EUROPEAN COMMISSION
DIRECTORATE-GENERAL FOR ENERGY

DIRECTORATE D - Nuclear Safety and Fuel Cycle
Radiation protection

TECHNICAL REPORT

VERIFICATIONS UNDER THE TERMS OF ARTICLE 35 OF THE EURATOM TREATY

NORTHERN GREECE

20 to 25 October 2012

Reference: EL-12/07

VERIFICATIONS UNDER THE TERMS OF ARTICLE 35

OF THE EURATOM TREATY

FACILITIES:	Installations for monitoring and surveillance of environmental radioactivity in northern Greece; discharge monitoring of a nuclear medicine facility; monitoring at phosphogypsum piles; food import control at border to FYROM.
SITES:	Thessaloniki, Larissa, Serrai, Kavala, Komotini, Alexandroupolis, Ptolemais, NeaKarvali, Evzoni.
DATES:	20 to 25 October 2012
REFERENCE:	EL-12/07
INSPECTORS:	Mr C. Gitzinger (Head of team) Mr S. Calpena Mr E. Henrich Mr E. Hrnecek Mr A. Ryan
REPORT DATE:	19/03/2014

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TECHNICAL REPORT

ABBREVIATIONS

ADSL	Asymmetrical Digital Subscriber Line (telecommunication)
ALMERA	Analytical Laboratories for the Measurement of Environmental Radioactivity
BSS	Basic Safety Standards
DG	Directorate - General
DLI	Department of Licensing & Inspections (within GAEC)
EC	European Commission
ELFE	Hellenic Fertilizers (at NeaKarvali)
EML	Environmental Measurements Laboratory (US Department of Homeland Security)
ERL	Environmental Radioactivity Laboratory (within Institute of Nuclear & Radiological Sciences & Technology, Energy & Safety (INRaSTES) formely INT-RP)
ERMD	Environmental Radioactivity Monitoring Department (within GAEC)
ERMP	Environmental Radioactivity Monitoring Programme
ESYD	Hellenic Accreditation Council
EURDEP	EUropean Radiological Data Exchange Platform
FYROM	Former Yugoslav Republic of Macedonia
GAEC	Greek Atomic Energy Commission
GMS	Greek Meteorological Service
GPRS	General Packet Radio Service (telecommunication)
GRR-1	Greek Research Reactor No. 1 (within INRaSTES)
GSRT	General Secretariat of Research and Technology
HPGe	High Purity Germanium (gamma radiation detector)
IAEA	International Atomic Energy Agency
INRaSTES	Institute of Nuclear & Radiological Sciences & Technology, Energy & Safety, former Institute of Nuclear Technology and Radiation Protection (within NCSR "D")
ISO	International Organization for Standardization
MCA	Multi-Channel Analyser
NaI(Tl)	Sodium iodide, thallium activated (gamma radiation detector)
NCSR "D"	National Centre for Scientific Research "Demokritos"
NORM	Naturally Occurring Radioactive Material
NPP	Nuclear Power Plant
PIPS	Passivated Implanted Planar Silicon (radiation detector)
TCP/IP	Transmission Control Protocol and Internet Protocol (telecommunication)
TRMN	Telemetric Radioactivity Monitoring Network (of GAEC)
UPS	Uninterruptible Power Supply
US DOE	United States Department of Energy

VPN	Virtual Private Network (telecommunication)
XRF	X-Ray Fluorescence

1 INTRODUCTION

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

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

For the EC, the Directorate-General for Energy (DG ENER), and in particular its Radiation Protection Unit ENER D.3, 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.

For the purpose of such a review, a verification team from DG ENER visited northern Greece from 20 to 25 October 2012. This mission dealt with:

- the (automatic) national monitoring system for environmental radioactivity in northern Greece;
- the environmental monitoring of the phosphogypsum pile of the Hellenic Fertilizers plant at NeaKarvali, east of Kavala;
- the laboratories at Aristotle University of Thessaloniki involved in emergency radiological monitoring;
- the discharge monitoring at Interbalkan Medical Centre, Thessaloniki; and
- control issues at the border to FYROM.

The present report contains the results of the verification team's review of relevant aspects of the radiological environmental surveillance in northern Greece. The purpose of the review was to provide independent verification of the adequacy of monitoring facilities for:

- Discharges of radioactive substances into the environment.
- Levels of environmental radioactivity in the terrestrial and aquatic environment in northern Greece.

With due consideration to the scope of the verification and taking into account the relatively short time available for the execution of the programme, it was agreed that emphasis would be put on:

- The implementation of the statutory environmental radioactivity monitoring programme as performed by the Greek Atomic Energy Commission (GAEC).
- The Aristotle University of Thessaloniki laboratories involved in measurements in emergencies, including aspects of quality assurance and control as well as document control.
- Food import control issues at a customs station on the border with FYROM.

The present report is also based on information collected from documents referred to in Chapter 2.3 and from discussions with various persons met during the visit, listed in Chapter 2.4 below.

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

2 PREPARATION AND CONDUCT OF THE VERIFICATION

2.1 PREAMBLE

The Commission's notification to conduct a verification under the terms of Article 35 of the Euratom Treaty was forwarded to the Greek competent authority on 16 April 2012. Subsequently, practical arrangements for the implementation of the verification were made with the Greek competent authority.

2.2 PROGRAMME OF THE VISIT

A programme of verification activities under the terms of Article 35 was discussed and agreed upon with the Greek competent authority.

The verification activities were carried out in accordance with the programme provided in Appendix 2 of this report. At the locations listed in the programme, the verification activities addressed technical aspects of monitoring and sampling, analytical methods used, quality assurance and control, archiving and reporting of data.

2.3 DOCUMENTATION

In order to facilitate the work of the verification team, a package of information was supplied in advance by the Greek authority. Appendix 1 provides a list of additional documentation provided during and after the verification visit.

The verification team noted the quality and comprehensiveness of all presentations made and documentation provided. The information thus provided has been extensively used for drawing up the descriptive sections of the report.

2.4 REPRESENTATIVES OF THE COMPETENT AUTHORITIES AND THE OPERATORS

During the verification visit, the following representatives of the national competent authority and the operators were met:

Greek Atomic Energy Commission (GAEC); Environmental Radioactivity Monitoring Department (ERMD); Department of Licensing & Inspection (DLI), Athens

Dr.Antonis Maltezos	Nuclear Physicist (ERMD)
Mr Stathis Kyriakopoulos	Electronics Engineer, MSc, MIET (ERMD)
Dr. Konstantinos Potiriadis	Nuclear Physicist, Head of the ERMD
Dr. Konstantina Kehagia	Radiochemist (ERMD)
Mrs. Stavroula Vogiatzi	Medical Physicist, DLI

Hellenic Fertilizers plant (ELFE), NeaKarvali

Mr Aristeides Terzis	Director of Research and Development

Interbalkan Medical Centre, Thessaloniki

Mr Apostolos Ballas	Medical Physicist, M.Sc.
Mr Vasiliki Zacharopoulou	Nuclear Medicine Physician

Department of Electrical & Computer Engineering, Nuclear Technology Laboratory, Aristotle University of Thessaloniki

Mr A. Clouvas	Professor, Director
Dr. S. Xanthos	Collaborator

Atomic and Nuclear Physics Department, Aristotle University of Thessaloniki

Mrs Metaxia Manolopoulou	Associate Professor
Mrs Alexandra Ioannidou	Assistant Professor

Customs Service

Mr K. Ntalampekos	Head officer

3 COMPETENT AUTHORITIES AND RELEVANT LEGISLATION

3.1 THE GREEK ATOMIC ENERGY COMMISSION (GAEC)

3.1.1 Scope and history

The GAEC was established in 1954 as the authority responsible for promoting the peaceful applications of nuclear energy in Greece.

