



**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**

**08 to 12 May 2006**

**Reference: CY-06/3**

**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 Nicosia; and the Cypriot nation-wide radiological environmental monitoring network.

DATE: 08 to 12 May 2006

REFERENCE: CY-06/3

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DATE OF REPORT: 27/02/2007

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<b>TECHNICAL REPORT</b>
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**1. ABBREVIATIONS**

ALMERA	Analytical Laboratories Monitoring Environmental Radioactivity (ALMERA)
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 <sup>th</sup> 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)
GM	Geiger Müller
GSM	Global System for Mobile communications (cell phone technology)
HPGe	High Purity Germanium
IAEA	International Atomic Energy Agency
ISDN	Integrated Services Digital Network (telephony)
LLD	Lower Limit of Detection
JRC	Joint Research Centre
MCIT	Ministry of Commerce, Industry and Tourism
MH	Ministry of Health
MLSI	Ministry of Labour and Social Insurance
NIM	Nuclear Instrumentation Module
NORM	Naturally Occurring Radioactive Material
NRPR	National Radiation Protection Regulations
QA	Quality Assurance
RA	Regulatory Authority
REM	Radioactivity Environmental Monitoring (European database at JRC Ispra)
RICS	Radiation Inspections and Control Service
SGL	State General Laboratory
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<sup>(1)</sup>.

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 in particular 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 visited Cyprus (08 to 12 May 2006).

The present report contains the results of the verification team's review of 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 met during the visit.

## **3. PREPARATION AND CONDUCT OF THE VERIFICATION**

### **3.1 Preamble**

The Commission's decision to require the conduct of verifications under the terms of Article 35 of the Euratom Treaty was notified to the Cypriot government on 3<sup>rd</sup> February 2006 (letter referenced TREN/H4/CG/2006/D/201437, 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. Subsequently, 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 verification of the environmental radiation monitoring programme as implemented by the Radiation Inspection and Control Service (RICS) on the Cypriot territory.

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<sup>1</sup> 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).

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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 08 May, 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 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 verification team presented and discussed its preliminary findings at a closing meeting on 12 May, in the presence of the responsible minister, Mr. Christos Taliadoros, Minister of Labour and Social Insurance (MLSI).

### 3.3 Documentation

In order to facilitate the work of the verification team, a package of information was supplied in advance by the Cypriot authorities, in form of detailed answers to a questionnaire prepared by the Commission Services. Additional documentation was provided during and after the verification visit. A list of this documentation is compiled in Appendix 2. The verification team noted the quality and comprehensiveness of all presentations made and documentation provided. The provided information has been extensively used for drawing up the descriptive sections of this report.

### 3.4 Representatives of Cypriot authorities

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

Leandros Nicolaidis	Director
Panicos Demetriades	Head RICS (DLI), Labour Inspection Officer, first grade
Michalis Tziortzis	Labour Inspection Officer, Specialist Inspector
Demetris Sakkas	Labour Inspection Officer, Specialist Inspector

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

Costas Michael	Director
Stella Canna-Michaelidou	Head of Radiation Laboratory
Popi Ziegler	Radio Analyst
Anastasia Caballero	Radio Analyst
Riana Loizidis	Chemist – technician

3) **CIVIL DEFENCE OPERATIONS CENTRE, Strovolos, CYPRUS**

Christos Kyriakides Commissioner

4) **DEPARTMENT OF FISHERIES AND MARINE RESEARCH, MINISTRY OF AGRICULTURE, NATURAL RESOURCES AND ENVIRONMENT, Lefkosia, CYPRUS**

Myrofora Chadjichristoforou Senior Fisheries Inspector

Theodora Nicolaidou-Siamma Fisheries Inspector

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

Efthymoulos Economou Electricity Authority of Cyprus (EAC)

Marilia Panayiotou Energy Service, Ministry of Commerce, Industry and Tourism

Savas Sava Institute of Energy of Cyprus

George Demetriou Cyprus Organization for Storage and Management of Oilstocks (COSMOS)

## 4. COMPETENT AUTHORITIES AND NUCLEAR LEGISLATION

### 4.1 Introduction

Cyprus does not operate nuclear power plants, nuclear installations, 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. Some recent studies carried out in the country for the assessment of the situation concerning radioactivity showed very low natural radioactivity background and insignificant radon levels.

