorso NPP: the site-related monitoring programme by the operator and the independent site-related programme by the ARPA-PC.
- RESORAD: the Emilia Romagna part of the National Environmental Radioactivity Network, as performed by the ARPA-ER in conjunction with the Regional Public Health Service.
- The two National Early Warning Networks: REMRAD (airborne particulate monitoring) and GAMMA (dose rate monitoring), managed by APAT.

8.1 The site-related monitoring programme implemented by SOGIN

An overview of this environmental monitoring programme is given in Appendix 3 of this report.

8.1.1 Dose rate monitoring

Six continuously operating on-line dose rate probes (NaI scintillation detectors) are installed in the immediate vicinity of the NPP site. The systems' measurement ranges from 10 nGy 10 mGy. Signals are relayed into the plant's operations control room.

8.1.2 Ambient sampling

- Water sampling

  Two locations, downstream of the NPP, are continuously sampled: one approximately halfway the discharge canal and the other on the banks of the river Po. Both locations are similarly equipped. The equipment is secured in a locked cabin.

  The flow rate through the system is set at 4 dm^3/h. This volume is first pushed through a suspension filter and subsequently equally split over an anion and a cation resin filter. Filters are exchanged on a monthly basis for laboratory analysis (total beta assay and gamma spectrometry).

- Air sampling

  Continuously operating low-volume air samplers (400 m^3/week). The particulate filter (paper + charcoal) is exchanged weekly for laboratory analysis (total beta assay and gamma spectrometry).

- Dry/wet deposition sampling

  A wet/dry deposition collector is situated on the premises of the NPP's emergency centre (outside the site perimeter). The sample collected is sent to the laboratory once a month for analysis (total beta assay and gamma spectrometry).

- Dose

  Twenty TL dose meters are installed on-site (10 items) and within the surveillance zone around the site (10 items). The dose meters are exchanged on a two-monthly frequency.

8.1.3 Sampling of environmental indicators

Soil, sediments, foodstuffs (milk, drinking water, different kinds of meat, fish and vegetables/fruits) and fodder are sampled for radiological analysis (see Appendix 3 for further detail).

8.1.4 The analytical laboratory for environmental samples

The laboratory equipment characteristics are identical to those described under section 6.4 above

The quality controlled Operations Manual, in its relevant sections, describes the procedures for:

- Use, maintenance and calibration of the various instruments.
- Analytical methodologies that are used.
- Data management (recording, reporting, archiving).

8.1.5 Reporting

A semestrial report is compiled and sent to both the ARPA-PC and the APAT.

Note: the regulatory verification and validation of the operator's environmental data is discussed insection 9.1.3 below.

8.2 The site-related monitoring programme implemented by the ARPA

8.2.1 Introduction

The ARPA-PC initiated a local site-related environmental surveillance programme back in 1980, concomitant with the start-up of the Caorso NPP. The scope and scale of the programme is formally decided by the ARPA-PC. However, the memorandum of understanding of 2005 (between the ARPA-PC and the APAT) defining the scope of their co-operation, specifies that the programme must be submitted yearly to the APAT for formal approval. The MoU also stipulates that any additional indicators for which APAT may request surveillance can be incorporated ad-hoc. The ARPA-PC issues a yearly surveillance report that is officially transmitted to the APAT.

8.2.2 Sampling of environmental matrices

Soil, sediments, foodstuffs (milk, drinking water, different kinds of meat, fish and vegetables/fruits) and fodder are sampled for radiological analysis.

An overview of the sampling programme is given in Appendix 4 of this report.

8.2.3 Analytical laboratory, quality assurance and control

The laboratory equipment characteristics are:

Measurement type	**Efficiency**	**Lower limit of detection**
Gamma spectrometry	30% ^{60}Co	^{60}Co 1,0 E-01 Bq
Liquid scintillation counting	21% ^{3}H	^{3}H 1,3 E-02 Bq
Plastic scintillator - total beta	45% ^{90}Sr	^{90}Sr 2,8 E-02 Bq
Gas proportional counting - total beta	32% ^{90}Y - ^{90}Sr	^{90}Sr 1,0 E-02 Bq
Gas proportional counting - total alpha	6.7% ^{242}Pu	^{242}Pu 2,8 E-02 Bq

Quality assurance and control at ARPA-PC is implemented through:

- A quality manual, comprising a comprehensive set of controlled written procedures of ARPA-ER. These procedures address managerial as well as technical requirements, the latter *inter alia* describing sampling procedures, statutory equipment, analytical methodologies, maintenance and calibration of measurement systems.
- Accreditation (ISO/IEC 17025) by SINAL, the Italian accreditation authority, and by the ISS-ORL ([7]) for the following procedures:
  - Gamma spectrometry in fooodstuff and milk (m/F/AL/001/LM rev 0 - 2006)
  - ^{90}Sr determination in food (M/F/AL/002/LM rev 0 – 2006)
  - ^{90}Sr determination in milk (M/F/AL/001/LM rev 0 - 2006)
  - Total beta and total alpha determination in water for human consumption (M/F/AC/001/LM rev 0 - 2006)
- Regular participation in proficiency test and intercomparison exercises at national and international level.

[7] ISS-ORL (Istituto Superiore di Sanità - Organismo Riconoscimento Laboratori): the certification body of the National Health Institute.

8.2.4 Reporting

The ARPA-PC issues a site-specific yearly surveillance report that is officially transmitted to the APAT and to the Local Autority. The ARPA-PC receives the data of the operator of the Caorso NPP and compares these with its own site-related environmental monitoring data: this paper-based exercise is not an official verification of the operator's declaration and does not entail any formal validation of the submitted data.

8.3 The regional monitoring programme implemented by the ARPA

8.3.1 Introduction

In 1982 a radiological monitoring programme covering the entire region of Emilia Romagna began. The regional programme was extended in 1987 to cover the radiological consequences of the 1986 Chernobyl accident.

In order to bring the programme in line with new regional, national and Community requirements, the programme was again updated in 2002. The modifications were agreed upon and validated by the Health Consultancy of the Emilia Romagna Region (the Regional Public Health Service and the Regional Veterinary and Food Hygiene Service).

The Emilia Romagna Region is responsible for its regional monitoring programme. Sampling activities proper are split between the ARPA-ER (ambient) and the Regional Public Health Service (foodchain); analysis of samples is however the sole responsibility of the ARPA-PC.