In 1987 the GAEC was separated from the National Centre of Scientific Research "Demokritos", and was re-established as an autonomous Civil Service[(2)], supervised by the General Secretariat of Research and Technology (GSRT) under the former Ministry of Development (now under the Ministry of Education and Religious Affairs), responsible, interalia, for issues concerning radiation protection of the public, workers, and environment, nuclear energy and nuclear technology as well as for issues of emergency response in case of nuclear accidents and other radiological events.

In the framework of environmental radioactivity monitoring, GAEC is assisted by a network of cooperating laboratories from universities and research centres in Greece.

3.1.2 Statutory responsibilities

The statutory responsibilities of the GAEC in the context of this report are:

1. Protection of workers, the general public and the environment from the use of ionising (and non-ionising) radiation through implementation of:
   - Monitoring the environmental radioactivity by measuring air, water and soil samples.
   - Individual monitoring of occupationally exposed workers in Greece.
   - Recurrent inspection of installations using radioactive materials in the medical, industrial, research, and educational sectors.
   - Licensing of non-medical applications of ionising radiation in the industrial, research and educational sectors. Issuing certificates of compliance from the radiation protection point of view for medical applications.
   - Licensing of import, export, transport, storage, use and disposal of fissile and non-fissile radioactive materials.
   - Licensing of the import and use of radiation producing equipment.

[2] By Decree Law Nr 1733 (Article 28), Official Gazetteof the Hellenic Republic Nr 171/A of 22 September 1987 "Establishing the Greek Atomic Energy Commission".

2. Drafting and implementation, in compliance with EU Directives, of radiation protection regulations, safety standards and codes of practice for ionising radiation installations.
3. Education and training of workers on radiation protection issues.
4. Implementation of emergency preparedness and response plans.

All GAEC laboratories participate in International and European networks and take part in inter-comparison exercises. The laboratories have been accredited by the Hellenic Accreditation Council (ESYD) according to ISO 17025. Furthermore, DLI has been accredited by ESYD according to ISO 17020 and the Department of Education and Training has been certified according to ISO 29990.

3.2 LEGAL FRAMEWORK

The legal basis for radiation protection in Greece consists of:

- Legislative Act Nr 181 "Protection against the dangers of ionizing radiation" (Official Gazette of the Greek Government Nr 347 of 20.11.74). This Act establishes the framework for the protection of the public and goods against the dangers from ionizing radiations. The Act also stipulates that matters of radiation protection shall be regulated through Ministerial Orders.
- Joint Ministerial Order No 1014 (FOR) 94 "Radiation Protection Regulations" (Official Gazette of the Greek Government, Nr 16B of 06.03.01): this Order transposes EU Council Directive 96/29/Euratom (Basic Safety Standards) and Council Directive 97/43/Euratom (medical exposure) into national law
- The General Plan of Civil Protection code name "Xenokratis" (Official Gazette of the Greek Government, Nr 12 Vol. B of 19.01.98), defining actors and laying down responsibilities for emergency preparedness and response in the case of radiation accidents or increased radioactivity levels.

Although there is no nuclear power plant (NPP) in Greece, the legislative framework establishing a system of licensing with regard to nuclear installations exists since 1971: Decree Law Nr 854 (Official Gazette Nr 54 of 18.03.1971) on the "Terms to establish and operate Nuclear Installations".

With regard to NORM (e.g. phosphogypsum piles) the main authorisation is by the Ministry of Environment or by the local Prefecture based on an assessment (report) by GAEC on radiation protection and radiological environmental issues, which is also incorporated in the license. GAEC can issue orders (e.g. that a NORM factory has to fulfil guidance given in the EC document RP-122 - Practical use of the conceptsof clearance and exemption.).

4 THE NATIONAL CENTRE FOR SCIENTIFIC RESEARCH "DEMOKRITOS"

The National Centre for Scientific Research "Demokritos" (NCSR "D") is a multidisciplinary research centre that started its operation in 1959 as an independent division of the public sector, under the name of Nuclear Research Centre "Demokritos".

The centre was not part of the present verification, it was verified in 2005 (see Technical Report GR-05/5).

The scientific activities of the NCSR are carried out in five institutes. The relevant institute in the framework of this report is the Institute of Nuclear & Radiological Sciences & Technology, Energy & Safety (INRaSTES)

INRaSTES resulted after the merger of the Institute of Nuclear Technology & Radiation Protection and the Institute of Radioisotopes and Radiodiagnostic Products, according to Law 4051/2012 and comprises amongst other laboratories the Greek Research Reactor and the Environmental Radioactivity Laboratory (ERL - see section 5.2 below).

5 ENVIRONMENTAL RADIOACTIVITY MONITORING IN GREECE

5.1 INTRODUCTION

GAEC, through its own laboratory infrastructure, the Environmental Radioactivity Monitoring Department (ERMD), is in charge of supervising, coordinating and implementing the national Environmental Radioactivity Monitoring Programme (ERMP). It operates the Telemetric Radioactivity Monitoring Network (TRMN) and the Environmental Radioactivity Laboratory, where various measurements are performed (see sections 5.3 and 5.4).

A small part of the national ERMP is performed at the Environmental Radioactivity Laboratory (ERL) of the INRaSTES, which implements also the research reactor (GRR-1) site-related environmental radioactivity monitoring programme.

5.2 THE NCSR DEMOKRITOS, INRASTES ENVIRONMENTAL RADIOACTIVITY LABORATORY (ERL)

The Environmental Radioactivity Laboratory (ERL) of INRaSTES did not form part of this verification. Detailed descriptions can be found in the technical reports of the verifications in 2000 and 2005 (GR-00/1 and GR-05/5). However, for completeness, a short updated description is presented here, which is based on the 2005 verification.

The staff of the ERL consists of 2 researchers, 1 expert-colleague, 1 post-doc colleague, 1 part-time technician, 4 Ph. D. Fellows, 4 research scientists under contracts and a number of scientific visitors and graduate students (diploma work for Bachelor Degree). Per year the ERL handles between 2000 and 3000 samples. The ERL comprises three basic units: the sample registry unit; the sample preparation unit, including separate divisions for physical and chemical treatment of the samples, and the radioactivity measurements unit (including separate divisions for gamma spectrometry, gross beta and other types of measurements).

Routine control samples from the environment are registered under a unique sample name. The registration information includes all the necessary data (sample type, sampling period, date and time of sample arrival, sampling location, sample volume (or mass) etc.). Where necessary, the sample is directed to the sample preparation unit and is treated physically and/or chemically. The parameters and results of the treatment are added to the sample registration document. After treatment, the sample proceeds to the radioactivity measurements section. The direct result(s) of measurement are also added to the sample registration document. In most of cases additional calculations are performed in order to derive the final quantity (usually a specific activity value) and its uncertainty (including statistical and systematic uncertainties).

