



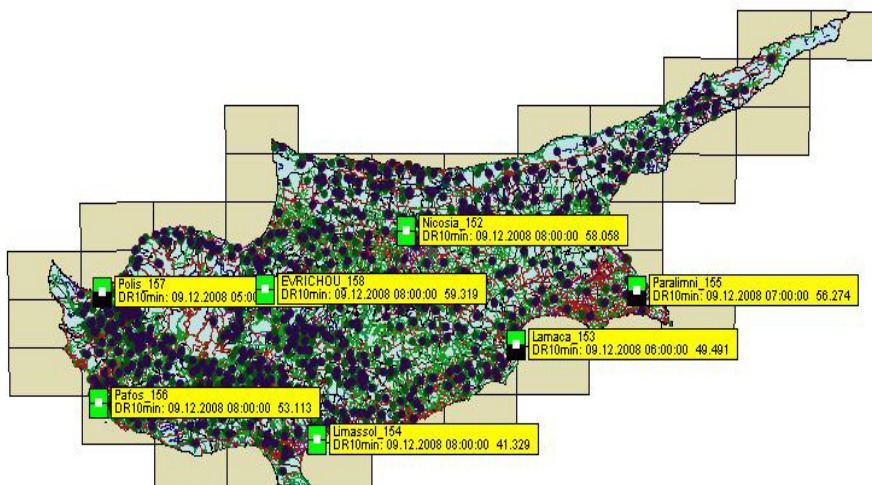
EUROPEAN COMMISSION
DIRECTORATE-GENERAL FOR ENERGY AND TRANSPORT
DIRECTORATE H - Nuclear Energy
Radiation Protection

TECHNICAL REPORT

VERIFICATIONS UNDER THE TERMS OF ARTICLE 35 OF THE EURATOM TREATY

CYPRUS

23 to 27 June 2008



Reference: CY-08/05

**VERIFICATIONS UNDER THE TERMS OF ARTICLE 35
OF THE EURATOM TREATY**

FACILITIES: Installations for surveillance of the environmental radioactivity on the territory of Cyprus.

SITE: Radiation Inspection and Control Service (RICS), Department of Labour Inspection (DLI) in Lefkosia; and the Cypriot nation-wide radiological environmental monitoring network.

DATE: 23 to 27 June 2008

REFERENCE: CY-08/05

INSPECTORS: Mr C. Gitzinger (Head of team)
Mr E. Henrich
Ms A. Godeanu-Metz

DATE OF REPORT: 16 December 2008

SIGNATURES:

[signed]
C. Gitzinger

[signed]
A. Godeanu-Metz

[signed]
E. Henrich

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TECHNICAL REPORT

1. ACRONYMS AND ABBREVIATIONS

ALMERA	Analytical Laboratories Monitoring Environmental RAdioactivity (IAEA project)
CT	Computerized Tomography
DG TREN	Directorate General Energy and Transport
DLI	Department of Labour Inspection
EAC	Electricity Authority of Cyprus
EC	European Commission
ERL	Environmental Radioactivity Laboratory (University of Athens, Demokritos Institute)
ERMP	Environmental Radioactivity Monitoring Programme
ESYD	Hellenic Accreditation Council
EU-FP7	European Union – 7 th Framework Programme (Research)
EURDEP	European Radiological Data Exchange Platform
EWS	Early Warning System
FAO	Food and Agriculture Organization
GAEC	Greek Atomic Energy Commission
GEMS	Global Environment Monitoring System (United Nations)
GIS	Geographical Information System
GM	Geiger Müller (radiation detector)
GSM	Global System for Mobile communications (cell phone technology)
HPGe	High Purity Germanium (radiation detector)
IAEA	International Atomic Energy Agency
ISDN	Integrated Services Digital Network (telephony)
ISO	International Organization for Standardization
JRC	Joint Research Centre
LIMS	Laboratory Information Management System
LLD	Lower Limit of Detection
MH	Ministry of Health
MLSI	Ministry of Labour and Social Insurance
NIM	Nuclear Instrumentation Module
NIST	National Institute of Standards and Technology (USA)
NORM	Naturally Occurring Radioactive Material
NRPR	National Radiation Protection Regulations
QA / QC / QM	Quality Assurance / Quality Control / Quality Management
REM	Radioactivity Environmental Monitoring (European database at JRC)

	Ispra)
RICS	Radiation Inspections and Control Service
RS-232	Recommended Standard 232: for computer serial-port transfers
SGL	State General Laboratory
Si(Li)	Silicon-Lithium drifted (radiation detector)
TRMN	Telemetric Radioactivity Monitoring Network of Cyprus
UPS	Uninterruptible Power Supply
WHO	World Health Organisation

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 the right of access to such facilities in order that it may review and verify their operation and efficiency.

Within the Commission, the Directorate-General Energy & Transport (DG TREN) and more particularly its Radiation Protection Unit (TREN.H4) is responsible for conducting 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 (as far as applicable in the Member State):

- 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 carried out a re-verification of the implementation of Article 35 according to the recommendations laid down in the technical report of the verification conducted from 08 to 12 May 2006 in Cyprus (verification reference CY-06/3).

In addition to this, a verification of the monitoring of radioactivity releases from the nuclear department of a Cypriot hospital and the monitoring of radioactivity in imported food from non-Member States, was performed.

The present report contains the results of the verification team's review of all these relevant aspects of the environmental surveillance of radioactivity on the territory of Cyprus.

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

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).

3. PREPARATION AND CONDUCT OF THE VERIFICATION

3.1 PREAMBLE

The Commission's decision to conduct a re-verifications under the terms of Article 35 of the Euratom Treaty was notified to the Cypriot government on 20 November 2007 (letter referenced TREN/H4/CG/cd(2007)326111, addressed to the Permanent Representative of Cyprus to the European Union). The Cypriot Government designated the Radiation Inspection and Control Service (RICS) of the Department of Labour Inspection (DLI) of the Ministry of Labour and Social Insurance (MLSI) to lead the technical preparations for this visit. Practical arrangements for the implementation of the verification were made with RICS, the Cypriot competent authority.

3.2 PROGRAMME OF THE VISIT

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

It comprised the re-verification of the implementation of the environmental radiation monitoring programme according to the recommendations and suggestions issued in the technical report of the Art. 35 verification conducted in 2006 and implemented by the Radiation Inspection and Control Service (RICS) on the Cypriot territory. In addition to this, a verification of the monitoring of radioactivity releases from the nuclear department of a hospital in Lefkosia and the monitoring of radioactivity in imported food from non-Member States, was performed.

A summary overview of this programme of verification activities is provided in Appendix 1. The verification activities were carried out in accordance with this proposed programme. At the locations listed in the programme, verification activities addressed technical aspects of monitoring and sampling, analytical methods used, quality assurance and control, archiving and reporting of data.

On 23 June 2008, an opening meeting was held at the RICS premises located at the Department of Labour Inspection of the Ministry of Labour and Social Insurance.

During the visit the verification team attended presentations on the following topics:

- The Cypriot Environmental Radioactivity Telemetric Network (automatic gamma dose rate monitoring and data management system),
- The National Environmental Radioactivity Monitoring Programme,
- The National Environmental Radioactivity Monitoring Database,
- The Radiation Inspection and Control Service,
- The State General Laboratory (SGL),
- Monitoring of environmental marine radioactivity in the Eastern Mediterranean: current and planned activities in Cyprus,
- The decommissioning of a fertiliser production plant at Vassiliko,
- The radioactivity discharge monitoring from nuclear departments of hospitals in Cyprus,
- The monitoring of radioactivity in food imported from non-Member States.

In order to facilitate the work of the verification team, a package of information was supplied in advance by the Cypriot authorities, in the form of detailed answers to a questionnaire prepared by the Commission Services and concerning the implementation of the recommendations of the previous verification and the monitoring of discharges from hospitals and of imported food from non-Member States. Additional documentation was provided during and after the verification visit. A list of this documentation is in Appendix 2. The verification team noted the quality and comprehensiveness of all presentations made and documentation provided. The information provided has been extensively used for drawing up the descriptive sections of this report.