The ARPA-PC:

- Delegates part of the sampling activities to the local ARPA-ER network laboratories. All samples taken by the network are transferred to the ARPA-PC for processing and analysis. The data obtained from the programme are kept in a central database.
- Has a formal co-operation agreement with the Health Service. This convention defines the scope and details of the surveillance programme. It also stipulates that the samples taken for the radiological surveillance of the foodchain must be handed over to the local ARPA laboratories, which in turn will forward them to ARPA-PC for processing and analysis. The data obtained from the programme are kept in a central database. The Health Service is systematically kept informed on the results obtained.
- According to the 2005 memorandum of understanding, the ARPA-PC submits the programme to the APAT for formal approval (on a yearly basis). The MoU also stipulates that any additional indicators for which APAT may request surveillance can be incorporated ad-hoc. The ARPA-PC issues a yearly surveillance report that is officially transmitted to the APAT.

8.3.2 Radiological surveillance of the ambient

Basically the part of the sampling programme conducted by the ARPA-ER covers the following matrices: air, dry/wet deposition (fall-out), gamma dose rate, surface waters, drinking water, sediments and flora in the fluvial (river Po) and marine environments (Adriatic Sea).

Air, fallout and gamma dose rate are assessed in one single location: the premises of the ARPA-PC.

- Air and gamma dose rate

  A continuously operating on-line air monitoring station (7 m^3/hour), collecting and measuring alpha and beta emitting particulates on a glass fibre step filter, as well as airborne ^{131}I on an active charcoal Marinelli beaker. The systems are linked in real time (via modem) to a local

computer that acquires and records the data and creates measurement result files at intervals of 10 minutes, 1 hour and 24 hours. Filters are not periodically removed and they are not analysed in the laboratory. The station is also equipped with a gamma dose rate probe.

Loss of power supply is initially covered by the system's internal batteries and backed up by the site's diesel generator.

- Dry/wet deposition

Fall-out samples are collected on a monthly basis in an array of nine polyethylene bins with an aggregate surface area of app. 1.3 m^2. At the start of the sampling period each bin receives 1.5 dm^3 of acidified distilled water (pH 1) and 5 mg of stable carrier for ^{137}Cs, ^{90}Sr, ^{7}Be, ^{60}Co. At the end of the sampling period the insides of the recipients are rinsed with distilled water. The sample and washing waters (including suspended matter and solid deposits) are collected and dried out and the residues measured, monthly, by gamma spectrometry. The determination of ^{90}Sr is performed twice a year on a composite sample.

8.3.3 Radiological surveillance of the foodchain

Sampling activities of foodstuffs (milk, drinking water, different kinds of meat, fish and vegetables/fruits) and fodder are performed by the ASL ("azienda sanitaria locale"), the local sanitary departments of the Regional Public Health Service.

See Appendix 5 for additional information on the extent of the sampling programme by the ASL.

8.3.4 Analytical laboratory, quality assurance and control

The laboratory equipment characteristics and the quality assurance and control are described above under section 8.2.3.

8.3.5 Reporting

The data of the radiological analysis obtained from the programme are kept in a central database. The ARPA-PC issues a yearly regional surveillance report that is officially transmitted to the APAT, other ARPA/APPA centers, the ASL of the Regional Public Health Service and other radiation protection stakeholders.

From this report the APAT extracts those results that are relevant in the context of data transmission to the European Commission (as per Art.36 of the Euratom Treaty – see Appendix 6).

8.4 The national network implemented by the APAT

The surveillance of environmental radioactivity in Italy is organized at national level through the following networks:

- RESORAD: the National Environmental Radioactivity Network (laboratory network).
- REMRAD and GAMMA: the National Early Warning Networks.

8.4.1 The RESORAD network

This network is constituted by the laboratories of the Agencies System (APAT, ARPA, APPA) and other qualified Institutions.

The directives of the MH and the METP require that APAT, *inter alia*:

- Co-ordinates the measurements carried out by the Agencies and Institutions belonging to the network in order to ensure that techniques and methods for sampling and analysis are consistent.
- Transmits the collected data to the European Commission.
- Ensure adequate levels of public information.

The aim of the network is the surveillance of environmental and foodstuff contamination patterns as well as the identification of anomalous variations of radioactivity. The data obtained are used for the assessment of radiation doses that the Italian population may receive. The network also produces data to support managerial and decisional processes in case of radiological emergencies.

The reference sampling programme, defined in agreement with the organisations participating to the network, is the following:

Matrix	Sampling frequency	Measurement frequency
Air particulate	Daily	Monthly
Fallout	Monthly	Monthly
Aquatic Environment	Six-Monthly	Six-Monthly
Drinking water	Six-Monthly	Six-Monthly
Milk	Weekly	Monthly
Meat	Monthly	Quarterly
Cereal and by-product	Seasonal	Seasonal
Pasta	Quarterly	Quarterly
Vegetable	Seasonal	Seasonal
Fruit	Seasonal	Seasonal

Note: the table in Appendix 6 shows the contribution of ARPA-ER to the RESORAD network.

8.4.2 The REMRAD network

This network (see Appendix 7) consists of 7 automated on-line monitoring stations for airborne particulate matter that are distributed over the national territory. One of the stations is located in Emilia Romagna, near the summit of the Monte Cimone Mountain, district of Modena.

Each station:

- Samples airborne particulate matter at a nominal 25 m^3/h over a moving filter tape (fibreglass).
- Measures total alpha/beta on-line as well as artificial alpha/beta after a 5-day delay time, using (in both cases) ZnS/plastic sandwich scintillators coupled to 2 inch photo multiplier tubes. The integration time under routine conditions is set at 60 minutes; in case of warning threshold transgression the integration time is reduced to 10 minutes (emergency frequency). The detection limit for the total artificial beta count is approximately 0.5 Bq/m^3.
- Performs on-line high resolution gamma spectrometry using a HPGe detector that is electrically cooled. The acquisition time and analysis cycle at a 2-hour rate. The daily sum spectrum and its analysis are downloaded on disc. The sum spectrum analysis can detect ^{137}Cs at less than 1 mBq/m^3.
- Performs measurements of the ambient gamma dose rate.
- Records local meteorological parameters.

All data collected are transmitted on-line to the National Emergency Center located at the APAT headquarters in Rome.

8.4.3 The GAMMA network

This network (see Appendix 7) consists of 50 on-line gamma dose rate probes, of which 2 are located within the Emilia Romagna region: one in the Ferrara district, the other in the Ravenna district.

Each probe consists of 3 Geiger-Mueller counters: two redundant large volume tubes for low dose level registration (normal conditions), one tube for counting high levels (emergency conditions). The devices' measurement range ranges from 10 nGy/h to 10 Gy/h. The alert threshold is set at 3 times the local background value.

Every probe is paired with a rain sensor (on-off type) so as to discern enhanced dose rate levels that are due to precipitations.

All data collected are transmitted on-line to the National Emergency Center located at the APAT headquarters in Rome.