The final calculations are made using *MS Excel* spreadsheets, where the whole sample data are recorded. These files are used for electronic storage of the results, in parallel to the physical (paper) records storage. Routine control samples are stored for at least 5 years.

Under normal conditions, the results of the routine environmental radioactivity control measurements are sent to the GAEC, in the form of standard *MS Excel* spreadsheets, accompanied by a letter signed by the Head of the ERL.

In the case of emergency, the frequency and the type of results provided to GAEC is determined by the related Nuclear Emergency Plan and may be subject to modifications according to the specific needs.

The ERL monitoring network consists of 5 air sampling, 3 radioactive deposition, 1 river and 2 milk and mixed-diet sampling stations.

For air sampling piston oil pumps assembled in 'Demokritos', with a sampling rate of 50 m^3 per day are used. The devices are supplied with air volume meters, the readings of which are reported with each sample. For sampling *Whatman 41* paper filters with a diameter of 4.7 cm are used. Most of the samplers are located in stations of the Greek Meteorological Service and are operated by its staff. In

three cases the stations are located in lignite power plants and operated by their staff. The ERL staff operates the 'Demokritos' station. Under routine conditions, the air samples are measured for gross beta activity. In the case of emergency, the determination of specific radionuclides will be performed by means of high-resolution gamma spectrometry. Additionally, gamma spec measurements in air (air filters: paper filter Whatman 41 – cut to d: 70 mm) are integrated to 1 week (pump operating 12h/d each day - air flow 20 cfm).

Radioactive deposition sampling is done using cylindrical plastic vessels of 0.075 m^2 area, directly exposed to the atmospheric fallout at the height of 1 m. An additional 1 m^2 stainless steel sampling vessel is in use at the 'Demokritos' station. In three cases the stations are located in lignite power plants and operated by their staff. The Athens stations are operated by ERL staff and the Thessaloniki station by Aristotle University of Thessaloniki staff. Under routine conditions, gross beta activity is determined. The deposition samples are also analysed for Cs-137 by means of high-resolution gamma spectrometry. In the case of emergency, the determination of specific radionuclides will be performed by means of high-resolution gamma spectrometry of the solid residue.

The monthly river water sample is composed of daily samples of 1 litre taken from the Nestos river. The composite 1-month sample is sent to ERL for further treatment. For the time being, the Nevrokopio municipality employees perform the sampling.

For milk, under routine conditions, a composite sample from the companies with the widest distribution is formed once per month. Mixed diet samples are prepared using 13 basic components (meats, milk, vegetables, cereals etc.) by mixing according to the official data on their percentage contribution to the average Greek diet. The mixed diet samples are taken from a number of Athens supermarkets, totaling 12 samples per year (monthly collected) of mixed diet according to the typical Greek diet during the year. For the determination of Cs-137 the ashed milk and mixed diet samples are measured by means of high-resolution gamma-spectrometry. In the case of emergency and/or when quick results are required, the samples can be measured directly after their homogenisation. In the case of determination of Sr-90, radiochemical analysis is applied using EML methodology.

On a non-routine basis the laboratory performs determinations of Cs-137 and mixed fission products in seawater and of radon concentrations in air.

For analysis several HPGe gamma spectrometry systems, two alpha spectrometry systems and a low-level beta measurement system are available.

A full description of the environmental monitoring/sampling programme and relevant technical details as implemented by the ERL can be taken from the technical reports of the verifications in 2000 and 2005.

ERL has no ISO certification. However, procedures have been externally approved by international expert groups. The ERL frequently contributes to international research projects and routinely participates in intercomparison exercises organised by various international bodies.

5.3 THE GAEC ENVIRONMENTAL RADIOACTIVITY MONITORING DEPARTMENT (ERMD)

The ERMD of GAEC operates the Telemetric Radioactivity Monitoring Network and the laboratory where analytical measurements of environmental samples are performed.

The staff of the Department is composed of 3 senior scientists (PhD), 2 physicists (PhD) and 5 technicians. Graduate students usually perform diploma or MSc thesis.

The laboratory part of the Department was not part of this verification. Detailed descriptions can be found in the technical reports of the verifications in 2000 and 2005 (GR-00/1 and GR-05/5). Again, for completeness, a short updated description is presented here.

The laboratory of ERMD performs routine measurements to survey and register the radiation levels of the radionuclide concentrations in different environmental media on the Greek territory. In particular, measurements are performed in:

- Surface water (rivers & lakes)
- Drinking water
- Spas
- Air
- Indoor radon
- Imported materials belonging to the Green Catalogue of Waste
- Imported scrap & final products
- Imported food stuffs and feeding stuffs
- Soil
- NORM industries
- Environmental samples around the Greek Research Reactor (GRR-1).

The laboratory operates the following infrastructure:

- Gamma-spectroscopic system: 2 HPGe (70% & 50% low energy)
- Alpha-spectroscopic system (12 chambers)
- Total α/β : 1 proportional counter
- In situ γ-spectroscopy: 2 HPGe (20% & 35% low energy)
- Mobile laboratory: HPGe 30%, proportional counter, etc.
- Radon measurements: track etch detectors, active system
- Fully equipped radiochemical laboratory
- Liquid scintillation counter (Quantulus)
- Whole body counter (thyroid uptake)

The isotopes of uranium, thorium, plutonium, americium, radium-226, and polonium-210 are determined by means of α-spectroscopy. Low background gamma spectroscopy is used to determine the concentration of radionuclides emitting gamma photons in the energy range of 25-2800 keV. This method is accredited by ESYD according to ISO 17025.

^{3}H and ^{14}C in water and urine samples and also ^{222}Rn, ^{226}Ra in water are determined by liquid scintillation counting (Quantulus).

Total alpha/beta counting is used for the determination of alpha/beta radiation in drinking water and filter samples as well as for smear tests.

The laboratory systematically participates in intercomparison exercises organized by organizations such as:

- WHO (World Health Organization)
- ALMERA (Analytical Laboratories for the Measurement of Environmental Radioactivity)
- IAEA (International Atomic Energy Agency)
- BfS (Bundesamt für Strahlenschutz)
- NPL (National Physical Laboratory)
- EU (European Commission)
- PROCORAD (Association for the Promotion of Quality Controls in Radiotoxicological bioassay)

One of the main responsibilities of the ERMD is to keep the national database of monitoring results and other relevant data and to perform measurements of radiation and radioactivity levels all over Greece. It is responsible of informing the national authorities of any increases in the radioactivity levels. ERMD also participates in the General Plan of Civil Protection, code name "Xenokratis".

5.4 THE GAEC TELEMETRIC RADIOACTIVITY MONITORING NETWORK (TRMN)

5.4.1 Current status

Another ERMD task is to assume responsibility for the Greek telemetric network for radioactivity monitoring (TRMN) by implementing a continuous and automatic on-line detection of ambient gamma dose rate within the whole Greek territory and by managing an automatic air monitoring network. The verification team was informed that the data management and presentation features of the latter will be integrated in the TRMN.