3.3 REPRESENTATIVES OF CYPRIOT AUTHORITIES

1) **RADIATION INSPECTION AND CONTROL SERVICE (RICS), DEPARTMENT OF LABOUR INSPECTION (DLI), MINISTRY OF LABOUR AND SOCIAL INSURANCE (MLSI), Lefkosia**

Leandros Nicolaides	Director DLI
Panicos Demetriades	Head RICS (DLI), Senior Labour Inspection Officer
Michalis Tzortzis	Labour Inspection Officer, Specialist Inspector
Demetris Sakkas	Labour Inspection Officer, Specialist Inspector
Anastasia Sisou	Labour Inspection Officer, Specialist Inspector

(Short Term Contract)

2) **STATE GENERAL LABORATORY (SGL), COMMISSION OF PUBLIC SERVICES, MINISTRY OF HEALTH (MH), Lefkosia**

Stella Canna-Michaelidou	Director
Popi Zigler	Senior Analyst
Anastasia Caballero	Radio Analyst
Maria Klavarioti	Radio Analyst Assistant

5) **FERTILISER FACTORY (closed), Vassiliko**

Efthymoulos Economou	Electricity Authority of Cyprus (EAC)
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6) **BANK OF CYPRUS AND THE MINISTRY OF HEALTH RADIOLOGY CENTRE, Lefkosia**

Alecos Stamatis	Director
Christodoulos Constantinou	Head, Senior Medical Physicist
Doris Demetriadou	Senior Medical Physicist
Erato Stylianou Markidou	Medical Physicist
Themis Efthymiou	Medical Physicist
Ali Aritkan	Senior Medical Physicist
Aristotelis Giannos	Medical Physicist

7) **CYPRUS UNIVERSITY, CHEMISTRY DEPARTMENT, RADIOANALYTICAL CHEMISTRY RESEARCH LABORATORY, Lefkosia**

Assoc. Prof. Ioannis Paschalidis Associate Professor (Radiochemistry)

8) **CYPRUS UNIVERSITY, NUCLEAR PHYSICS RESEARCH LABORATORY, Lefkosia**

Professor Charalambos Tsertos	Professor (Nuclear Physics)
Dr Ioannis Parpottas	Lecturer-Collaborating Researcher (Nuclear Experimental Physics)

4. COMPETENT AUTHORITIES AND LEGISLATION IN THE NUCLEAR / RADIOLOGICAL DOMAIN

4.1 INTRODUCTION

Cyprus does not operate nuclear reactors or uranium or thorium mines. The main use of ionizing radiation in the country is for medical purposes with some applications in industry, construction and research.

Cyprus has introduced a legal framework, in line with the "EURATOM acquis" and the IAEA standards for ionizing radiation control, since 2002. Cyprus has created the necessary basic administrative structure for efficient monitoring of environmental radioactivity throughout the country.

4.2 AUTHORITIES INVOLVED IN RADIOACTIVITY MONITORING

4.2.1 Scope, history and current situation

Under the framework law for the protection against ionizing radiation of 2002, the Radiation Inspection and Control Service (RICS), within the Department of Labour Inspection (DLI), was established as the Regulatory Authority for Radiation Protection, Nuclear Safety and Radioactive Waste Management in Cyprus. Appendix 3 shows the structure of DLI. RICS reports to the Department of Labour Inspection (DLI) of the Ministry of Labour and Social Insurance (MLSI). The Regulatory Authority has the responsibility to enforce the above mentioned legislation, to ensure environmental radioactivity monitoring and for regular reporting to the European Commission (EC) on the basis of Article 36 Euratom Treaty, to ensure for emergency preparedness and response in case of radiological accidents and to deal with all matters concerning the relations of Cyprus with the EU, the IAEA and other international organisations in this field. In particular, Cyprus as member of the EU has made efforts to establish and operate the necessary system for environmental radioactivity monitoring and to apply in an effective and efficient way the "EURATOM acquis".

In the past, environmental monitoring of radioactivity was occasionally conducted in Cyprus by various institutions, although no specific legal framework existed in the country. The State General Laboratory (SGL) was conducting radioactivity measurements in samples of milk, infant food and drinking water. Other institutions such as the University of Cyprus and the Geological Survey Department have also conducted radionuclide investigations and measurements in ground water, sea, soil, consumer goods, building materials etc.. A study conducted recently by the Nuclear Physics Laboratory of the Physics Department of the University of Cyprus is available on the website of the Nuclear Physics Laboratory (http://www-np.ucy.ac.cy/radio_isotopes/wwwen/radio_start.html).

RICS, within its regular radioactivity monitoring programme, has recently also conducted a number of investigations and measurements concerning foodstuffs, animal feeding stuffs, building materials, drinking water, sea water and milk. RICS is presently running three projects, in collaboration with the Nuclear Physics Laboratory of the University of Cyprus, concerning the preparation of the radon map of Cyprus, the radioactivity levels in building materials and the radioactivity levels in local foodstuffs.

RICS is presently staffed with one Senior Labour Inspection Officer as head and three Labour Inspection Officers with engineering and science background and trained in radiation protection and medical physics. RICS has established a network for continuous monitoring of ambient gamma radiation and sampling of particles in the atmosphere for total beta radioactivity monitoring. RICS has also procured various portable radiation monitoring instruments (alpha, beta, gamma and neutron survey and contamination meters, portable spectrometers) for inspection and monitoring purposes.

RICS does not have its own analytical radiation laboratory; it is supported by the State General Laboratory (SGL; under the responsibility of the Ministry of Health in Lefkosia) for laboratory radionuclide analysis.

In order to strengthen the monitoring capabilities of RICS and SGL a number of initiatives have been taken including the implementation of relevant projects in collaboration with IAEA which aim at the improvement of the above mentioned environmental monitoring system. RICS is also implementing an EU Transition Facility Project with the same objectives (the service contract with the Greek Atomic Energy Commission has been completed; the tender for additional equipment procurement has been announced, it closed on 21.10.2008 and the contracts will be signed until 15.12.2008). New laboratory equipment (a new gamma spectrometer and an alpha/beta-counter) has been bought by SGL. Relevant training has been provided both locally and abroad. An additional portable gamma spectrometer for RICS and an alpha spectrometer for SGL will soon be bought. RICS and SGL, together with the Department of Fisheries and Marine Research of the Ministry of Agriculture, Natural Resources and Environment, are implementing a project for marine radioactivity assessment. Under this project a network of six stations for monitoring the sea around Cyprus has been established.

4.2.2 Statutory responsibilities

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

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

The State General Laboratory (SGL) of the Ministry of Health supports the competent authority (RICS) in laboratory radioactivity measurement tasks by supplying analytical services.

4.3 LEGAL FRAMEWORK

The legal basis for radiation protection in Cyprus consists of:

- The Protection from Ionizing Radiation Law of 2002 and the relevant Regulations issued under the above framework law,
- The EURATOM Treaty,
- European Union legislative acts, and
- A number of ratified or signed conventions, agreements and other legal instruments.

A detailed list of legal instruments regulating environmental radioactivity including foodstuffs and feeding stuffs as well as of relevant guidance documents is given in Appendix 4.

5. NATIONAL MONITORING OF ENVIRONMENTAL RADIOACTIVITY – DESCRIPTION AND VERIFICATION

5.1 INTRODUCTION AND PROGRAMME

Environmental radioactivity monitoring has been developed and is under advanced implementation in Cyprus. Some recent studies carried out in the country for the assessment of the situation concerning radioactivity showed very low natural background radioactivity and insignificant radon levels. RICS as the Regulatory Authority is responsible for operating the radiation monitoring network, including sampling, data management and reporting. The SGL radionuclide laboratory provides laboratory radioactivity analysis and measurement services for all samples collected and sent by RICS. Based on past sampling and measurement programmes and considering knowledge stemming from previous studies, SGL is currently conducting routine laboratory radionuclide analysis, taking into account the available equipment and personnel resources.

The verification team notes that within RICS (and also SGL, see 5.3.3.1.1) staffing issues exist, some personnel being employed on relatively short term contracts. This might negatively affect running the sampling and analysis programmes.

For specific measurements and for any situation with extensive contamination, RICS has established co-operation with the University of Cyprus and the laboratory of the Geological Survey Department. RICS co-operates also with the Regulatory Authority in Greece (GAEC), the Greek Research Institute “Demokritos” and the Greek Oceanographic Research Institute.

Radioactivity data from laboratory measurements in Cyprus are sent to the REM data base at JRC Ispra via a specific data communication program.

Furthermore, RICS is participating in the European data platform EURDEP: every hour the Telemetric Radiation Monitoring Network automatically sends the one hour average gamma dose rate measurement values from all local stations in Cyprus to the data server at JRC Ispra. The data are transferred to the control centres manually or automatically at a user specified time period. With the present setting the system is transmitting average data of gamma dose rate to the control centres and to the JRC ISPRA EURDEP server. RICS is working towards the establishment of a web based operating software with a view to improve operability and transparency and to facilitate access of the public to online measurements.

The verification team strongly supports all efforts overcoming the existing staffing issue.

5.2 THE TELEMETRIC RADIOACTIVITY MONITORING NETWORK (TRMN) – AMBIENT GAMMA DOSE RATE AND PRECIPITATION GAUGE

RICS has established an ambient gamma radiation monitoring network, with seven local monitoring stations (Lefkosia, Larnaca, Limassol, Pafos, Paralimni, Polis and Evrychou) and three control centres to continuously monitor gamma radiation in the air (for geographical distribution see Appendix 5). This network, will also serve as the Early Warning System (EWS) of the country by sending alarms in case of a radiological emergency, if preset dose rate threshold levels would be exceeded.