9 VERIFICATION ACTIVITIES - ENVIRONMENTAL PROGRAMMES

9.1 The site-related monitoring programme implemented by SOGIN

9.1.1 The programme

- Water sampling

The team visited the water sampling system located on the discharge canal as well as the system sampling the River Po downstream of the Caorso NPP (at Isola Serafini). At both locations the verification team confirmed the existence and functionality of the sampling systems.

The verification team noted that:

(1) The cabins housing the equipment are duly secured. The systems are checked every second day by health physics staff. Ledgers attesting these interventions were present and well kept. Loss of sampling capacity therefore will normally not exceed 48 hours. Guaranteed power supply is not available.

(2) In addition to the suspension filter (0.45 μ) and the anion (DOWEX) and cation (CHELEX-100) filters a further system is present that collects app. 100 dm^3/month. The sample collected by the third system is assessed in the laboratory every month: specific determination of ^{137}Cs and ^{134}Cs (with a LLD at app. 1.5 mBq/dm^3 for ^{137}Cs).

- Air sampling and dose rate monitoring

The team confirmed the existence and functionality of two air sampling systems, coupled with dose rate monitors, located east and west of the NPP. The latter is situated on the premises of the off-site emergency centre.

It was noted that:

(1) The cabins housing the equipment are duly secured. The systems are checked every second day by health physics staff.

(2) The dose rate probes (Studsvik Gammameter 2414A) are on-line and relayed into the emergency centre and the operations control room. At the emergency centre the incoming signals were demonstrated to the verification team. This confirmed the presence of 6 probes.

(3) The components of the systems are comprehensively tagged with identifiers. Maintenance and calibration information is also attached.

The third air sampling system to the south of the NPP was also visited: this system has been put out of function when the NPP stopped production and is now considered as a back-up system that can be made operational at short notice.

- Dry/wet deposition sampling

The team confirmed the existence and functionality of two dry/wet deposition samplers located west of the NPP on the premises of the off-site emergency centre.

It was noted that:

(1) One sampler consists of a funnel (0.1352 m²) on top of a 50 liter polythene flask that is replaced monthly. Prior to being installed the flasks are filled with one litre of 0.2N NaOH and 30 mg of iodine carrier. The sample collected is measured in a 3 dm³ Marinelli geometry by gamma spectrometry.

(2) The other sampler is combined with an on-line rain gauge that transmits data into the emergency centre. The collecting funnel (0.1 m²) feeds a 25 liter polythene flask that is replaced monthly. Of the collected sample maximaly 3 dm³ are reduced by evaporation and subsequently measured for 1000 seconds in order to assess total beta.

- TLD dose meters

The presence of TLD meters ($CaSO_4$ Panasonic), on-site as well as off-site has been confirmed.

- Environmental indicators

The sampling methodologies for soil and milk as environmental indicators were satisfactorily demonstrated to the verification team.

The verification team could verify a significant part of the site-related radiological surveillance programme as implemented by the operator of the Caorso NPP.

The verification activities performed do not give rise to particular remarks; the monitoring and sampling programmes are comprehensive, the systems in place are operational and the methodologies used are adequate.

9.1.2 The laboratory for environmental samples

The verification team visited the laboratory where it verified the adequacy of the analytical systems in place, including various aspects of quality assurance and control (working instructions, methodologies, calibration, maintenance, bookkeeping of results, reporting etc.).

The verification team noted that:

(1) The laboratory is adequately equipped and staffed for the assessment of environmental samples.

(2) A comprehensive quality controlled operations manual for all systems is in place and readily available. The manual also includes maintenance and calibration procedures.

(3) Analytical procedures and methodologies are described in quality controlled documents.

(4) Reporting and archiving of analytical results is well managed; the chain of custody is clearly defined; the traceability of data is accurately maintained.

(5) The laboratory regularly participates in (inter)national intercomparison exercises and proficiency tests. The laboratory is a member of the ALMERA ([8]) network co-ordinated by the IAEA (International Atomic Energy Agency).

The verification activities performed do not give rise to particular remarks; the analytical laboratory for environmental samples is well equipped and efficiently managed. The results of intercomparison exercises show that high standards of quality are achieved.

(6) The laboratory is seeking SINAL accreditation for the following analytical procedures:

- Gamma spectrometry.
- Determination of ^{90}Sr, ^{63}Ni and ^{55}Fe (in the framework of future decommissioning activities – accuracy needed for establishing compliance with clearance and exemption).

The verification team fully endorses the efforts made to obtain accreditation.

9.1.3 Independent verification

The APAT is legally responsible for the control of the operator's environmental monitoring programme. This responsibility may include the conduct of independent verifications.

The ARPA-PC runs a site-related environmental surveillance programme since the start-up of the Caorso NPP in the 1980s. This surveillance programme was formalised in July 2005 when the APAT signed a memorandum of understanding with the ARPA-PC on the subject. A site-specific yearly surveillance report is issued by the ARPA-PC and it is officially transmitted to the APAT.

The verification team noted that:

(1) According to Italian legislation only the APAT is legally empowered with the regulatory means to perform independent controls on the Italian nuclear power plants. The memorandum of understanding of 2005, in essence, devolves the practical implementation of the site-related environmental surveillance to the ARPA-PC.

(2) The ARPA-PC programme runs in parallel with the programme implemented by SOGIN. Both programmes are to a certain extent overlapping.

(3) The APAT performs a paper-based review and subsequent acceptance of the operator's environmental surveillance results through a comparison between the SOGIN and ARPA-PC reports.

(4) The ARPA-PC programme, despite being validated at regional level (by both the Regional Public Health Service and the Regional Veterinary and Food Hygiene Service) as well as at national level (by the APAT), cannot be considered as a fully fledged independent control over the operator.

(5) A well-defined and effective independent regulatory control to validate the operator's declarations is not in place.

Without prejudice to section 7.6 above, it is suggested that the APAT, in conjunction with the (Regional) Public Health Service, consider whether it would be beneficial, from the point of view of achieving adequate regulatory control over the statutory site-related environmental surveillance by SOGIN, to amend the Memorandum of Understanding signed with the ARPA-PC to include control responsibilities. These controls should be

[8] ALMERA: Analytical Laboratories Monitoring Environmental Radioactivity. ALMERA is a network of analytical laboratories with special skills and experience to provide assessments of radionuclide contamination in the environment in case of a radiological emergency.

adapted to the operational status of the Caorso NPP and therefore be restricted in their scope: even though the operator's laboratory has proven to maintain a high level of quality, it should at least encompass a small but representative programme of sharing environmental samples with subsequent formal comparison of the analytical results obtained.