The Telemetric Radioactivity Monitoring Network (TRMN) consists of two sub-networks: a network of 24 wide range detectors for gamma dose rate measurements covering all Greece, and a network of three air radioactivity monitoring stations. Figure 2 shows the locations of the devices in the two networks.

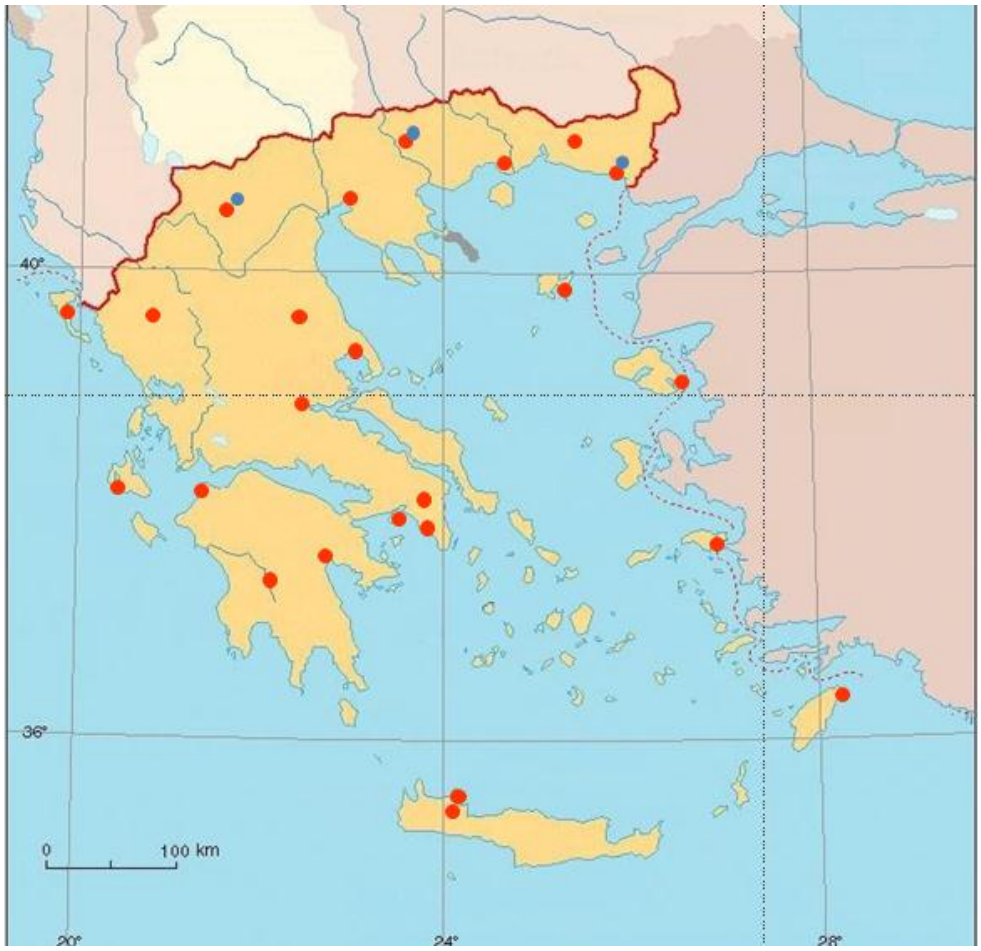

Figure 2: Locations of measuring stations: ambient gamma dose rate meters (dark/red spots); air monitors (blue spots).

Online computers placed at GAEC give the possibility to evaluate any signal from the systems before eventually alerting the emergency planning offices. Gamma dose rate is calculated on 10 minute intervals, and data are stored in one hour intervals during normal periods and 10 minute intervals during emergencies ('intensive mode'). The air monitoring system provides alpha/beta (aerosols) and gamma (aerosols, elemental and organic iodine) spectra in programmable intervals on-line, simultaneously with meteorological data.

Since most of the measuring stations are located at sites of the Greek Meteorological Services (GMS) GAEC also receives meteorological data, in a specific format to be used for meteorological models in case of an emergency (such models are available at GAEC).

The verification team notes that currently the automatic air monitoring stations are concentrated in the north of the country. The team suggests reflecting if a more even distribution of the devices over Greece could be an advantage.

5.4.2 Characteristics

Ambient gamma dose rate

All systems for ambient gamma dose rate in continuous mode have backup power supplies and are linked to a local *RSS-131* microprocessor. This microprocessor in turn is linked with data loggers and a modem. The data loggers ensure both data storage capacity and remote alarm, the latter function being controlled by pre-set alarm levels. The alarm levels can be remotely modified. The modem ensures communication with GAEC headquarters as well as interrogation capabilities from the headquarters control room.

The dose rate probes are *ReuterStokes* spherical high-pressure ionisation chambers using argon at approx. 25 MPa (25 atm) as counting gas. Each gamma dose rate detector has a sensitivity of < 10 nSv/h for a 10 minute measurement. The energy range is 50 keV to > 10 MeV, the measuring range is 10E-08 to 0.1 Gy/h with an accuracy of ± 5% for the range between 10E-08 to 0.01 Gy/h and ± 7% above 0.01 Gy/h. The directional response is ± 2% over an angle of 4π.

Each detector is coupled to a tipping bucket rainwater gauge model *Young*, Traverse City, MI, USA. The latter device is also connected to the local data logger and modem, allowing registration and on-line consultation of pluviometric data.

Each station has the ability to add other probes. An anemometer and a wind direction indicator can be connected to the *RSS-131* microprocessor via spare ports and thus be linked to the data recording and transmission system. The frame supporting the gamma probe is designed to allow quick mounting of a pole with these meteorological instruments, should conditions require.

All stations contain an electric power box with UPS, GSM module and interface as well as a data transmission box.

Compared to the last visit in Central Greece (2005), the system has not changed, but communication will be upgraded to ADSL lines.

Formerly, stations frequently needed a manual restart. Meanwhile (new since 2006) a system to check the power system of the station was developed: switching power on/off is now possible via GPRS and an appropriate web address, as well as a check of the status info etc. In addition, in case of failure the station can send a message. Since that time the new additional system has been deployed throughout the country. All 24 stations have been equipped with this system which constitutes an additional parallel network for the support of the telemetric network.

Generally, every two years checks of the equipment are performed using Cs-137 point sources. Due to the age of the *Reuter Stokes* ionisation chambers a systematic recalibration is planned.

Few changes have been made since 2006 to the network; one detector has been removed from its original position in New Philadelphia to a new position in Hellinicon (close to the old Athens International Airport). Also, data transmission to EURDEP is performed every 2 hours. For the near future, upgrading of the communication lines from PSTN to ADSL is planned, accompanied by the respective change of the controlling network software.

Air monitoring system

Each air monitoring station consists of a container with a *Bitt Technology AMS-02* device (NaI(Tl) version), a *Bitt technology RS03/X* ambient gamma dose rate probe (proportional counter, mounted on the roof of the container) and a meteorological mast with several meteorological probes. Greece does not operate *AMS-02* versions with high resolution gamma spectrometry using HPGe detectors.