This network was set up by *TechniData AG*, Markdorf, Germany, in cooperation with the local company *Medisell Co. Ltd.* It is fully automatic with data communication through ISDN lines and GSM. It covers the main urban areas of Cyprus.

Each local measuring station consists of:

- A gamma dose rate detector (*TechniData IGS-421 A-H*) with 2 GM tubes (one for low and one for high dose rate) with a measuring range from 10 nSv/h to 10 Sv/h. The probe has a polyvinyl chloride ring to prevent excessive heating-up by the sun, manufactured by *TechniData*.
- A precipitation gauge (*Theodor Friederichs & Co. Meteorologische Geräte und Systeme GmbH*, Hamburg-Schenefeld, Germany; tipping bucket system) with a possibility of rain collection. A

small protective grid prevents leaves or larger particles from blocking the outlet tube. The samples may be collected for analysis in the SGL radionuclide laboratory.

- A data logger (*TechniData DLM 1450*) with data storage capacity of 72 hours. Local data download to a computer is possible via an RS-232 interface.
- The stations are generally connected by ISDN and/or GSM to the main data centre at RICS. Averages of measurements are stored every 10 minutes in a local database. During normal operation, due to participation in EURDEP, averaged measurement values are transferred every hour to the main data centre and the JRC ISPRA. In case of an alarm the system turns automatically to intensive mode and the signal is transferred immediately. Measurement values can also be retrieved manually.

The verification team was informed that at the Paralimni station a storey was added to the building since the last Article 35 visit. The dose rate probe and the precipitation gauge were moved to the new roof accordingly.

The team was informed that RICS is currently working on an update of the emergency response plan (drafted by Greece), which includes several Cypriot authorities. TRMN will play an essential role in this plan.

The team was also informed that it is planned to extend the network soon with an automatic online aerosol monitor. RICS expects to receive one or two automatic stations with NaI(Tl) detectors (probably from *TechniData*), one of which is foreseen to be installed in Lefkosia. It is under discussion to use some automatic stations powered by solar energy. In addition, the operating software shall be upgraded soon to the latest web-based version announced by *TechniData*.

The team was told that with regard to the telemetric system RICS has a five years service contract with *Medicell* (12 hours reaction time). This contract includes a routine maintenance by the company every three months. It is possible to operate and maintain the system remotely by *TechniData* in Germany. Till now, no problems arose.

The verification team supports all plans to strengthen the automatic network, in particular with regard to any geographical extension of the system.

5.2.1 Department of Labour Inspection - Data Centre (re-verification)

At the time of the last verification visit (in 2006) the telemetric system had been set-up to a high degree at the data centre at the Department of Labour Inspection; however it had not yet been commissioned. In the meantime commissioning was done and the system has reached routine operational status.

Three data centres are available, one at RICS, one at the Civil Defence Operations Centre and a mobile one (notebook computer with GSM communication). Communication with the Civil Defence centre is wireless, independent of the general telephone system, and test messages are exchanged every first Wednesday of the month.

The centre at RICS is equipped with a UPS system providing two hours autonomy. Two computers serve as back-up.

The system can be fully configured and administered from the stationary control centres and every local station has battery backup. Data can be retrieved automatically or manually from each station and are stored in the servers of the stationary control centres in Lefkosia.

The verification team visited the RICS Data Centre and inspected the control functions. It noted that the software used is *TechniData NMC-RAD 1.4.6*, Java Version. The verification team was informed that the system is planned to be moved to a web based version in order to allow public on-line access to data. A contract was signed at the end of June 2006.

The present averaging measuring time at station is done every 10 min and the data is collected automatically every hour. The communication to JRC Ispra (EURDEP) is also made every hour. The communication to the stations is via ISDN and GSM.

The verification team was given an in-depth presentation of the system:

For ambient gamma dose rate data the system provides a station overview by showing the map of Cyprus with measuring results, with a possibility of zoom. The system contains a real GIS with vector maps supplied by the Cypriot Land Survey Department. RICS informed the verification team that the use of better maps is in preparation.

According to the parameters and the thresholds set up there is an automatic change into a technical warning and an alarm mode (currently set at 250 respectively 500 nSv/h). The status of messages (e.g. exceeding a threshold) is colour coded (e.g. turning from green to red). Text messages such as in case of alarms are sent to the mobile phone of the staff member on duty. The system also shows the status of the 72 hr battery backup of the monitors. Station status information is also presented in a colour code. For test purposes an alarm (indicator light and acoustic) was generated by 'virtually removing' electric power. Calculations of averages are done in tables.

The team received a presentation of the EURDEP data export facility and was shown a EURDEP file thus generated. An export to *EXCEL csv* files (for average calculations etc.) is possible as well.

The verification team was shown the data of the rain gauge device at Evrychou, the other stations having had no rainfall at all for a long time period. Rain activity values were not yet available.

The team was told that the backup-PC is also used for storing data measured in laboratories for transfer to the European REM system at JRC Ispra. At RICS the data from the telemetric system are not mirrored (however, at the Civil Defence centre they are). Changing operation to the backup system requires manually switching the wiring to connect to the monitoring stations. The team was given a presentation of the REM data submission tool; results from SGL (received as printout) are manually typed in at RICS although electronic data transfer would be possible.

Verification activities do not give rise to recommendations. However, the team would support increasing the availability and reliability of the system by having the data mirrored on hard disks in the servers and by installing an automatic switching possibility for connecting the monitoring stations to the backup system. The team supports installing a web based version of the operating software and to allow online public access to the data.

5.2.2 Monitoring station at Evrychou – Village Municipality

The verification team visited the monitoring station at Evrychou, which had not been part of the visit in 2006. Generally, the location lying in a wide valley is well suited. However, the dose rate detector was mounted on a small roof protecting the entrance of the building, between the ground floor and the 1st floor of a 1 storey building. Being somehow "shielded" by the building, this probe is not ideally placed.

The precipitation gauge / sampler was placed on the flat roof of a small building some 10 metres away from the main building. To collect a rain water sample a person has to climb with a ladder onto the roof of the "kitchen" building.

The verification team noted the connection between the small annex and the main building by two cables, the antenna of the rain gauge, and the data logger (with two antennae) fixed to the main building wall close to the dose rate detector. It noted that access to the devices for maintenance is rather inconvenient, the technicians having to use a ladder.

The verification team recommends reflecting on moving of the dose rate detector to the annex building, close to the rain gauge, to avoid any shielding effect by the main building.

5.2.3 Monitoring station at Pafos – Labour Inspection building (re-verification)

The team noted that the dose rate monitor – which was fixed to the building wall at the time of the verification in 2006 – has been removed from the wall and is now situated about 5 m away from the wall towards the centre of the flat roof. It could have been moved a bit further away from the wall, but

its current location is definitely an improvement. The team noted that the roof platform is still prepared for an expansion of the building.

The precipitation gauge / sampler had not been moved and is thus still located about 6 m from the wall. It has a diameter of ca. 20 cm and is made of a black material which, due to sunshine and in case the outlet hole is blocked by leaves or other debris, could increase temperature and lead to heating up and evaporation of rain in the container bottle before sampling and measurement. The precipitation sampler was connected to a locked white sample container underneath the gauge; this part of the device was not cooled.

The verification team suggests moving the dose rate device further towards the centre of the roof in case this can be done with little effort. It also suggests exploring the possibility to reduce any losses of rain water in the precipitation sample container by e.g. applying suitable reflecting material and cooling. The rain sampler could also be used for collecting 'total deposition' (i.e. dry plus wet deposition) in monthly samples (by rinsing with distilled or demineralised water; after turning off the 'precipitation amount' measurement data collection).

5.3 LABORATORY BASED SYSTEM

Besides the automatic (telemetric) monitoring system that provides ambient dose rate data and rain values (plus any rain samples) Cyprus operates a system based on sampling, sample preparation for analysis, and measurement in a laboratory. Currently sampling is done by members of the staff of RICS; most of sample preparation and measurement is done in the State General Laboratory. The sampling and analysis programme has been designed by the Department of Labour Inspection, in close collaboration with the laboratories involved.

5.3.1 Sampling programme

5.3.1.1 Airborne radioactivity; gases and particulates

RICS has purchased two state of the art medium volume sequential pumps (*LECKEL Seq 47/50* – currently installed in Limassol – and *DERENDA MVS 6.1* – currently installed in Lefkosia) which are used for sampling of air particulates.

Recently also a high volume air sampler has been purchased (Polish *ASS500* device). Originally there were problems with the noise associated with the operation of the device and the siting could not be immediately resolved. Finally RICS found a place at the Civil Defence storage building in the outskirts of Lefkosia where the device will soon be installed by a team from the Polish supplier.²

The verification team was informed that currently the medium volume air sampler of type *Derenda* is out of order.

At the Civil Defence storage site the verification team was shown the location of the high volume sampler. Currently the location is well suited; the general placing is excellent – an area in the large plain south of Lefkosia – and there are no major obstacles in the close vicinity. However, any construction in that industrial development area may change the positive evaluation.