Cyprus has recently introduced a new legal framework, in line with the "EURATOM acquis" and the IAEA standards for ionizing radiation control. 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 (RA) for Radiation Protection, Nuclear Safety and Radioactive Waste Management in Cyprus. RICS reports to the Ministry of Labour and Social Insurance (MLSI). The Regulatory Authority has the responsibility to enforce the above mentioned legislation, to ensure for 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](http://www-np.ucy.ac.cy/radio_isotopes/wwwen/radio_start.html)). A similar study concerning the phosphogypsum issue at Vassiliko, a closed fertiliser factory, will soon be published by the Radiochemistry Laboratory of the Chemistry Department of the University of Cyprus.

RICS is presently staffed with three Labour Inspection Officers with engineering and science background and trained in radiation protection and medical physics. RICS has recently established a network for continuous monitoring of ambient gamma radiation (see 6.2). RICS has also procured various portable radiation monitoring instruments (alpha, beta, gamma survey and contamination portable meters, portable spectrometers) for inspection purposes.

RICS has no own laboratory; it may utilise the State General Laboratory (SGL; under the responsibility of the Ministry of Health in Lefkosia) for laboratory services concerning 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. DLI has also submitted a proposal for an EU Transition Facility Project with the same objectives (meanwhile approved by the Commission Services for support). New laboratory equipment (a new gamma spectrometer and an alpha/beta-counter) has been procured to SGL, together with relevant training provided both locally and abroad. 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. Sampling from five monitoring stations around Cyprus is foreseen to start in June 2006 within the framework of this project.

#### 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;
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. Implementation of emergency preparedness and response plans.

The State General Laboratory of the Ministry of Health supports the competent authority in radioactivity monitoring 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 2.

## 5. THE STATE GENERAL LABORATORY (SGL) OF THE MINISTRY OF HEALTH (MH)

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 21 different laboratories (see organization chart in Appendix 3). Sixteen of these are related to food, water, environment and drugs and were accredited according to international standards by the Greek Accreditation Body (ESYD). Meanwhile a Cypriot accreditation authority was established. The six 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, the one of the radiation laboratory being scheduled to take place in 2007. SGL has a QA unit and a quality manager. The laboratory participates in intercomparison exercises such as those carried out by IAEA.

Radionuclide analysis for food, feeding stuff, water and environmental samples is covered by the Radiation Laboratory under the Environmental Chemistry, Ecotoxicology, Pesticides and Radioactivity Laboratory. The radiation laboratory is structured into 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 radiation laboratory at SGL is equipped as follows:

- A gamma spectrometer (based on an Ortec 35% efficiency HPGe detector), provided by IAEA. At the time of the Article 35 verification this device was still in the customs office.
- A low activity alpha / beta counter (Ortec Protean Instrument Corporation - PIC - WPC9950 with sample changer, plus PIC Vista 2000 software) received in 2005 is used for measurements of radioactivity in water and milk samples and of the air filter particulates.
- A gamma spectrometer, comprising a 22% Canberra HPGe detector, Canberra NIM electronics; PC based Ortec 'InterWinner' software and a Canberra series 35+ Multichannel Analyzer as backup, provided some years ago by WHO. This equipment was used in the last years for measurement of foodstuff like meat products, imported baby food-formula, fish, cereals, vegetables; in particular food from Chernobyl affected areas.

The radiation laboratory handles a few hundreds analyses per year. Measurement results are regularly reported to the Regulatory Authority (RICS).

## **6. THE ENVIRONMENTAL RADIOACTIVITY MONITORING PROGRAMME**

### **6.1 Introduction**

Environmental radioactivity monitoring has been developed and is under advanced implementation in Cyprus. RICS as Regulatory Authority is responsible for operating the radiation monitoring network, including sampling, data management and reporting. SGL radiation laboratory provides 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 discussing a draft environmental radioactivity monitoring programme with RICS, which will approve the future routine monitoring programme on the basis of this draft, taking into account the available equipment and personnel resources.