For air monitoring, air is pumped through the system with a maintenance free pump at a flow rate of ca. 6 m^3/h. Aerosols are collected on glass fibre filters (60 mm diameter) and immediately analysed by alpha and beta spectrometry (PIPS detector with an area of 1700 mm^2, resolution of ~55 keV for α and ~30 keV for β particles) and by gamma measurement (2"x2" NaI(Tl) detector with a resolution of 8.5% for the 661 keV Cs-137peak). A subsequent special active carbon filter (60 mm diameter) allows analysis of elemental iodines with a 2"x2" NaI(Tl) detector. In case of elevated measuring results organic iodines are measured in a temperature controlled bypass system using a NaI (Tl) detector and activated carbon in a Marinelli geometry. The *AMS-02* device contains racks with 400 aerosol filters and 100 iodine filters. Before each measurement series, energy calibration is performed using Cs-137 in filter geometry (positions 498 and 500 in the filter trays). The filters (including check filters for calibration) are moved within the device using a robotic manipulator system.

The container housing the device has air conditioning but no intruder alarm (all stations are located in fenced areas). A UPS keeps power for ¼ hr. with the pump shut off; after that interval a controlled shutdown of the device is performed within a few minutes.

Data (including meteo data) are transmitted to Athens, but they are not yet included into the control data base and thus cannot yet be found in the EURDEP system.

Maintenance of the device is performed by GAEC (including remotely managed tasks; with support from the producer which has online access to the devices by using a Virtual Private Network – VPN). A database keeps track of the 'history' of used filters. It is routinely refreshed which allows re-use of filters if they are not contaminated.

GAEC can remotely restart the whole device by GSM (SMS or link).

The collection of meteorological data (temperature at two heights, wind velocity and direction, and the amount of rain) is done on a 5 m mast.

Currently, *Bitt technology SCADA (Supervisory Control and Data Acquisition)* software is used for data management and presentation at GAEC. Plans are to build a single data system for all automatic networks. Data transmission to EURDEP is being prepared.

Control Centre at GAEC in Athens

The TRMN control room at GAEC headquarters, as well as the national environmental radioactivity monitoring database were not part of the present verification. A description of its verification can be found in the technical reports of the 2000 and 2005 verifications to Greece.

The database contains relevant data from all fields of radiation protection in Greece since 1990. Amongst others it contains data on:

- All Greek institutions and laboratories using ionising radiation equipment or radioactive sources;
- The national dose registry information system for monitored workers;
- The national inventory of radioactive sources;
- Use and distribution (inventory) of radionuclides in nuclear medicine or research laboratories;
- Environmental monitoring data, including:

  - Gamma dose rate data (TRMN and data collected by the ERL network);
  - Gross beta results in air, deposition (wet/dry), surface and drinking water samples;
  - Cs-137 and Sr-90 results in mixed diet and milk samples;
  - Gaseous discharge monitoring data from the GRR-1 reactor (noble gas, iodine and particulates);
  - Data on fission products in sea water samples taken at mooring locations of nuclear ships.

6 VERIFICATION ACTIVITIES

6.1 ENVIRONMENTAL MONITORING AROUND THE PHOSPHOGYPSUM PILE OF THE HELLENIC FERTILIZERS PLANT AT KAVALA

The *Phosphoric Fertilizers Industry SA* (*PFI*) was founded in 1961 by the *Commercial Bank Group* and started operating in 1965 at NeaKarvali near Kavala.

In 2000 the two most important fertiliser manufacturers in Greece, *PFI* and *Chemical Industries of Northern Greece SA*, merged to form Greece's largest chemical company. The new business was owned by two major banks. In September 2009, *PFI SA* was acquired by *ELFE SA*, a company controlled by a private equity fund.

In 2008 the company was ISO 9001 certified for production. At present, there is a significant ongoing investment programme in the maintenance and improvement of production divisions, warehouses and packing facilities at the Kavala plant.

Ore (phosphate rock) is shipped to the company from different parts in the world (Africa, Middle East). The team was informed that the U-238 content of this raw material is about 500 – 1000 Bq/kg. According to literature the average U content in phosphate rock is 50 – 200 ppm, i.e. ca. 600 to 2400 Bq/kg. From this raw material, the company produces (among other products) phosphoric acid. A by-product of this synthesis is phosphogypsum (ca 300 000 t/year), which is moved to a nearby deposit (ca 600 000 m^2 area, ca 20 m high). This phosphogypsum pile is under supervision by GAEC, which performs measurements to check that there is no leakage. For this purpose 10 groundwater samples are taken from 25 drill holes around the deposit, each year at different locations. Sampling is subcontracted to a company which sends all samples for measurement to GAEC, where Ra-226 – as the most important radionuclide – and U content are determined. At least every two years, or when considered necessary, GAEC performs an onsite inspection, covering various measures performed by the company. In the synthetic process which is used by the company, about 10% of the uranium content of the raw material goes into the phosphogypsum. U can be found also in underground water of the site.

The team was informed that in Pentalofos (near Thessaloniki) there is also an old phosphogypsum pile, covered only with soil and without membrane protection. The site is also controlled by GAEC. No houses have been built there and any change of land use has to be accepted by GAEC.

Having received all relevant explanations, the team visited the phosphogypsum pile, beginning from the sea side. The whole industrial area is fenced and guarded, with the phosphogypsum pile having a separate fence with a locked gate. The phosphogypsum deposit is surrounded by a 'ring' channel except at the shoreline. This channel collects seepage water, which is returned to the plant (recycling system). The pumping station is situated at the SW corner of the phosphogypsum deposit, close to the seashore.

The phosphogypsum pile (deposit) is divided into six sectors, which are filled in turn. Sampling places are always selected close to the sector 'in operation'. The phosphogypsum pile is in use since 1965. The lower sides of the pile (sea side, ca. 5-10 m high) are already partly covered with natural vegetation.

The top area of the pile is flat, partly covered by a lake. At the time of the visit the deposit was not in filling operation (plant was stopped due to a 'problem'). A pipe was flushing only (recycled) liquid on the fresh deposit, and not sludge as usual. Water could be observed in (slightly lower) neighbouring levels of the pile due to seepage from higher levels.

Formerly sea water was also sampled and analysed, but not routinely.

The team saw ground water sampling stations 1 to 4, close to sea and noticed that only part of the shoreline is comprised of rock, part is sandy which increases the risk of erosion of that part by waves.

This was denied by company staff mentioning that an island situated several km from the coast would protect this shore from heavy seas. Staff is aware that the seashore samples contain a mixture of sea water and seepage water from the pile, thus the contamination is lower than in the landside samples. In addition, the sea facing side of the pile is not active (not used).

The verification team recommends carefully studying the erosion situation at the shore and if necessary reinforcement of sandy shoreline parts, with a view to protect from erosion which could negatively impact ground water sampling locations.

6.2 TRMN FOR ENVIRONMENTAL RADIOACTIVITY IN NORTHERN GREECE

6.2.1 Larissa

Gamma dose rate monitoring station

The station located at Larissa military airport belongs to and is operated by the Greek Meteorological Service (GMS). It has a slightly different status than other stations because it is situated within a military area, which is fenced and guarded (accessible only with control). The meteorological 'garden' is in close vicinity of the dose rate station.

Location of the station is excellent, in a wide airfield (several km^2 flat surface).

The placement of the device is on a dry meadow; the nearest buildings (one ground floor and a small 2-storey tower) are ca. 20 m distant; several medium height trees are ca. 15 m away.