With respect to the high volume air sampler the verification team would like to point out that – although currently the site seems well suited – any future construction in that industrial area might impair the quality of the site.

² The Commission has been informed that the new high volume pump for Cs measurements in air has been put in operation in Lefkosia.

5.3.1.2 Water samples

Rain water sampling is possible at each local station of the ambient gamma dose rate network as explained in 5.2. Locally produced or imported drinking water and bottled waters are monitored regularly.

The verification team verified the rain water samplers at the local gamma dose rate monitoring stations of Pafos and Evrychou.

The team was informed that RICS is currently discussing the possible installation of a 1 m² surface precipitation sampler in Lefkosia.

Verification activities with respect to water sampling do not give rise to particular remarks.

5.3.1.3 Marine environmental radioactivity and water monitoring

Marine sampling is conducted at six sampling stations as shown on the map in Appendix 5. The following measurements are performed on the samples collected:

Matrix	Anthropogenic radionuclides	Natural radionuclides	Sampling frequency
Seawater	Cs-137, Sr-90	U-238, Ra isotopes*	2/yr
Beach sand	Gamma emitters		
Sediment	Gamma emitters, Pu-239, 240	Pb-210	1/yr
Seaweed	Gamma emitters		1/yr
Molluscs	Gamma emitters, Pu-239, 240	Po-210	2/yr
Fish	Gamma emitters, Pu-239, 240	Po-210	2/yr
Atmospheric deposition (coastal)	Gamma emitters		Minimum 4/yr

* In areas of interest for NORM

Analysis and measurements of these samples are performed at the SGL and – as appropriate – in cooperation with the Greek Atomic Energy Commission and the Demokritos Research Institute, Greece.

In addition an IAEA inter-regional programme is under consideration by the IAEA board. For sea water analyses, 80 litre samples will be collected by the Fishery Department. SGL will perform sample preparation with a view to concentrate the Cs content. The samples then undergo gamma spectrometry.

Fish from the six sea water stations; algae, seaweed, sea sediment and sand from the beach are sampled twice per year within this IAEA regional programme that is foreseen to also include other Mediterranean countries (Syria, Lebanon, Egypt, Libya, Tunisia etc).

Verification activities with respect to marine environment sampling do not give rise to particular remarks.

5.3.1.4 Samples of milk produced in Cyprus

Routine sampling of milk is conducted at the milk processing plants in Lefkosia and Limassol. Analysis is performed by SGL.

Verification activities with respect to milk sampling do not give rise to particular remarks.

5.3.1.5 Foodstuff

A routine programme has been set up recently. RICS is regularly collecting samples of infant food, cereals, Cypriot and imported cheese and flour, and SGL is conducting laboratory analysis for gamma emitters.

Analysis of mixed diet samples is foreseen to be introduced soon.

The team was informed that food imports are declared by the customs to RICS, which decides on whether such imports should be sampled and measured by SGL. This is not yet done on a full scale (depending on the laboratory capacities). Samples of imported milk, infant food, water and cheese are currently analysed. In future sampling of imported meat, cereals, animal feed etc. is planned. Certificates for imported foodstuffs from third countries are requested.

Verification activities with respect to food sampling (local and imported food) do not give rise to particular remarks. The team fully endorses the authorities' plans for a more systematic approach in the control of imported foodstuffs.

5.3.2 Meteorological stations

Meteorological data such as wind speed, wind direction, atmospheric pressure, relative humidity and ambient temperature are obtained from the Meteorological Service of Cyprus and from the Air Quality mobile stations operated by the Air Quality Section of the Department of Labour Inspection.

5.3.3 Laboratories with tasks in environmental monitoring

5.3.3.1 The State General Laboratory (SGL) of the Ministry of Health (re-verification)

5.3.3.1.1 General issues and staffing

The State General Laboratory (SGL) is one of the five departments of the Ministry of Health. It was established in 1932 as the government laboratory within the department of medical services. In 1981, it was upgraded to an independent department of the ministry and since then it has developed a strong multidisciplinary infrastructure providing efficient and effective services to many government organisations and to the socio-economic sector as well as to the private sector. It also cooperates closely with other ministries, the University of Cyprus and with municipalities. A strong collaboration in terms of research and international programs is maintained with various countries and international organisations such as IAEA in Vienna and Demokritos Institute in Greece. SGL is member of the IAEA's ALMERA Network. It has actively participated in international programmes such as:

- EU-FP7 'Environment and Health' section,
- GEMS/Food-EURO/CY United Nations 'Research and Monitoring Project on the environmental Contamination of Food' achieved in 1999, and
- 'Radiological Impact Assessment in the South-Eastern Mediterranean Area', a project in collaboration with the University of Athens, Greece.

The current infrastructure of SGL encompasses 19 different laboratories (see organization chart in Appendix 6). Sixteen of these are related to food, water, environment and drugs and were accredited according to international standards by the Hellenic Accreditation Council (ESYD). Meanwhile a Cypriot accreditation authority was established. The three not yet accredited laboratories of SGL apply the same QA system (procedures, manuals etc.) and most of these laboratories are in an advanced process of accreditation, including the radionuclides laboratory. SGL has a QA unit and a quality manager. The laboratory participates in intercomparison exercises such as those carried out by IAEA.

Radio-analytical determinations in food, feeding stuff, water and environmental samples are performed by Laboratory 09 ("Radionuclides") belonging to Section D of SGL. The radionuclide laboratory is structured in three parts: sample registration; sample preparation including physical and chemical treatment of the samples, and radioactivity measurements, such as gamma spectrometry, gross beta and alpha measurements.

The radionuclides laboratory handles a few hundred analyses per year (in 2007, it analysed 210 samples.). Measurement results are regularly reported to the Regulatory Authority (RICS).

The verification team was informed that the radionuclides laboratory at SGL is only staffed with two persons, a chemist/technician on a one year contract and the manager of the laboratory. The team noted that the staffing issue, already noted at the previous verification visit, still persists and is a serious problem considering the future work tasks of the laboratory (fast raising sample numbers, additional monitoring programmes etc.). Only two persons are available to perform all activities that the laboratory requires. In case of illness there is no staff back-up. Existing personnel is highly trained and motivated. Difficulties in the recruitment process due to the complicated procedure of contracting people have been discussed.³

Concerning the very small space actually available to the lab, the team learned that the ministry had approved a plan for a new building for SGL, comprising about 360 m² for the radioactivity laboratory. Until this project will be implemented the radiation laboratory is planned to receive two additional rooms in the present building at the end of 2008.

The team recommends considering very seriously the existing staff issue (too few persons for the projected workload) and to find a stable position for personnel with regard to routine monitoring tasks. It also encourages strongly all efforts to receive full accreditation. The team fully endorses the planned allocation of 360 m² of space in a new building to the radiation laboratory.

5.3.3.1.2 Sample registration and preparation

The team noted that environmental radioactivity monitoring programme samples are registered and tagged with unique identifiers upon receipt at SGL. The registration information includes data such as: sample type, sampling period, date and time of sample arrival, sampling location, sample volume (or mass) etc.. Samples are directed to the sample preparation unit. They are treated physically and/or chemically. Information on the parameters and results of the treatment is added to the sample registration document. Then samples are transferred to the radioactivity measurement area. Each measurement performed on a sample leads to a new protocol number. The final measurement reports are established by computer.

Sample preparation for fish is depending on its size and on the measurement methodology. Normally, the edible part of the fish is homogenized, dried at 200 °C, homogenised again, sieved to a particle size of 2 mm, and then measured by gamma spectrometry (no beta measurement is performed).

In 2007 a drinking water programme (related to the European Drinking Water Directive) was started on Cypriot tap water incl. desalinated water and imported bottled water. Samples are prepared for gross alpha and beta measurements. Since some waters contain a high content of dissolved salts a specific method for sample preparation is applied.

The verification team was informed that the laboratory is working on a method for the routine determination of Sr-90 in milk and that four new methods of measuring gross beta activity in air filters have been developed.

Verification activities with respect to sample registration and preparation do not give rise to particular remarks. The verification team encourages applying strontium analysis in milk as routine task.

5.3.3.1.3 Laboratory Equipment

The radionuclide laboratory at SGL is equipped as follows:

- A 'new' gamma spectrometer (based on an *Ortec* HPGe detector), provided by IAEA;
- A low level alpha / beta counter with sample changer, received in 2005, used for measurements of radioactivity in water and milk samples and of air filters, provided by IAEA;

³ The Commission has been informed that an additional analyst/technician on a short term contract has been recruited.

- An 'old' gamma spectrometer (based on a *Canberra* HPGe detector), provided some years ago by WHO. This equipment was used in the last years for measurement of foodstuff such as meat products, imported baby formula, fish, cereals, vegetables; in particular food from Chernobyl affected areas.