9.2 The site-related monitoring programme implemented by the ARPA

The site-related monitoring programme, apart from continuous dry/wet deposition collection, is fully based on periodic sampling of environmental indicators. The verification team visited a number of sampling locations where staff of ARPA-PC demonstrated the sampling techniques used:

- At the location of Mortizza: sampling of river water and sediments.
- At the location of San Nazarro: sampling of DMOS, macrophytes and periphyton.
- At the location of Roncarlo (factory farm Losi): sampling of milk, soil and cereal.
- At the location of Monticelli (factory farm Avanzi): sampling of milk, soil and fodder (maize).

The team noted that the site-related sampling programme is integral part of the regional surveillance.

The verification activities performed do not give rise to particular remarks; the ARPA-PC sampling programme and sampling methodologies for the surveillance of the Caorso NPP are adequate.

The dry/wet deposition collector that is located on the premises of ARPA-PC is discussed under section 9.3 below.

9.3 The regional monitoring programme implemented by the ARPA

9.3.1 The programme

The site-related radiological surveillance being integral part of the regional environmental monitoring programme, please refer to section 9.2 above: sampling methodologies and techniques were demonstrated to be satisfactory.

The verification team, after having studied all documentary material it was provided with, believes that the scope of the regional environmental monitoring programme as implemented by the ARPA-ER, laboratory network, in conjunction with the local services of the Ministry of Health, is adequate. However, the implementation of the programme leaves room for improvement: see sections 9.3.2 and 9.3.3 below.

The verification activities performed do not give rise to particular remarks; the scope of the regional monitoring and sampling programmes is comprehensive and adequate.

9.3.2 The monitoring/sampling systems

The team verified the continuously operating monitoring/sampling systems located on the premises of the ARPA-PC: a dry/wet deposition collector as well as a sampling/monitoring station for airborne particulate matter, the latter combined with a doserate monitor.

- Air sampling and dose rate monitoring

The team could verify the presence of an on-line continuous monitoring/sampling station as described under section 8.3.2 above.

It was noted that:

(1) At the time of the visit the system was taken out of operation because of a recurrently failing air conditioning unit for cooling the various electronic components. The team was informed that the system would resume its operation within the next fortnight.

(2) The continuous operation of the system, the only one present within the region of Emilia Romagna, is not sufficiently guaranteed. A lasting situation where a basically sound system is suffering from the repeated malfunction of one single badly adapted sub-unit is not acceptable, especially since it is the only one such station present in the Emilia Romagna region.

> *The verification team suggests, as a matter priority, that the Regional Ministry of the Environment provides the ARPA-PC with the necessary means to effectively and efficiently maintain its continuous monitoring and sampling capability for airborne particulate matter.*

- Dry/wet deposition sampling

The team could verify the presence of the dry/wet deposition sampler as described under section 8.3.2 above.

It was noted that:

(1) The collector is a homemade array of open garbage bins covered with an iron mesh (concrete reinforcing mesh). The evaporation of the sample is not controlled. Pluviometric data are not recorded locally but acquired from a pluviometre situated somewhere else in Piacenza. The team takes the point of view that the system, the only dry/wet deposition collector present in the region of Emilia Romagna, is not in line with modern standards.

(2) The location of the collector is not ideal as it is situated under trees, at app. 10 m from the ARPA-PC building and in the immediate vicinity of heavy traffic lanes.

> *The verification team suggests, as a matter priority, that the Regional Ministry of the Environment provides the ARPA-PC with the necessary means to acquire a dry/wet deposition monitoring/sampling system that is in line with modern standards. It is furthermore suggested that the system be located in an area that ensures representative sampling conditions.*

- Sampling of the river Po

From discussions with ARPA-PC staff it transpired that:

(1) The continuous sampling station located on the Po River (at the Isola Serafina dam, downstream of the Caorso NPP) is property of the Centro Elettronico Sperimentale Italiano (CESI). The sampling system was decommissioned in 1995.

(2) In September 1997 CESI agreed to lease the sampling station to the ARPA-PC so as to enable the latter to acquire environmental data. However, in February 2001 the sampling activities using the station had to be stopped because of budgetary constraints.

(3) Since February 2001 the river is spot-sampled every quarter. The verification team takes the point of view that this sampling regime cannot satisfactorily replace a continuously operating monitoring/sampling system. The absence of such a system is contrary to generally accepted good practice.

> *The verification team suggests, as a matter priority, that the Regional Ministry of the Environment provides the ARPA-PC with the necessary budgetary means to restore the continuous monitoring and sampling capability for surface water of the river Po.*

9.3.3 The laboratory

The team visited the following laboratory areas: the sample reception area (identification and registration procedures), the sample preparation area (pre-measurement preparation methodologies) as well as the radiochemical and measurement laboratories.

The team verified the adequacy of the analytical systems in place, including various aspects of quality assurance and control (working instructions, methodologies, calibration, maintenance, bookkeeping of results, reporting etc.).

The verification team noted that:

(1) The laboratory is adequately equipped and staffed for the assessment of environmental samples.

(2) All activities of the laboratory, from sampling itself to analytical methodologies and data management, are ruled by a comprehensive set of quality controlled working procedures. Where appropriate, these take into account technical guidance documents that were issued by the former ANPA (now APAT).

(3) Quality controlled manuals for all systems, including maintenance and calibration procedures, are in place and readily available.

(4) The chain of custody, from sample reception to final analytical result, is clearly defined. The traceability of data is accurately maintained.

(5) Reporting and archiving of analytical results is well managed, both on paper as well as electronically, the latter as an Oracle-based LIMS (Laboratory Information Management System).

(6) The laboratory regularly participates in (inter)national intercomparison exercises or proficiency tests.

> *The verification activities performed do not give rise to particular remarks; the ARPA-PC laboratory for environmental samples is well equipped and efficiently managed.*

(7) The ARPA-PC has a co-operation agreement with the Regional Health Service that is renewed on a yearly basis. This convention defines the annual activy programme of the regional network for radioactivity surveillance in Emilia Romagna, in particular the scope and details of that part of the programme that the local sanitary departments (the "ASL") of the Regional Public Health Service have to implement (see section 8.3.1 above). The team was informed that the ARPA-PC intends to expand the modalities of in this agreement to include (from 2007 onwards) quality assured written sampling procedures for all types of samples taken by the ASL.

> *The verification team fully endorses the ARPA-PC objective to strengthen quality control on the sampling activities devolved to the ASL by issuing a set of specific quality assured sampling methodologies and associated working documents as well as requesting that these be put into effect by ASL personnel.*

9.4 The national early warning network implemented by APAT

The verification team visited the REMRAD station located at Monte Cimone.

It was noted that:

(1) The systems are housed in a secured building with guaranteed power supply.