The gamma dose rate measuring device follows the Greek 'standard' setup. The high pressure ionisation chamber (serial Nr. 98100161) is mounted at an effective height of ca. 1 m above ground on an individual pole. A separate mounting pole holds the precipitation gauge, the electric power box and the data transmission box. The cables for electric power and data transmission are ca. ½ m underground.

No data display for dose rate data or device status information was available on site.

At the time of the verification the precipitation (rain) gauge was not operational. The outlet of the inlet cylinder was clogged and the device was half filled with (reddish) liquid; evaporation marks showed that the device had not been cleaned for quite a while.

The verification team recommends routinely cleaning the rain gauge in order to keep it operational.

At the time of the verification the gamma dose rate monitoring station was not accessible (Saturday).

6.2.2 Serres

Gamma dose rate monitoring station

The station (SN 150 in the Greek network) is equipped with standard instrumentation and located in the fenced meteorological garden of the Greek Meteorological Service.

The location is good, in a very wide plain. The local placement is on a meadow with some bushes nearby (at and outside the fence). The nearest building is at about 30 m distant (1-storey building).

The ambient gamma dose rate chamber (serial Nr. 98100150) was mounted at an effective height ca. 1 m above ground. A wooden pole is set up to hold electric and data cables, ca 2 m above ground.

The inlet cylinder of the pluviometer (ca. 1 m above ground) was empty and clean.

Air monitoring station

The container housing the air monitor (*Bitt technology ASM-02*, NaI(Tl) version), the dose rate device and the meteo mast is situated at the Prefecture of Serres, Division of Agricultural Upgrade and Water Resources, in a yard (lawn, orchard, old machinery and trucks). At the time of the verification the station was fenced but not locked, however the container with the equipment was locked (no. 16 in the Greek network).

A 1-storey building is located some 20 metres from the container. The average height of the surrounding trees is ca. 20 m.

Elemental iodine filters are generally changed after 72 hours (the system performs an automatic filter change when the air throughput decreases to a certain extent), aerosol filters are changed more often because of quicker filter clogging. The proportional counter on the mast gives similar results as the device of the ionisation chamber based network, which is installed at some 50 metres distance. The technician who accompanied the verification team said the system is complex but reliable.

There are three types of maintenance work: at 3 months (filter replacement, mechanical parts check), at 6 months and at 12 months (including pump check, calibration).

The new control and restarting procedure is very reliable and also performs an electric power check.

At the beginning of the verification the monitor of the computer had a problem (no display). After a restart of the system (with mechanical checks etc.), the system worked again and showed a 15 minute background measurement with spectra display (NaI(Tl) and PiPS) and status display.

Verification does not give rise to specific remarks.

6.2.3 Kavala

Gamma dose rate monitoring station

The station is situated at the International Airport of Kavala. Public access is prohibited by a locked fence and access control.

The location is good, in a very wide plain. The local placement is on a concrete support surrounded by soil cover with low growing vegetation. Nearby scrap is stored and some bushes are growing. The nearest building (2-storey) is at ca 15 m; relatively high trees are growing at ca. 5 m.

The ambient gamma dose rate monitor chamber (serial number 98100060) was mounted at an effective height ca. 1 m above ground on a concrete foundation.

The electric power box with UPS, GSM module and interface as well as the data transmission box are standard. The cables for electric power and data transmission are supported by a pole ca 2 m above ground.

The inlet cylinder of the pluviometer (ca. 1 m above ground) was empty and clean.

Aerosol sampler

There was also an old aerosol sampler, belonging to Democritus University of Thrace, near the dose rate probe. It is a manual device and still operational. The filters (ca. 5 cm filter diameter) are changed by local staff and sent by post to the National and Kapodistrian University of Athens.

The verification team points to the necessity of cutting some of the trees in the medium term or alternatively moving the station to a new position close by.

6.2.4 Komotini

Gamma dose rate monitoring station

The station is situated at the water supply installation of Komotini. At the time of the verification the station was fenced but not locked.

The location is good, in a very wide plain. The local placement is in an orchard; fruit trees, some 4 m tall, were located at some 3-5 m distance. These trees seem to be regularly cut. The nearest building is a water tower at ca 15 m (ca 10 to 12 m high) that causes some shielding of the measuring device.

The ambient gamma dose rate monitor with serial number 98100067 was mounted at an effective height ca. 1 m above the ground.

All auxiliary devices (electric power box with UPS, GSM module and interface, data transmission box) are of Greek standard setup. The cables for electric power and data transmission are supported by a pole ca 2 m above the ground.

The verification team observed that the inlet cylinder of the pluviometer (ca. 1 m above ground) was empty and clean.

Verification does not give rise to specific remarks.

6.2.5 Alexandroupolis

The station is located at the Alexandroupolis airport (fenced and guarded) together with equipment of the Greek Meteorological Service. The location is good, in a very wide plain on the airfield near the sea. The local placement is on a meadow with some bushes. The nearest building (1-storey) is at about 10 m.

Gamma dose rate monitoring station

The ambient gamma dose rate monitor (station no. 17) with serial number 98100160 was mounted at an effective height ca. 1 m above ground, apparently not affected by the inundation.

All auxiliary devices (electric power box with UPS, GSM module and interface, data transmission box) are of Greek standard setup. The cables for electric power and data transmission are supported by a pole ca 2 m above ground.

The verification team observed that the inlet cylinder of the pluviometer (ca. 1 m above ground) was empty and clean.

Air monitoring station

The *Bitt AMS-02* air monitor (NaI(Tl) version) with auxiliary devices is located in a locked container ca 10 m from the dose rate probe of the national network, nearer to the air field, further away from trees and buildings. Several years ago there were problems with an inundation following very heavy rainfall. Thus, a 1 m high concrete foundation was constructed to place the container with all the measurement equipment.

At the time of the verification the PC monitor was operational and the PIPS spectrum could be seen on the computer screen, as well as the NaI(Tl) gamma spectra for the aerosol, the elemental iodine and the organic iodine measurement. The team verified the display of the *AMS-02* control programme, the status and hardware control and the server window.

An important feature is air conditioning which allows stable temperature (and thus stable operation) during winter and summer.

Verification does not give rise to specific remarks.

6.2.6 Aristotle University of Thessaloniki

Gamma dose rate monitoring station

Equipment was located in a fenced area and situated about 1 m above ground, however largely shadowed by a large pine tree in close proximity (this was a mere seedling when the station was put into operation). The site is the property of the University which precludes felling the offending tree.

The verification team suggests moving the station to another position within the fenced area where there are no overhanging trees.

6.2.7 Ptolemais

Gamma dose rate monitoring station

The verification team visited the gamma dose rate monitoring system situated at Ptolemais Power Station, a 550 MW lignite-fired power plant consisting of 4 units. The first unit was commissioned in 1959 and the last in 1973.

All equipment, situated about 1 m above ground was located some 2 m from a nearby single storey building in an unfenced area. Though there was a very large weeping willow tree nearby this did not interfere with the measurements.

Of greater concern was the fact that the rain gauge was almost permanently blocked by ash from the nearby power plant and at times also by fallen leaves from the adjoining tree. Power plant staff is not responsible in any way for the equipment's maintenance, which would necessitate a technician making the 380 km road journey from Athens.