The verification team visited the radionuclides laboratory at SGL and verified the presence and operability of the laboratory instruments. 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 team noted that all the instructions and procedures are present and readily available at all workstations.

The laboratory is equipped with two electrical back-up systems (one for gamma spectrometry and one for alpha/beta measuring equipment) which provide full autonomy for half an hour. For longer power outages a generator provides electricity to the whole SGL.

With regard to **gamma spectrometry** the verification team noted that: The 'new' gamma spectrometer (based on an *Ortec GEM40P4* HPGe detector with 40% relative efficiency), provided by IAEA, is in operation. The laboratory uses an *Ortec* shield (10 cm Pb, Cu lining, centering device as sample holder; no contamination protection device such as cling film is applied), an *Ortec DSPECjr2.0* device and *Ortec GammaVision* software.

The 'old' *Canberra SGL037* 22% relative efficiency HPGe detector with *Canberra* NIM electronics and PC based *Ortec InterWinner* software is not working (at the 2006 verification visit it was operated with a *Canberra Series35+* Multi Channel Analyser in a backup mode). The team was informed that the detector crystal has to be overhauled. Plans are to remove NIM electronics and to connect the device to the *Ortec* system (by an additional *DSPEC* device).

SGL has certified reference standards from *Eckert & Ziegler* in various densities and geometries, also as liquid to produce their own calibration and test sources.

Control of the gamma spectrometry system is done by weekly checks of energy position and energy resolution (using calibration sources of Am-241, Co-60 and Cs-137). In spite of the air conditioning sometimes energy re-calibrations have to be performed. Background is measured every 2 months. At the time of the verification visit a calibration source was measured.

With regard to **alpha spectrometry** the verification team noted that an alpha spectrometer is about to be procured from IAEA.

For **(gross) alpha and beta measurements** a model *WPC 9550* device from *Protean Instrument Corporation (PIC)*, Tennessee, USA, is available with *PIC Vista 2000* software. Calibration is done using self prepared sources based on certified standards (NIST): for beta measurements eight Sr/Y-90 sources have been prepared in the same way as the samples. For alpha measurements 12 Am-241 sources have been prepared to cover a range of salts from '0' to 100 mg on 2 inch trays.

The calculations of the alpha/beta measuring device are checked with *MS Excel* programmes. For some samples (air filters) the result calculation is performed in *EXCEL* using manually typed in values.

Control samples and blanks are prepared for each measuring batch; background measurements last 720 min for each batch.

Background and calibration sources' results are stored in control charts on PC (graphical display); paper versions (including printouts of charts) are archived on site.

By the control mechanism set-up recently a quality problem in the counting gas supply could be identified. Currently the counting gas (argon-methane) distributor is one of the Cypriot branches of *Linde*; a supply contract agreement has been signed.

The verification team encourages all efforts to obtain full operability with all measuring equipment.

5.3.3.1.4 *Quality control, reporting, record keeping, tracing*

The verification team was informed that SGL is in the process of installing a laboratory information management system (LIMS) for all laboratories and that some departments are using it already. The radionuclide laboratory is about to put it into operation.

The team was told that the radionuclide laboratory participated in the IAEA inter-comparison 2007 exercise and obtained good results. The exercise comprised analysis of water, soil (measurements of Pb-210, Cs-134, Cs-137, and Co-60) and spinach (K-40, Cs-137).

The laboratory archives all spectra on paper and as a backup on CD. The team was informed that archiving of documents is done every five years, since 1992. Air filters are archived on an annual basis.

The verification team performed a tracing of a sea water sample from the 2nd half of 2007. A sample of 80 litres that had been taken near Pafos on 11 October was measured on 6 November. The team was shown the result for Cs-137 in the registry book and the value from the gamma spectrometry system which served as the basis for the calculation in *Excel* (that takes into account the 'real' efficiency as determined using the measurement of a certified Cs-137 source in appropriate geometry).

The team was informed that the laboratory wants to buy certified standard sources to avoid tedious procedures for individual production.

With regard to paper archiving, the team noted that the registry books generally are kept on another shelf; only the one from the current year is located on the table in front of the PC which is used for calculating results. The values are manually input and double checked by a staff member.

Results to the Department of Labour Inspection are currently transmitted in printed form; the team was informed that an electronic transfer would be feasible if the DLI so wishes, albeit under certain conditions.

Verification activities with respect to quality control and record keeping do not give rise to particular remarks. The participation of the Radionuclide Laboratory in the setting-up of a LIMS is strongly encouraged. The team suggests avoiding manual data inputs as much as possible and replacing such by equipment interfaces that allow ample control. It also encourages using electronic data transmission e.g. to the Department of Labour Inspection to reduce the risk of input errors in the further usage of results.

5.3.3.2 University of Cyprus, Lefkosia – Radiochemistry Unit– Radioanalytical Chemistry Research Laboratory

The verification team was informed that the Radiochemistry Unit, headed by Assoc. Prof. Ioannis Paschalidis, was and still is involved in projects dealing with monitoring of the Vassilikos site and the sea. The Vassilikos study was finished in 2007; an application for continuation of the study has been submitted, since several areas still merit further investigation. For example, since, in spite of the cover at the Vassiliko 'lagoon' site there is still contact with sea water, the dissolution process is supposed to continue. One of the questions is whether the solubility of Ra is enhanced; thus, more studies are deemed to be needed (e.g. with regard to redox conditions). The team was told that it was not yet clear if this study will be accepted by the local foundation for research promotion. A main interest of the unit lies in studying the separation of radionuclides in the sea water matrix.

The team was given a presentation of the unit's laboratory where research with uranium is performed, phosphogypsum being the specialty. It is not part of the Cypriot routine monitoring system, but performs special investigations. For sample preparation and measuring tasks the lab uses students that are working for their master's degree. The students receive suitable training and have to elaborate themselves the necessary procedures (as part of the thesis). Because of this staffing method the lab will never become an institution for routine tasks.

The lab operates two LSC devices (*Hidex* single sample counters), a NaI(Tl) detector (single sample counter) and a *Sarad RTM1688* device (for radon measurement within studies of Rn emanation from phosphogypsum). It has a small specific alpha spectrometry preparation lab (custom designed, with electrodeposition device).

The verification team was shown the equipment which is set up in a temperature controlled environment.

Until now samples of various waters are prepared and the U measurement is done with LSC or alpha spectrometers in other departments. Recently the lab applied for an alpha spectrometer of its own.

Collaboration with SGL (e.g. with regard to preparation of sources) exists. Collaboration with the Department of Labour Inspection regarding instrumentation would be welcome; however the interest lies only in alpha and beta analysis, not in gamma measurements.

Verification activities do not give rise to particular technical remarks. The verification team encourages all efforts to develop and use the expertise of the Department with respect to environmental monitoring; in particular it encourages collaboration with SGL.

5.3.3.3 University of Cyprus, Lefkosia – Nuclear Physics Research laboratory

The research interest of the nuclear physics research laboratory amongst others lies in the field of radon, food, and building materials. The laboratory conducted several studies on the behaviour of radiosulphate in the Vassilikos phosphogypsum fertiliser factory. The laboratory employs two persons. At the time of the verification visit the specialist for the measuring equipment was not available.

The verification team received an overview of the equipment used, in particular devices for tasks related to environmental and food samples. The laboratory has a portable HPGe gamma detector system *Ortec Nomad Plus*, and operates an *Ortec* HPGe detector (30% relative efficiency, 1.8 keV resolution) in a custom made round shield (5 cm lead, 1 cm steel, 1 cm aluminium) using *Ortec* and *Tennelec* NIM devices. A sample centering device is available. *Ortec Maestro-32* Version 6.01 and *Ortec GammaVision* software is used for spectrum acquisition and evaluation.

For gamma spectrometry energy checks are done on a daily basis; an oscilloscope is used for fine tuning of peak shape and position. System background is determined before every measurement.

The laboratory also has an *Ortec XRF* Si(Li) detector. The verification team was told that it will also receive a portable one for archaeological uses.

For alpha spectrometry the laboratory employs an *Ortec 808* vacuum chamber; an *Ortec* pump; and *LeCroy*, *Ortec* and *Tennelec* NIM devices. The results are calculated using *Ortec Alpha Vision 32* software.

Radon is measured with a radon monitor manufactured in the Czech Republic, *Radim-3* (*Jiří Pleh, JP-060; SMM, Prague*), gamma dose rate with a *TechniData HDG101* monitor.

The verification team noticed that procedures and instruction manuals are at the working places, as well as measurement log books with short sample descriptions and measurement details.

Small data amounts are stored locally. For storage of large data amounts and for archiving the laboratory uses the possibility of the *GSI-cluster* (*Gesellschaft für Schwerionen-Forschung, Darmstadt, Germany*).

Verification activities do not give rise to particular technical remarks.