(2) The systems as described under section 8.4.2 above were present and operational.

> *The verification activities performed do not give rise to particular remarks; the REMRAD station is a state-of-the-art monitoring facility.*

10 CONCLUSIONS

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

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

With respect to the radiological surveillance programmes related to the Caorso NPP:

(1) The verification activities that were performed demonstrated that the facilities necessary to carry out continuous monitoring of levels of radioactivity in the air, water and soil around the Caorso nuclear power plant site are adequate. The Commission could verify the operation and efficiency of these facilities.

(2) A topical recommendation shall be formulated that aims at improving quality assurance related to the processing of discharge data by the Caorso NPP operator. This recommendation does not discredit the fact that the radiological surveillance of the Caorso NPP site is in conformity with the provisions laid down under Article 35 of the Euratom Treaty.

(3) The absence of a well defined programme of independent regulatory control on discharge monitoring as well as environmental surveillance is noted and shall lead to recommendations addressed to the competent authorities.

With respect to the radiological surveillance programmes for the Emilia Romagna region:

(4) The scope of the regional radiological surveillance programme is adequate; the implementation thereof does however present shortcomings.

(5) The facility for continuous monitoring/sampling of surface water of the Po River was found to be out of operation since 2001. The loss of this facility has been replaced by a spot sampling regime. Spot sampling of a major river is not in line with good practice.

(6) The facility for continuous monitoring/sampling of airborne particulate matter and dose rate, operated by the ARPA-PC, suffers from recurrent technical problems that jeopardise the representativeness of the data obtained.

(7) The facility for dry/wet deposition sampling, operated by the ARPA-PC, does not comply with modern standards.

(8) Points (5), (6) and (7) shall lead to recommendations to the regional competent authority, with the aim to forthwith provide the ARPA-PC with those means that are necessary to restore the latter's continuous monitoring/sampling capabilities.

(9) The Commission services having competence will closely follow up the progress made by the Italian authorities with respect to point (8).

Final remarks:

- The verification findings and ensuing recommendations are compiled in the ‘Main Findings’ document that is addressed to the Italian competent authorities through the Italian Permanent Representative to the European Union.
- The present Technical Report is to be enclosed with the Main Findings.

APPENDIX 1

DOCUMENTATION RECEIVED AND CONSULTED

1. Legislation

1. 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.
2. Legislative Decree Nr 241 of 26 May 2000, amending Government Decree Nr 230.
3. Legislative Decree Nr 257 of 9 May 2001, amending Government Decree Nr 230.
4. Legislative Decree Nr 151 of 26 March 2001, amending Government Decree Nr 230.

2. APAT

5. National environmental radioactivity monitoring networks in Italy – 2002 report
6. Reply to European Commission preliminary information questionnaire in view of preparing the verification activities.

3. ARPA

7. Radiological environmental monitoring around the Caorso nuclear site – results 2001-2002.
8. Radiological environmental surveillance around the Caorso nuclear site – monitoring and sampling programme for 2006 (as appended to the official communication between the Regional Public Health Service and ARPA-RC, reference ASS/PRC/06/3628 dated 02/02/2006).
9. Environmental radioactivity in Emilia Romagna – 2003 report (ISBN 88-448-0157-4).
10. Radiological surveillance in Emilia Romagna – overview map with sampling locations.
11. Radiological surveillance in Emilia Romagna – sampling programme 2006 (environmental and foodchain indicators).
12. Quality assured document I50605/PC (rev.0 of 16/01/2006): operating instruction for the calibration and efficiency controls of the gamma spectrometric systems.
13. Collaboration agreement / memorandum of understanding (ref. 2389 of 18/07/2005) between ARPA and APAT on the environmental surveillance of the Coarso site.

4. SOGIN

14. Reply to European Commission preliminary information questionnaire in view of preparing the verification activities.
15. Radiological environmental surveillance on and around the Caorso nuclear site – monitoring and sampling programme for 2006.
16. Radiological environmental surveillance on and around the Caorso nuclear site – overview map with sampling locations.
17. Operations manual vol.6 – procedure ref. 4.8.B.1/A (rev.1): airborne radioactive discharges, on the monitoring of noble gases.
18. Operations manual vol.6 – procedure ref. 4.8.B.1/B (rev.1): airborne radioactive discharges, on the monitoring of particulates.
19. Operations manual vol.6 – procedure ref. 4.8.B.1/C (rev.1): airborne radioactive discharges, on the determination of the isotopic composition of particulates.
20. Operations manual vol.6 – procedure ref. 4.8.B.1/5-11/b (rev.2): airborne radioactive discharges, on maintenance and calibration of the on-line particulate monitors.
21. Operations manual vol.6 – procedure ref. 4.8.B.1/5 (rev.5): airborne radioactive discharges, on maintenance and calibration of the on-line noble gas monitors.

22. Operations manual vol.6 – procedure ref. 4.8.B.1/G (rev.1): airborne radioactive discharges, on operational control of the sampling devices.
23. Operations manual vol.9 – procedure ref. 901 (rev.2): determination of gamma emitters in river water samples.
24. Operations manual vol.9 – procedure ref. 904 (rev.1): determination of beta and gamma emitters in deposition samples.
25. Operations manual vol.9 – procedure ref. 909 (rev.2): determination of Sr-90 in milk samples.
26. Operations manual vol.9 – procedure ref. 913 (rev.1): determination of gamma emitters by spectrometry.
27. Preparatory documentation in view of obtaining SINAL accreditation for the determination of gamma emitters by spectrometry.
28. Operating instruction ref. I.E. 41/CFS (rev.0): operating instructions and quality controls for the Berthold LB770.
29. Technical note ref. NT 111/CFS (rev.0): morphological and radiometrical characterisation of the discharge canal (towards to river Po).

Web sites

30. APAT www.apat.gov.it
31. ARPA www.arpa.emr.it
32. SOGIN www.sogin.it
33. ENEA www.enea.it
34. Legislation www.parlamento.it/leggi
35. European Commission (radiation protection) http://europa.eu.int/comm/energy/nuclear/radioprotection/index_en.htm

APPENDIX 2

THE VERIFICATION PROGRAMME

Monday 15/05

1. Arrival at site at 09:030 and site access formalities (AM).
2. Opening meeting: introductions / presentations / programme of the visit (AM).
3. Verification of the provision for monitoring/sampling of radioactive discharges from the Caorso NPP (airborne and liquid) and visit of the reactor's operations control room (PM).

Tuesday 16/05

4. Verification of a representative set of environmental surveillance stations and sampling locations on and around the Caorso site, as performed by the operator (AM).
5. Verifiaction activities at the analytical laboratories for discharge as well as environmental samples (PM).