The verification team suggests moving the station to another location devoid of trees and where the ash fallout would be minimised.

Air monitoring station

The verification team visited the air monitoring station, located in the grounds of the Prefectural air quality monitoring station, situated on the outskirts of the town of Ptolemais (population +/- 30 000).

The *AMS-02*, manufactured by *Bitt technology* is an automatic measuring system for counting radioactive aerosols through routinely measuring iodine, so that the non-natural radioactivity α, β and γ -radiation is counted. The filter equipment is served by a manipulator from a stock of 500 activated charcoal and glass fibre filters.

The unit is housed in a locked steel container; the air intake is located about 1.5 m above ground level. At the time of the visit the nominal flow rate was +/- 6 m^3/hour. The presence of a lignite fuelled power plant some distance from the station does not interfere with operation. Data are transmitted by ADSL line to Athens.

The verification does not give rise to any specific recommendations.

6.3 LABORATORIES INVOLVED IN EMERGENCY RADIOLOGICAL MONITORING AT ARISTOTLE UNIVERSITY OF THESSALONIKI

6.3.1 Introduction

The Aristotle University of Thessaloniki was named after the philosopher Aristotle, who was born in Stageira, Chalcidice, about 55 km east of Thessaloniki, in Central Macedonia. Its campus covers 230 000 square metres in the centre of the city of Thessaloniki.

More than 95 000 students study at the Aristotle University, 86 000 in undergraduate programmes and 9 000 in postgraduate programmes. Furthermore, the teaching and research staff number 2248 people (716 professors, 506 associate professors, 576 assistant professors, and 450 lecturers), the scientific teaching staff number 84 and the special laboratory teaching staff 275 people. This is further supported by the 309 members of the special technical laboratory staff for teaching services and the 1028 members of administrative staff.

6.3.2 Nuclear Technology Laboratory - Department of Electrical & Computer Engineering

Objectives and targets

The scientific staff of the Nuclear Technology Laboratory is active in the fields of environmental radioactivity (measurements-models), diagnostics of industrial systems, co-production of heat and electricity and the interaction of fast ions with matter.

The development of the Nuclear Technology Laboratory started in 1981 with the main research interest being on the subject of the diagnostics of nuclear reactors and environmental radioactivity. During the following years the laboratory broadened its activities. The laboratory gradually obtained equipment mainly with financial support from research contracts from the European Commission and the General Secretariat of Research and Technology of Greece.

The scientific staff of the laboratory teach the following courses at the Department of Electrical and Computer Engineering:

- introduction to nuclear technology;
- theory and technology of nuclear reactors;
- heat transfer;
- electrical power plants.

About 6 students per year work on their final project at the laboratory.

Equipment

The laboratory possesses a complete set of instruments for the implementation of special measurements on radiation detection, currently:

- 4 laboratory systems for gamma spectroscopy each consisting of a high purity germanium detector connected with a multi-channel analyser (MCA) and a PC;
- 2 portable systems for in-situ gamma spectroscopy consisting of a portable high purity germanium detector connected with a portable multi-channel analyser and a portable computer;
- 2 portable systems for radon-thoron progeny measurements.
- 2 portable systems for radon measurements in air, water and soil;
- about 500 passive radon detectors (electrets);
- 1 portable XRF system;
- 1 system for alpha spectroscopy;

- 2 hand held NaI(Tl) gamma spectrometers (*Canberra Inspector 1000* and *Identifier*) ,1 ionisation chamber, several GMdetectors;
- portable air sampling system;
- a network of computers with several PCs (Quad core).

This equipment offers the ability for the qualitative and quantitative detection of radionuclides (e.g. Cs-137 from the Chernobyl accident, NORM etc.) within the laboratory as well as with in-situ measurements. The laboratory is a member of the national network for measuring the environmental radioactivity and in this framework environmental radioactivity is measured on a daily basis. The laboratory is also a member of the IAEA ALMERA network and participates regularly in the proficiency tests organized by IAEA on the detection of radionuclides in environmental samples.

The laboratory's staff worked on the consequences of the Chernobyl accident for agricultural production and natural ecosystems in Northern Greece, on indoor radon, on the development of new techniques (e.g. in situ gamma spectrometry for indoor measurements), on the simulation of Germanium and plastic detectors, on industrial systems diagnostics, as well as on fast ion interaction with matter with emphasis on the ion induced electron emission from solids.

Presently there is one permanent staff member and one external collaborator.

The verification team were given detailed explanations concerning the installed equipment and the laboratory’s operation. Though there was no UPS system in place this is not a problem due to the limited number of analyses carried out.

> *Current staffing is considered the minimum to keep the lab running. In case of employing students for analysis tasks in an emergency, the verification team strongly recommends having very well laid out written procedures in place, both for sample preparation methods and for measurement tasks but also for work regarding data management. Routine exercises should be performed in order to reveal any shortcomings of the procedures.*

6.3.3 Department of Nuclear and Elementary Particle Physics

The laboratory of Atomic and Nuclear Physics is accommodated on the 1st floor (East side) and in the basement (west side) of the Faculty of Positive Sciences building. The Theoretical Physics Section is accommodated on the 4th floor.

This laboratory was founded in 1974 and currently employs 3 persons, all professors.

Equipment consists of:

- 2 gamma detectors from *Canberra* (25 and 42% efficiency) and a planar detector for low energy gamma (*Tennelec*), a further 2 are in need of repair;
- a high volume air sampler with glass fibre filters.

Calibration samples are from the UK National Physics Laboratory and the IAEA (ore samples for U, Th, K). Density corrections are made using Monte Carlo simulation, whilst evaluation is performed using *GammaTrac* (*Oxford Instruments*).

The laboratory regularly takes part in proficiency tests with Greek Atomic Energy Commission and in annual IAEA intercomparisons.

For backup of results a portable external hard disk is used. A UPS is not available.

> *The verification team suggests using the university's IT infrastructure (server) for backup. Furthermore the possibility to integrate the existing UPS (School of Sciences) should be investigated.*

Current staffing is considered the minimum to keep the lab running. As for the Nuclear Technology Laboratory (chapter above), in case of employing students for analysis tasks in an emergency, the verification team strongly recommends having very well laid out written procedures in place, both for sample preparation methods and for measurement tasks but also for work regarding data management. Routine exercises should be performed in order to reveal any shortcomings of the procedures.

6.4 DISCHARGE MONITORING AT THE INTERBALKAN MEDICAL CENTRE, THESSALONIKI

6.4.1 Introduction

The Interbalkan Medical Centre (ΙατρικόΔιαβαλκανικό Κέντρο, Iatriko Diavalkaniko Kentro), is a private general hospital founded in 2000 by businessman Giorgos Apostolopoulos, located about 12 km southeast of Thessaloniki, close to Macedonia International Airport. It is a modern and comprehensive medical centre. It now belongs to the Medical Group of Athens.

The building complex covers an area of 50 000 square metres and offers 380 beds.