6. THE FERTILISER FACTORY IN VASSILIKO; PHOSPHOGYPSUM SITE – NORM PLANT – RE-VERIFICATION

The former fertiliser factory is located on the coast at Vassiliko, between Limassol and Larnaca. It had three plants for the production of sulphuric acid (180.000 tons/yr), phosphoric acid (40.000 tons/yr) and fertilizers (150.000 tons/yr). The factory used as raw material local pyrites, imported phosphates, and ammonia. One of the process by-products was phosphogypsum which was disposed off in a lagoon close to the sea.

The factory started operation in 1982, stopped operation end of 1983, restarted operation in 1987 to stop in 1989, and resumed operation in 1992 until 1995 when it was closed for ever. The plant remained in place until recently when the government (Ministry of Commerce, Industry and Tourism) decided to use the site for the erection of an energy centre next to it, which should become the major

energy supply for Cyprus. It is planned to construct an anchoring and discharging site for liquefied natural gas tankers.

At the time of the verification visit in 2006 parts of the plant were still standing, albeit not anymore used. The plant is now completely dismantled and the contaminated material has been transported to Greece and Germany.

The verification team was informed that the "historical phosphogypsum lagoon" close to the sea is still a major issue. The team witnessed that the area of the phosphogypsum lagoon has now been completely covered by a plastic membrane and by a 1.50 m layer of industrial soil. As a protection against the sea, concrete blocks have been placed to consolidate the waterfront. It is planned that the covered area shall contain the facility for excess-gas burning of the neighbouring power plant; the engineers are aware of eventual issues with the foundations of such installations.

Radioactivity monitoring results until now do not indicate any significant impact of the site on the marine environment. A monitoring station for sea water, sea sediments and marine organisms has been established by RICS, together with the Fisheries and Marine Research Department of Cyprus and the SGL. The team was also informed that a specific study concerning the effects of the phosphogypsum lagoon on the sea next to it (water, plankton, fish, mussels etc.) has been carried out with the collaboration of the University of Cyprus, the Demokritos Institute, Greece, and the Greek Oceanographic Research Institute and a specific monitoring programme is in place.

The government is discussing the possibility that the former lagoon will be used as a parking place and maybe also to place tanks for liquefied natural gas but not for office buildings.

On the land formerly occupied by the fertilizer plant, close to the oil powered electricity production plant, a new unit of the power station is planned. Currently the location is used to store containers stemming from Malaysia for the construction of unit III.

The verification team encourages all efforts to set up and implement a suitable routine sea water monitoring programme in the region of Vassilikos with a view to detect any impacts of the former activities in time.

7. MONITORING OF RADIOACTIVE DISCHARGES FROM NUCLEAR MEDICINE DEPARTMENTS AND RESEARCH LABORATORIES

7.1 GENERAL

There are only a few small nuclear medicine departments and research laboratories in Cyprus and the radionuclides used are generally of short half-lives. All these centres are licensed and inspected regularly by RICS. The wastes produced are handled properly according to the requirements of the legislation and the conditions of the license and are kept in stores until the radioactivity levels are very low to be disposed of as normal waste. The verification team was informed that taking into account the radionuclides used, the number of patients treated, the quantities of waste produced and the sewage systems used in these centres, according to Cypriot legislation no retention tanks are needed for such small nuclear medicine centres.

In case of usage of long lived radionuclides any radioactive waste is kept in safe stores and sent abroad for proper disposal.

Each licensee has an advisor with regard to radiological issues, who is also responsible for radioactive waste and discharges. Controls are performed by the Department of Labour Inspection.

The verification team was informed that currently plans are to open an oncology centre in Limassol; depending on the capacity the installation of a retention tank may have to be considered.

The verification was originally foreseen to cover the largest nuclear medical installation in Cyprus, situated in the General Hospital, Lefkosia. However the schedule had to be changed and covered the Medical Physics Department of the Bank of Cyprus Oncology Centre, Lefkosia, since at the time of the verification visit the General Hospital nuclear department was being renovated and all patients were addressed to the Oncology Centre.

The verification team recommends considering the installation of a retention tank system when planning new or in case of modifications of existing nuclear medical installations. It recommends periodically taking and analysing appropriate discharge samples in order to prove that no relevant activities (as defined by the competent authority) are released to the environment.

7.2 BANK OF CYPRUS ONCOLOGY CENTRE - DESCRIPTION AND VERIFICATION

The Medical Oncology Centre was created in 1992, following an agreement between the Cypriot Government and the Bank of Cyprus. The Centre is situated in Lefkosa. The centre operates specialist oncology units for several types of cancer as well as for less common oncological diseases such as endocrine cancer and benign tumours. The hospital provides the following services: radiotherapy, chemotherapy, hormone therapy, and diagnostic examinations, including blood tests and radiological investigations.

The Centre's medical services are organised in two main departments: the Department of Radiation Oncology and Diagnostic Radiology, and the Department of Medical Oncology. The main medical equipment is of the latest technology and includes two linear accelerators, two beam-view units, one superficial treatment unit, one High-Dose Rate (HDR) brachytherapy system, one spiral CT scanner, one ultrasound unit, one mammography unit, one conventional X-ray unit and one gamma-camera. The Centre's facilities also include a day care unit for chemotherapy, two wards for hospitalisation and in-patient treatment, a bone marrow transplantation unit and out-patient examination.

Seven medical physicists – including the department head – are working in the Department of Radiation Oncology and Diagnostic Radiology and the Department of Medical Oncology. They had studied and received training in Korea, the UK, and Canada.

The verification team visited the nuclear medicine department, where radiotherapy and brachytherapy is performed. Treatments are using liquid sources of I-131, Tc-99m and Ga-67; and Ir-192 sealed sources (for afterloading for brachytherapy). Technetium generators are being bought from the Netherlands. Also iodine comes from the Netherlands, in batches every week. Statistics of the annual use of radioiodine are calculated on the basis of shipment data. The team was informed that any damaged packages are swipe-tested at arrival as standard procedure.

For I-131 applications the maximum activity used per patient is 200 mCi (7.4 GBq), the average is 100 mCi (3.7 GBq).

Dose rate measurements are used to decide if a patient can be released.

The team witnessed a special shielded suite for patient treatment at the oncology centre. The suite has its own bathroom with a special sink and automatic waste flushing to the sewage system. The centre has no decay or storage tank. Currently the oncology centre has 2 to 3 patients per week. Liquid releases are estimated on the basis of patient numbers and application data; no measurements of the released liquids are performed.

Before 'normal' cleaning medical physicists decontaminate the suite after measuring contamination. A constraint is set at 5 μ Sv/hr at 10 cm distance from surfaces. Any radioactive waste is disposed of by placing it in the storage room for radioactive decay. When the measurement shows background levels items go to trash or to the laundry.

With regard to solid waste detailed records are kept. A refrigerator is available for storage of bags; these are measured bag by bag and then disposed of as normal waste if below a certain level. The team noted that the radioactive waste room (marked with a radiation warning sign) is not easy to access; staff currently has to walk a large distance, using a complex route. The construction of an elevator for easier transport of waste is foreseen.

All procedures were available in printed form (in English) and on the IT network as part of the hospital's QM system. All personnel (nurses) are trained for the case of need (according to a medical directive). Before staff can treat patients, they undergo specific training using a simulator. Refreshment courses have to be attended every 6 months.

Forms used are elaborate and contain much information on measurements on the patient and the patient room, and with regard to any packages. Logs exist on waste bags, including information about patient name and other details.

The verification team noted radiological warning signs for pregnant and breastfeeding women in Greek and English (staff would also like to have these in Turkish). It saw a radiation survey meter (*Victoreen 450P*) which is used for dose rate measurements and a well counter (*Capintec*) used for swipe tests. The Centre has a liquid dose calibrator (used for calibrating the syringes) which is checked every day.

Verification activities do not give rise to particular remarks.

8. CONCLUSIONS

The verification team appreciates the progress achieved since the verification visit in 2006 in further developing the monitoring system for environmental radioactivity in Cyprus.

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 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 the air, water and soil in Cyprus are installed and fully operational (with regard to the automatic network) or in an advanced stage of implementation (with regard to the laboratory based system). The Commission could verify the operation and efficiency of most of the facilities.
- (2) The team noted that the current monitoring campaigns are part of a newly established routine programme, and it welcomes the efforts undertaken to further develop this routine programme in close collaboration between RICS and SGL.
- (3) A few topical recommendations are formulated. These recommendations aim at improving some aspects of environmental surveillance in Cyprus. In particular, with regard to sufficient staffing of the bodies involved in the monitoring tasks some effort still seems to be necessary. The recommendations do not discredit the fact that environmental monitoring in Cyprus is in conformity with the provisions laid down under Article 35 of the Euratom Treaty.
- (4) The verification findings and ensuing recommendations are compiled in the 'Main Findings' document that is addressed to the competent authority in Cyprus through the Permanent Representative of Cyprus to the European Union.
- (5) The present Technical Report is to be enclosed with the Main Findings.
- (6) The Commission Services ask the Cypriot competent authority to inform them of any progress or significant changes with regard to the situation at the time of the verification.
- (7) The verification team acknowledges the excellent co-operation it received from all persons involved in the activities it performed.