Wednesday 17/05

6. Verification activities at the ARPA-ER laboratory at Piacenza: the local environmental monitoring and sampling provisions; the laboratory itself.
7. Verification of a part of the Caorso site-related monitoring and sampling provisions operated by the ARPA-ER.

Thursday 18/05

9. Verification of the national REMRAD environmental surveillance station operated by APAT, located on the Monte Cimone (district of Modena).

Friday 19/05

10. Closing meeting: presentation of preliminary verification findings.

APPENDIX 3

THE SITE-RELATED ENVIRONMENTAL SURVEILLANCE PROGRAMME – AS IMPLEMENTED BY SOGIN

Matrix	Sampling points	Sampling frequency	Measurement frequency	Measurement type	Lower limit of detection
Air	3 (or 2) (*)	Continuous	Weekly Monthly	Total beta Gamma spectrometry	0,18 mBq/m³ 0,11 mBq/m³ (Cs-137)
Milk	4 (or 3)	Monthly or quarterly (**)	Monthly or quarterly	Sr-90 Gamma spectrometry	30 mBq/dm³ 20 mBq/dm³ (Cs-137) 30 mBq/dm³ (Co-60)
Forage/fodder	5 (or 3)	Semestrial	Semestrial	Gamma spectrometry	150 mBq/kg (Cs-137) - dry 300 mBq/kg (Co-60) - dry
Salad	5 (or 3)	Semestrial	Semestrial	Sr-90 Gamma spectrometry	100 mBq/kg 200 mBq/kg (Cs-137) 200 mBq/kg (Co-60)
Maize	5 (or 3)	Yearly	Yearly	Gamma spectrometry	100 mBq/kg (Cs-137) 100 mBq/kg (Co-60)
Tomatoe	5 (or 3)	Yearly	Yearly	Gamma spectrometry	10 mBq/kg (Cs-137) 10 mBq/kg (Co-60)
Meat (porc)	5 (or 3)	Yearly	Yearly	Gamma spectrometry	100 mBq/kg (Cs-137) 100 mBq/kg (Co-60)
Meat (beef)	5 (or 3)	Yearly	Yearly	Gamma spectrometry	100 mBq/kg (Cs-137) 100 mBq/kg (Co-60)
Fish	2	Trimestrial or semestrial	Trimestrial or semestrial	Gamma spectrometry	100 mBq/kg (Cs-137) 100 mBq/kg (Co-60)

Cont'd

(*) & (**) The number of sampling points and the sampling frequency may vary in function of the levels of radioactivity discharged by the NPP: the minimum requirements are only allowed if liquid and airborne discharges are shown to be smaller than 2% of both the quarterly and the yearly discharge limits.

Matrix	Sampling points	Sampling frequency	Measurement frequency	Measurement type	Lower limit of detection
"Whitebait" (very small fish – "pesce da frittura" in Italian)	1	Semestrial	Semestrial	Sr-90 Gamma spectrometry	100 mBq/kg 100 mBq/kg (Cs-137) 100 mBq/kg (Co-60)
Eggs	1	Trimestrial or semestrial	Trimestrial or semestrial	Gamma spectrometry	100 mBq/kg (Cs-137) 100 mBq/kg (Co-60)
River water	1 Discharge canal 1 River Po	Continuous	Monthly	Cs-137 Gamma spectrometry	1,5 mBq/dm³ 0,3 mBq/dm³ (Co-60)
Drinking water	3 (or 2)	Trimestrial or semestrial	Trimestrial or semestrial	Cs-137 Gamma spectrometry	0,7 mBq/dm³ 1,8 mBq/dm³ (Co-60)
Sediments (Po)	8 (or 6)	Semestrial	Semestrial	Gamma spectrometry	500 mBq/kg (Cs-137) 400 mBq/kg (Co-60)
Soil	2	Semestrial	Semestrial	Gamma spectrometry	500 mBq/kg (Cs-137) 400 mBq/kg (Co-60)
TLD	20 (or 10)	Two-monthly	Two-monthly	Exposition intensity	30 µGy for two months
Dry/wet deposition	1	Continuous	Monthly	Total beta Gamma spectrometry	----- -----

APPENDIX 4

THE SITE-RELATED ENVIRONMENTAL SURVEILLANCE PROGRAMME – AS IMPLEMENTED BY ARPA-PC

Matrix	Sampling points	Sampling frequency	Sample quantity	Measurement type
Milk	3	Weekly Monthly (bulk sample) Quarterly (bulk sample)	 2 dm^3 2 dm^3	 Gamma spectrometry Sr-90
Forage/fodder	3	Semestrial	3 kg	Gamma spectrometry
Salad	1	Semestrial	5 kg 1 kg	Gamma spectrometry Sr-90
Cereals (wheat, maize)	3	Yearly	3 kg	Gamma spectrometry
Tomatoes	3	Yearly	10 kg	Gamma spectrometry
Meat (porc and/or beef)	3	Yearly	3 kg	Gamma spectrometry
Garlic	2	Yearly	3 kg	Gamma spectrometry
Fish	2	Quarterly	3 kg	Gamma spectrometry
"Whitebait" (very small fish – "pesce da frittura" in Italian)	2	Semestrial	1 kg	Sr-90
Eggs	2	Monthly Semestrial (bulk sample)	 2 kg	 Gamma spectrometry
River water (Po)	2	Quarterly Semestrial	200 dm^3 25 dm^3	Gamma spectrometry Sr-90
Drinking water	2	Monthly Yearly (bulk sample)	20 dm^3	 Gamma spectrometry Sr-90
Sediments (river Po)	3	Quarterly	5 kg	Gamma spectrometry

Cont'd

Matrix	Sampling points	Sampling frequency	Sample quantity	Measurement type
DMOS (river Po) (*)	2	Quarterly Semestrial (bulk sample)	1 kg 50 g	Gamma spectrometry Sr-90
Periphyton (river Po)	2	Quarterly	50 g	Gamma spectrometry
Macrofites (river Po)	2	Semestrial	1 kg	Gamma spectrometry
Soil	3	Semestrial	5 kg	Gamma spectrometry
Dry/wet deposition	1 (at ARPA-PC premises)	Monthly Semestrial (bulk sample)		Gamma spectrometry Sr-90

(*) Detrito Minerale Organico Sedimentabile. Freely translated: mineral and organic detritus that is liable to sedimentation.

Note: the nominal acquisition time for gamma spectrometric analysis is 1000 minutes.