6.4.2 Nuclear medicine department

The verification team visited the nuclear medicine department which houses two laboratories. The in vitro laboratory uses I-125 for radioimmunoassays; iodine is collected and released to an exclusive use (i.e. dedicated) sink, whilst solid waste from tubes is collected in an exclusive use (i.e. dedicated) waste bin with a yellow bag for appropriate disposal. The hot laboratory uses Tc-99m generators, I-131, Tl-201, Ga-67 and on rare occasions Re-186, In-111, and Sr-89. This laboratory only generates solid waste which is stored in a locked room to allow for radioactivity decay.

A therapy unit with 3 treatment suites is used for radio iodine treatment. In 2011 Greece counted a total of 37 such units, compared to 13 in 2003.

For liquid waste there are 3 retention tanks with 11 m^3 each and a small pre-tank in a separate room. Release limits are 1 MBq/day and 1 GBq/m^3 for I-131. A computerised system monitors the filled volume in each tank. Prior to release an evaluation is carried out based on calculation (using the number of patients treated and the activity administered). No sample is taken before release; the only possibility would be from the side of the tank, however the pipe is very narrow and there would be a risk of it becoming clogged. Additionally the staff expressed uncertainty concerning the total volume which, though levels are monitored they have been found to be untrustworthy in the past.

There is a raised metal grill walkway around the tanks. Should a leak occur in any of the tanks there is no possibility for waste to reach an outside drain. In such an event there is a drain in the floor to return the waste to the smaller of the tanks; when full the liquid would be sent to an undamaged tank having sufficient capacity.

An IRSS (IAEA) mission in May 2012 concluded that the existing release limits were too low/strict and recommended amending them in line with the new Euratom BSS.

Reports on the number of therapies performed are sent to both the GAEC and the local health authority.

Solid waste (I-131) is left in separate room for decay, after decay it is disposed of with infectious waste.

The verification does not give rise to any specific recommendations.

6.5 RADIOLOGICAL CONTROL OF FOOD IMPORTS AT THE BORDER TO FYROM

The main border crossing between Greece and FYROM (Former Yugoslav Republic of Macedonia) is located at the end of the Greek Motorway 1 from Athens, part of the European route E75. The nearest towns are Evzoni on the Greek side and Bogorodica on the Macedonian side.

In total 12 vehicle portal monitors are installed at the border station; 4 on exit lanes and 8 on entry lanes. The portal monitors, donated by the US DOE in collaboration with the IAEA were installed at the end of 2003 in advance of the Olympic Games.

The portal monitors can detect gamma radiation and neutrons and are equipped with cameras.

Data is transferred to a server by TCP/IP protocol and alarms can also be seen on a monitor in the guard house. The system incorporates software which enables the production of quick statistics using the day files. In common with all local systems the database of measurements is backed up and there is a mirror database available. 'State of health' is monitored remotely. Data from the local system is transferred to the national centre using ADSL, which also includes the capacity to send pictures.

Typically 10-20 alarms per day are recorded with each event being assigned a sequential ID. A procedure to handle alarms is available in the guardhouse. Customs officers have hand held detectors for further investigation. If radioactive sources are found in a consignment the goods are impounded and the Greek authorities assume the costs of remediation.

The portal monitors were found in operation, procedures were in place. There are 5 staff members at the moment per shift (1 supervisor and 4 operatives) to operate the equipment. Daily some 80 buses per shift, 150 in the tourist season, 400 trucks and several thousand cars use the border crossing.

The customs stations to FYROM are not contained in the list of customs offices for control of imports according to Commission Regulation (EC) No 1635/2006 of 6 November 2006 laying down detailed rules for the application of Council Regulation (EC) No 737/90 on the conditions governing imports of agricultural products originating in third countries following the accident at the Chernobyl nuclear power station. Physical sampling is not performed by the custom officers, but by employees from the Ministry of Rural Development and Food. According to scheduled arrivals of goods, sampling is performed by the Frontier Health Center check point, close by the Customs. However, the team was told that in accordance with Commission Regulation (EC) No 1635/2006 adequate checks are carried out at other (designated) customs offices before product can be marketed.

> *In order to enable e.g. import of mushrooms from FYROM the verification team would encourage naming a customs office to FYROM with regard to Commission Regulation 1635/2006 controls.*

7 CONCLUSIONS

All verifications that had been planned by the verification team were completed successfully. The information supplied in advance of the visit, as well as the additional documentation received before the start and during the verification, was useful. The information provided and the outcome of the verification activities led to the following observations:

(1) The verification activities that were performed demonstrated that the facilities necessary to carry out continuous monitoring of levels of radioactivity in Northern Greece as far as included in the verification are adequate. The Commission could verify the operation and efficiency of these facilities.

(2) A few topical recommendations are formulated. These recommendations aim at improving some aspects of environmental monitoring in Northern Greece. The recommendations do not discredit the fact that environmental monitoring as far as included in the verification is in conformity with the provisions laid down under Article 35 of the Euratom Treaty.

(3) With regard to using university laboratories for analysis tasks in an emergency, in case of employing students for such work, the verification team strongly recommends having very well laid out written procedures in place for all steps, such as sample preparation, measurement and data handling. Exercises should be performed in order to reveal any shortcomings of the procedures.

(4) In order to enable e.g. import of mushrooms from FYROM the verification team would encourage naming a customs office to FYROM with regard to Commission Regulation 1635/2006 controls.

(5) The verification findings and ensuing recommendations are compiled in the 'Main Conclusions' document that is addressed to the Greek competent authority through the Greek Permanent Representative to the European Union.

(6) The present Technical Report is to be enclosed with the Main Conclusions document.

(7) The Commission Services ask the Greek competent authority to inform them of any implementation achievements with regard to the situation at the time of the verification.

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

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APPENDIX 1

DOCUMENTATION

GAEC:

- Greek Atomic Energy Commission
  http://www.gaec.gr/en/
- Environmental Radioactivity Monitoring Department
  http://www.eeae.gr/en/index.php?fvar=html/enviro/_enviro
- Total gamma dose rate detectors in air
  http://www.eeae.gr/en/index.php?fvar=html/enviro/_telemetry_types
- 'Environmental Radioactivity Monitoring' (brochure, version 2011)

APPENDIX 2

VERIFICATION PROGRAMME

	Team 1	Team 2
Sat, 20 Oct	Travel to Thessaloniki	
	Transfer to Larissa Verification of Larissa monitoring station	
Sun, 21 Oct	Transfer to Thessaloniki	Travel to Thessaloniki
Mon, 22 Oct	Opening Meeting in Thessaloniki	
	Transfer to Serrai Verification of Serrai gamma dose rate and air monitoring station Transfer to Kavala	Verification at Nuclear Technology Dept., Thessaloniki Verification at Nuclear Physics Dept., Thessaloniki Verification of Thessaloniki gamma dose rate monitoring station
Tue, 23 Oct	Verification of phosphogypsum plant New Karvali Verification of Kavala gamma dose rate monitoring station Transfer to Komotini Verification of Komotini gamma dose rate monitoring station Transfer to Alexandroupolis	Verification at Nuclear medical facilities, Diavalcanicon hospital, Thessaloniki Verification of FYROM border import control
Wed, 24 Oct	Verification of Alexandroupolis gamma dose rate monitoring station Transfer to Thessaloniki	Transfer to Ptolemais Verification of Ptolemais gamma dose rate and air monitoring station Transfer to Thessaloniki
	Closing meeting	
Thu, 25 Oct	Return travel	

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