VERIFICATION PROGRAMME

Art.35 Verification
National monitoring system, Cyprus
23 to 27 June 2008
(including follow-up of the 2006 verification)
Programme of activities

Sunday 22 June

1. EC party travels to Cyprus

Monday 23 June

2. Opening meeting: introduction + presentations with special emphasis on achievements since the verification in 2006. [AM]
3. Verification of radioactive discharge control from hospitals with nuclear medicine departments in Cyprus. [PM]

Tuesday 24 June

4. Verification of the State General Laboratory (Lefkosia). [AM]
5. Verification of air and precipitation monitoring facilities in Cyprus. [PM]

Wednesday 25 June

6. Verification and follow-up verification of the ambient gamma dose rate measuring facilities at Evrychou and Paphos. [AM]
7. Follow-up verification of the NORM activities at Vasiliko and discussion of the respective marine monitoring programme. [PM]

Thursday 26 June

8. Verification of radioactivity monitoring in nationally produced food and feeding stuffs (milk, vegetables, mixed diet, etc.). [AM]
9. Verification and discussion of radioactivity monitoring in imported foodstuffs, Limassol harbour. [PM]

Friday 27 June

10. Verification of the Cypriot national environmental radioactivity monitoring data centre (Lefkosia). [AM]
11. Verification of the Radiochemistry and Nuclear Physics Laboratories of the University of Cyprus (Lefkosia) - Radioisotope Project. [PM]
12. Closing meeting. [PM]

Saturday 28 June

13. EC party returns to Luxembourg.

DOCUMENTATION

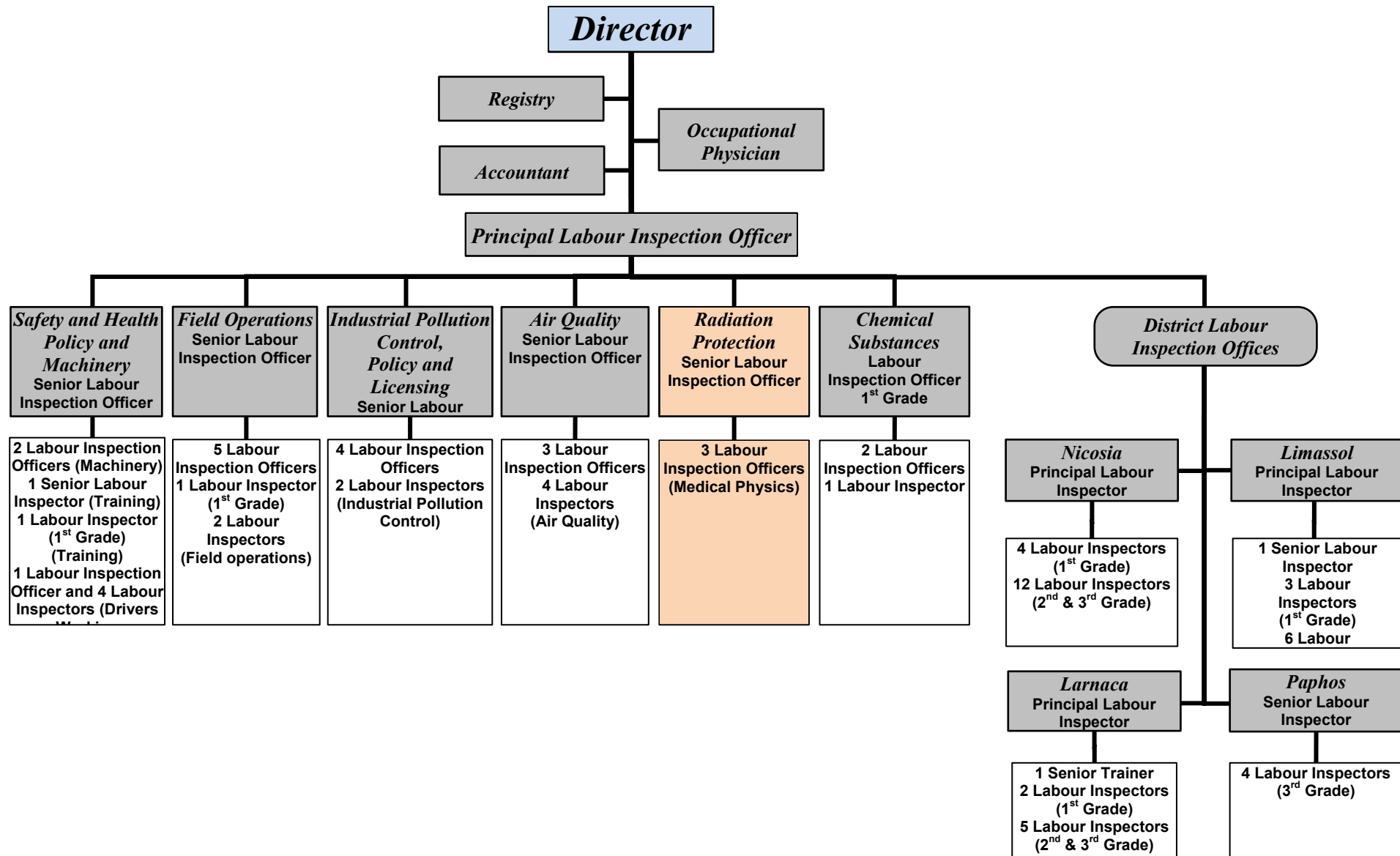
1° LOCAL AUTHORITIES' AND OTHER RELEVANT WEBSITES

- 1) University of Cyprus
<http://www-np.ucy.ac.cy/>
- 2) Ministry of Labour and Social Insurance, Department of Labour Inspections
http://www.mlsi.gov.cy/mlsi/dli/dli.nsf/dmlindex_en/dmlindex_en?OpenDocument
- 3) Legislation concerning radiation protection
http://www.mlsi.gov.cy/mlsi/dli/dli.nsf/dmllegislation_New_en?openform&p=9&t=f&e=
http://www.moh.gov.cy/MOH/SGL/SGL.nsf/DMLlegislation_en/DMLlegislation_en?OpenDocument
- 4) Ministry of Health, State General Laboratory
http://www.moh.gov.cy/moh/moh.nsf/laboratory_gr/laboratory_gr?OpenDocument
<http://www.moh.gov.cy/Moh/SGL/SGL.nsf/All/728341312C05CDDBC2257107003878FC?OpenDocument>
- 5) Institute of Energy of Cyprus
<http://www.cie.org.cy/homeeng.htm>
- 6) Electricity Authority of Cyprus (EAC)
<http://www.eac.com.cy/>
- 7) TechniData equipment
www.technidata.de
- 8) Medical Oncology Centre, Lefkosia
www.bococ.org.cy

2° DOCUMENTS RECEIVED

- 9) Verification activities under the terms of Art.35 of the Euratom Treaty, preliminary information questionnaire addressed to the national competent authority in view of preparing the Art.35 verification in Cyprus 23-27 June 2008.