APPENDIX 5

ARPA-ER - THE REGIONAL ENVIRONMENTAL SURVEILLANCE PROGRAMME – EMILIA ROMAGNA – 2006

Matrix	Type	Sampling location	Sampled by	Sampling frequency	Measurement frequency
Air	Airborne particulate	1 (ARPA-Piacenza)	ARPA	Weekly	Weekly + monthly bulk
Dry/wet deposition	Total fallout	1 (ARPA-Piacenza)	ARPA	Monthly	Monthly + semestrial bulk
External radiation	Gamma dose rate	1 (ARPA-Piacenza)	ARPA	Continuous	Daily
Surface waters	River water Coastal sea water	1 (river Po) 1 (river Po) 1 (Adriatic Sea)	ARPA ARPA ARPA	Continuous Quarterly Quarterly	Weekly Quarterly + semestrial bulk Semestrial bulk
Drinking water		2	ARPA	Quarterly	Quarterly
Sediment	Fluvial Marine DMOS	2 (river Po) 2 (Adriatic Sea) 2 (river Po)	ARPA ARPA ARPA	Quarterly Semestrial Quarterly	Quarterly Semestrial Quarterly + semestrial bulk
Flora (fresh water)	Periphyton	2 (river Po)	ARPA	Quarterly	Quarterly
Flora (sea water)	Algae (ulva rigida /ulva lactuca)	1 (marine sample)	ARPA	Quarterly	Quarterly
Molluscs	Tapes decussates [1] (carpet-shell clam) Scapharca inaequivalvis (ark clam) Mytilus edulis [1] (common mussel)	1 (market sample) 1 (Adriatic Sea) 1 (market sample)	ASL ARPA ASL	Semestrial Semestrial Semestrial	Semestrial Semestrial Semestrial
Sea fish	Sardines Anchovy Cod (deep frozen) Tuna (canned)	2 (market / Adriatic Sea) 2 (market / Adriatic Sea) 1 (supermarket) 1 (supermarket)	ASL / ARPA ASL / ARPA ASL ASL	Semestrial Semestrial Semestrial Semestrial	Semestrial Semestrial Semestrial Semestrial
Fresh water fish	Trout Miscellaneous	1 (fishery) 1 (river Po)	ASL ASL	Semestrial Semestrial	Semestrial Semestrial

Note: ASL = "azienda sanitaria locale" (the local sanitary departments of the Regional Public Health Service)

Cont'd

Matrix	Type	Sampling location	Sampled by	Sampling frequency	Measurement frequency
Milk	Dairy milk (fresh) [1] Processed milk (UHT)	1 3 1	ASL ASL ASL	Weekly Weekly Weekly	Monthly bulk Monthly bulk Monthly + semestrial bulk
Milk products	Parmigiano cheese Grana cheese Butter Yoghurt	2 1 1 2	ASL ASL ASL ASL	Monthly Monthly Monthly Monthly	Semestrial bulk Semestrial bulk Semestrial bulk Semestrial bulk
Meat	Beef [1] [2] Horse [3] Porc [1] [2] Rabbit [2] Chicken [1] Game [3]	3 1 3 1 2 2	ASL ASL ASL ASL ASL ASL	Monthly Quarterly Monthly Monthly Monthly Quarterly	Quarterly bulk Quarterly Quarterly bulk Quarterly bulk Quarterly bulk Quarterly
Eggs	Chicken [2]	2	ASL	Monthly	Semestrial bulk
Forage	Medicinal herbs	1	ASL	Twice a year	Twice a year
Cereals	Wheat (durum) [1] Wheat [1] Maize [1]	1 1 1	ASL ASL ASL	Yearly Yearly Yearly	Yearly Yearly Yearly
Vegetables	Tomatoes [1] [2] Cauliflower [2] Onions [2] Potatoes [1] [2] Lettuce [1] [2] Spinach (deep frozen) [2]	3 (2 market) 2 (market) 2 (market) 3 (2 market) 3 (2 market) 1	ASL ASL ASL ASL ASL ASL	Weekly Weekly Weekly Weekly Weekly Weekly	Weekly Weekly Weekly Weekly Weekly Weekly
Fruit	Peaches [1] [2] Pears [1] [2] Apples [1] [2] Oranges [2] Chestnut (sweet) [2] Wild (straw)berries [3]	3 (2 market) 3 (2 market) 3 (2 market 2 (market) 2 (market) 3 (2 market / 1 *in situ*)	ASL ASL ASL ASL ASL ASL	Weekly Weekly Weekly Weekly Yearly Yearly	Weekly Weekly Weekly Weekly Yearly Yearly

Cont'd

Matrix	Type	Sampling location	Sampled by	Sampling frequency	Measurement frequency
Mushrooms	Edible mushrooms [4] Various species	2 (markets) 3 *(in situ*)	ASL ASL	Yearly Yearly	Yearly Yearly
Cereal derivatives	Pasta Wheat flour	2 1	ASL ASL	Monthly Monthly	Quarterly bulk Quarterly bulk
Sugar	-----	2	ASL	Yearly	Yearly
Wine	5 specifications	5	ASL	Yearly	Yearly
Infant food	Baby milk (powder) Baby milk (liquid) Biscuits Baby food (in jars)	1 1 1 1	ASL ASL ASL ASL	4-monthly 4-monthly 4-monthly 4-monthly	4-monthly 4-monthly 4-monthly 4-monthly
Fruit juice	3 specifications	1	ASL	Yearly	Yearly
Jam	6 specifications	1	ASL	Yearly	Yearly
Mixed diet	School Hospital Catering company	1 1 2	ASL ASL ASL	Weekly Weekly Weekly	Quarterly bulk Quarterly bulk Quarterly bulk
Honey	3 specifications [1]	1	ASL	Yearly	Yearly

[1] One sample of regional produce required.

[2] Samples of national or foreign origin allowed, depending on commercial availability.

[3] Produce from third countries is preferred.

[4] Samples must originate in a third country.

Note: [3] and [4] in pursuance to Commission Regulation 99/1661/EC of 27 july 1999 laying down detailed rules for the application of Council Regulation (EEC) N° 737/90 on the conditions governing the import of agricultural products originating in third countries following the accident at the Chernobyl nuclear power station (OJ L-197 of 29/07/99 page 17).

APPENDIX 6

ARPA-ER CONTRIBUTION TO RESORAD
Data transmitted to the European Commission
Article 36 EURATOM Treaty

The following data for the Emilia Romagna region are collected by APAT in the framework of Article 36 of the Euratom Treaty.