ORGANIGRAMME – DLI



LEGISLATION

1 LEGISLATIVE ACTS REGULATING ENVIRONMENTAL RADIOACTIVITY

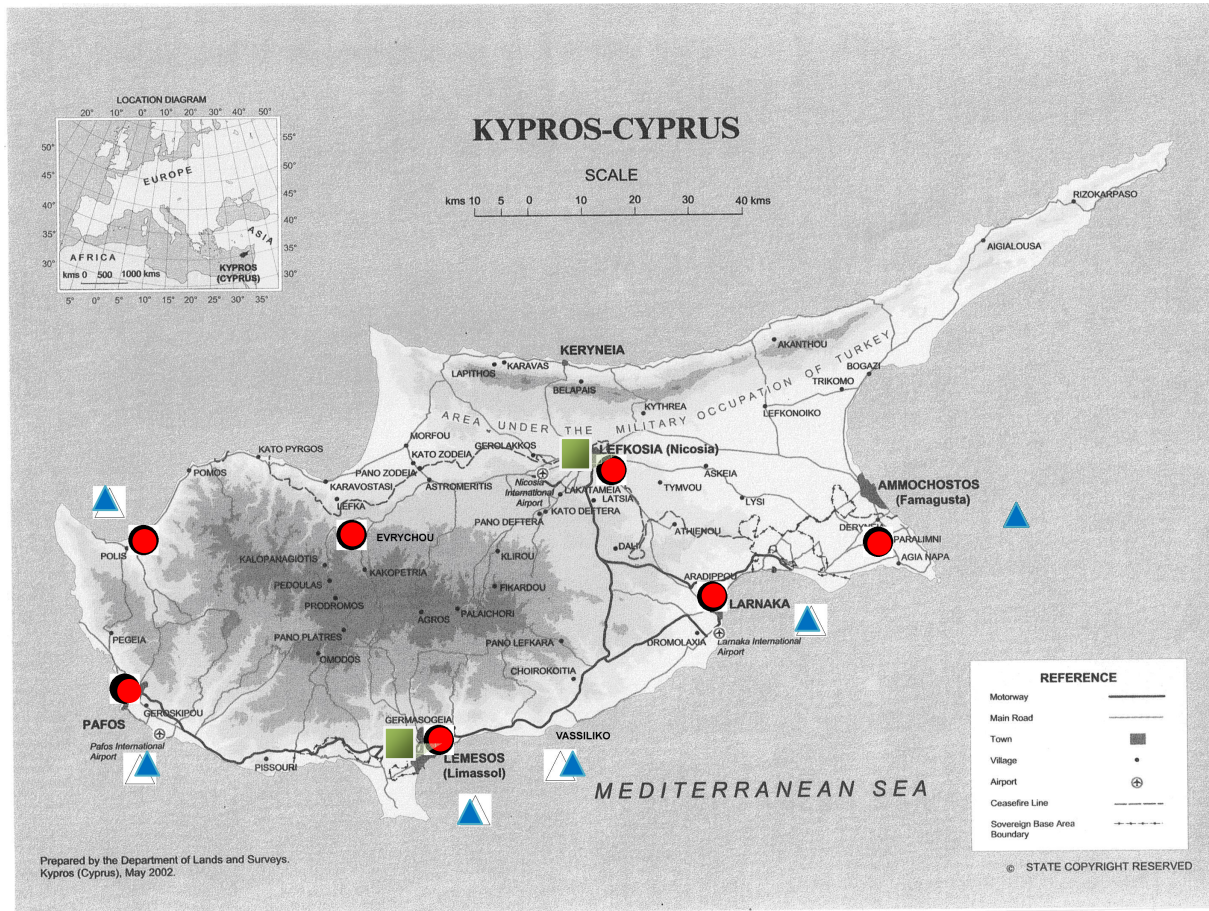
- 1) The protection from ionizing Radiation Law of 2002, N.115(I)/20002 implemented by the MLSI.
 - a) The Protection from Ionizing Radiation (Basic Principles) Regulations of 2002, ΚΔΠ 494/2002
 - b) The Protection from Ionizing Radiation (Medical Exposure) Regulations of 2002, ΚΔΠ 497/2002.
 - c) The Protection from Ionizing Radiation (Information to the Public on Applicable Measures in case of Emergency) Regulations of 2002, ΚΔΠ 495/2002.
 - d) The Protection from Ionizing Radiation (Supervision and Control of Shipments of Radioactive Waste) Regulations of 2002, ΚΔΠ 496/2002.
 - e) The Protection from Ionizing Radiation (Control of High Activity Sealed Radioactive Sources and Orphan Sources) Regulations of 2006.
- 2) The Conventions on Early Warning and Assistance in the case of Nuclear Accident Ratification Law, N164/1988.
- 3) The Convention on Nuclear Safety (Ratification) Law of 1998, N.20 (III)/98.
- 4) The Convention on Physical Protection of Nuclear Material Ratification Law, N.3 (III)/1998
- 5) The Comprehensive Nuclear Test Ban Treaty Ratification Law, N.32(III)/2003
- 6) The Treaty on the Non-Proliferation of Nuclear Weapons Ratification Law, N.8/1970
- 7) The Safeguards Agreement between Cyprus and the International Atomic Energy Agency for the Application of Safeguards in Connection with the Treaty on the Non-Proliferation of Nuclear Weapons Ratification Law, N.3/1973.
- 8) The Protocol Additional to the Agreement between Cyprus and the International Atomic Energy Agency for the Application of Safeguards in Connection with the Treaty on the Non-Proliferation of Nuclear Weapons Ratification Law, N.27(III)/2002
- 9) The International Convention for the Suppression of Acts of Nuclear Terrorism (Ratification) Law of 2007, N.44(III)/2007.
- 10) The Euratom Treaty

2 GUIDANCE DOCUMENTS

- 11) Main international guidance documents (IAEA, ICRP, EU) used in the environmental radioactivity and foodstuffs radioactivity monitoring in Cyprus
- 12) IAEA, Basic Safety Standards, Vienna 1996
- 13) IAEA, Environmental and Source monitoring for purposes of Radiation Protection, RS-G-1.8, Vienna 2005
- 14) IAEA, Documents on Emergency Preparedness and Response
- 15) FAO/WHO Codex Alimentarius
- 16) WHO Guidelines on drinking water quality
- 17) Guidelines for the assessment of radionuclides in the sea
- 18) European directives, decisions and recommendations
- 19) Guidelines on sampling
- 20) EC (JRC) radioactivity reports

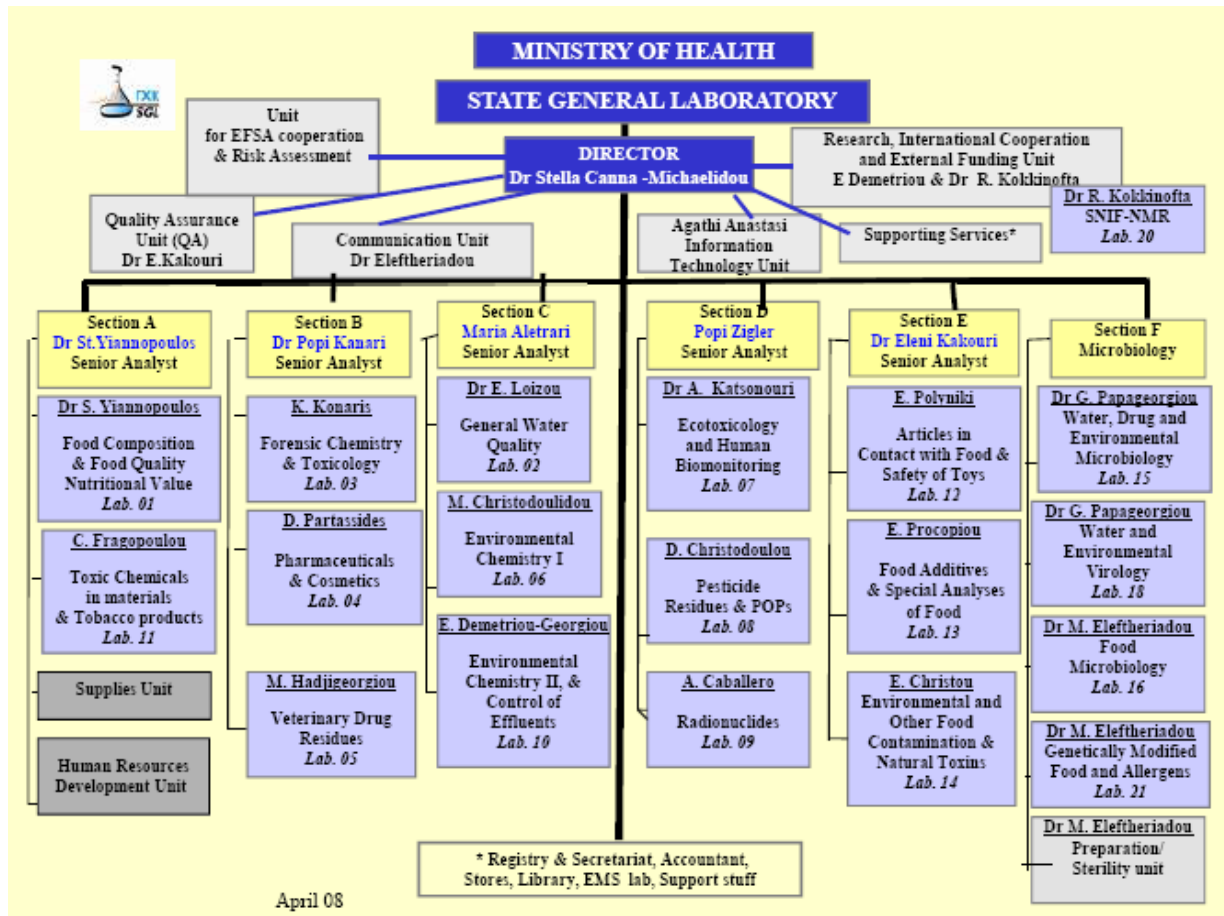
APPENDIX 5

Cyprus Radioactivity Monitoring Network: ambient gamma dose rate measurement (and rain gauge) stations, aerosol monitoring stations and marine sampling locations



- Dose rate monitoring
- ▲ Marine samples
- Aerosol sampling

ORGANIGRAMME – SGL



See also website:

[http://www.moh.gov.cy/moh/sgl/sgl.nsf/All/83A51D40C1A3C98DC22574430021776B/\\$file/Organogramme.pdf](http://www.moh.gov.cy/moh/sgl/sgl.nsf/All/83A51D40C1A3C98DC22574430021776B/$file/Organogramme.pdf)