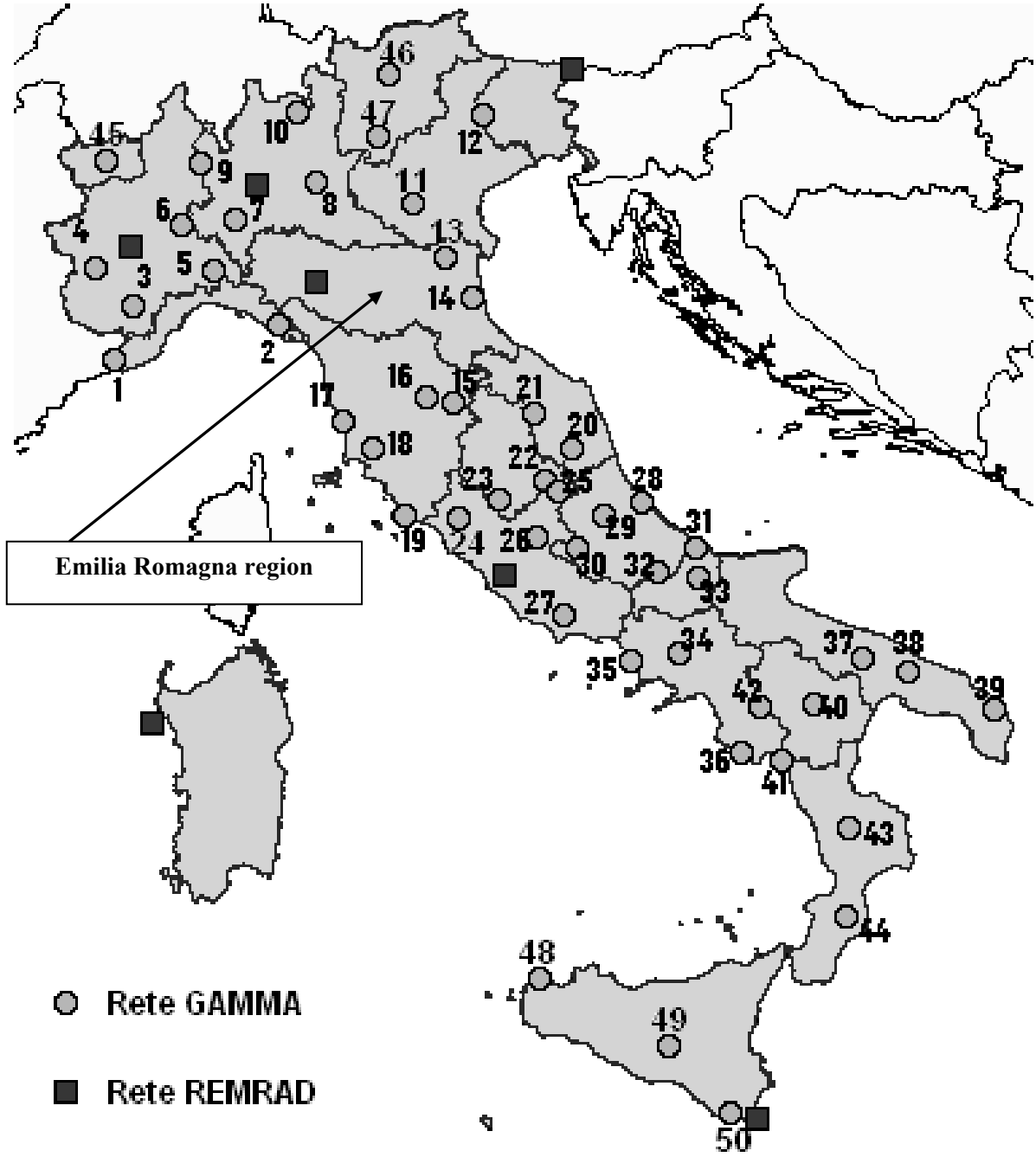
Matrix	Sampling frequency	Sampling locations in Emilia Romagna	Measurement frequency	Radionuclides assessed
Dose rate	Continuous	Piacenza (PC)	10 min 60 min 24 h	Gamma dose
Air particulate	Continuous	Piacenza (PC)	10 min 60 min 24 h	I-131 Total beta Total alpha
Fallout	Monthly	Piacenza (PC)	Monthly Six-monthly	Cs-137 Sr-90
Surface waters	Quarterly	Pontelagoscuro (FE) - Po River Cesenatico (FC) - Adriatic Sea	Quarterly Six-monthly	Cs-137 Sr-90
Drinking water	Quarterly	Pontelagoscuro (FE) San Martino in Strada (FC)	Quarterly	Cs-137 Sr-90 H-3
Sediment and DMOS	Quarterly Six-monthly	Pontelagoscuro (FE) - Po River Porto Garibaldi (FE) - Adriatic Sea Cesenatico (FC) - Adriatic Sea	Quarterly Six-monthly	Cs-137 I-131 Sr-90
Terrestrial and aquatic biota and flora (incl. mushrooms)	Quarterly (aquatic) Six-monthly (terrestrial)	Albareto (PR) Bondeno (FE) - Po River Cesenatico (FC) - Adriatic Sea Castelnuovo Monti (RE) Collagna (RE) Bedonia (PR) Borgo Val di Taro (PR) Ligonchio (RE) Pontelagoscuro (FE) - Po River Pavullo (MO)	Quarterly (aquatic) Six-monthly (terrestrial)	Cs-137
Milk	Weekly	Bologna (BO) Collecchio (PR) Reggio Emilia (RE)	Monthly Quarterly	Cs-137 Sr-90
Infant food	Four-monthly	Collecchio (PR) Reggio Emilia (RE)	Four-monthly	Cs-137 Sr-90
Mixed diet	Quarterly	Bologna (BO) Piacenza (PC) Modena (MO)	Quarterly	Cs-137 Sr-90

Cont'd

Matrix	Sampling frequency	Sampling locations in Emilia Romagna	Measurement frequency	Radionuclides assessed
Meat	Monthly	Carpi (MO) Castelvetro (MO) Colorno (PR) Faenza (RA) Forlì (FC) Imola (BO) Reggio Emilia (RE)	Quarterly	Cs-137
Cereal and by-product	Seasonal	San Giovanni in Persiceto (BO) Argenta (FE)	Seasonal	Cs-137
Pasta	Monthly	Bologna (BO) Parma (PR)	Quarterly	Cs-137
Vegetable	Seasonal	Bologna (BO) Cesenatico (FC) Loiano (FC) Mancasale (RE) Podenzano (PC) Reggio Emilia (RE)	Seasonal	Cs-137 Sr-90
Fruit	Seasonal	Bologna (BO) Ferrara (FE) Mancatale (RE) Pavullo (MO) Ravenna (RA) Reggio Emilia (RE)	Seasonal	Cs-137

APPENDIX 7

THE EARLY WARNING NETWORKS - APAT



GAMMA = on-line gamma dose rate monitoring

REMRAD = on-line airborne particulate monitoring