For some specific measurements and for any situation with extensive contamination, RICS foresees a 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) and the University of Athens (Demokritos Institute and its Environmental Radioactivity Laboratory - ERL) within a common project for monitoring radioactivity in the sea, partly related to natural radioactivity (see 6.5 and 7).

Radioactivity data measured in Cyprus are sent to the REM data base at JRC Ispra via the specific data communication program 'EasyProteo'.

### **6.2 The Telemetric Radioactivity Monitoring Network (TRMN) - ambient gamma dose rate**

RICS has established an ambient gamma radiation monitoring network, with seven local monitoring stations (Lefkosa, Larnaca, Limassol, Pafos, Paralimni, Polis, Evrychou) and three control centres to monitor continuously gamma radiation in the air (Appendix 6). 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, set up by TechniData AG, Markdorf, Germany, in cooperation with the local company Medisell Co. Ltd., is fully automatic with data communication through ISDN lines and GSM. It covers the main urban areas of Cyprus. Future extension is possible.

Each measuring device 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.
- A data logger (TechniData DLM 1450) with data storage capacity of 72 hours. Local data download to a computer is possible via a RS232 interface.
- The stations are generally connected by ISDN and/or GSM to the main data centre at RICS. Measurements are performed every 10 minutes. During normal operation, measurement values are transferred once per day to the main data centre. In case of an alarm the system turns automatically to intensive mode and the signal is transferred immediately.

Three data centres are available, one at RICS, one at the Civil Defence Operations Centre and a mobile one (notebook computer based with GSM communication). There is also wireless communication with the Civil Defence centre and test messages are exchanged every month. The central software and data management programs are provided by TechniData. The presentation software may be upgraded to include a Geographical Information System (GIS). Archived data are planned to be stored in a data base.

The centre at RICS is equipped with a UPS system providing 2 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 network will also send data to JRC Ispra (EURDEP platform; at the moment a test application is used) either automatically or under manual control. At all network stations rain water can be collected and may be analysed in the SGL radiation laboratory.

### 6.3 Airborne radioactivity; gases and particulates

RICS has purchased two state of the art medium volume sequential pumps (LECKEL Seq 47/50 and DERENDA MVS 6.1) which will be installed soon and will be used for sampling of air particulates. One will be positioned in Lefkosia and the other in Limassol. The implementation is ongoing and sampling is foreseen to start very soon taking into account the capabilities and limitations for laboratory analysis of the SGL.

RICS has also made arrangements for the procurement in the near future (2007) of a high volume air sampler, especially for improving Cs-137 measurements.

### 6.4 Rainwater samplers

Rain water will be sampled from each local station of the ambient gamma dose rate network as explained in 6.2. The samplers are already installed.

### 6.5 Marine environmental radioactivity and Water monitoring

Marine sampling is planned to start in June 2006 at five sampling stations as shown on the map in Appendix 6. The following measurements are foreseen to be performed in the samples to be collected when the system is fully operational:

Matrix	Anthropogenic Radionuclides	Natural radionuclides	Sampling Frequency
Seawater	$^{137}\text{Cs}$ , $^{90}\text{Sr}$	$^{238}\text{U}$ , Ra isotopes*	2/yr
Beach sand	Gamma emitters		
Sediment	Gamma emitters, $^{239,240}\text{Pu}$	$^{210}\text{Pb}$	1/yr
Seaweed	Gamma emitters		1/yr
Molluscs	Gamma emitters, $^{239,240}\text{Pu}$	$^{210}\text{Po}$	2/yr
Fish	Gamma emitters, $^{239,240}\text{Pu}$	$^{210}\text{Po}$	2/yr
Atmospheric deposition	Gamma emitters		Minimum 4/yr

\* In areas of interest for NORM

Analysis and measurements of these samples will be performed at the SGL and – as appropriate – in co-operation with the University of Athens, Demokritos Institute, Greece (see also 6.1).

In the past years SGL conducted measurements in drinking water for  $^{134,137}\text{Cs}$ .

## **6.6 Samples of milk produced in Cyprus**

Routine sampling of milk will be conducted at the milk processing plants in Lefkosia and Limassol. Analysis will be performed by SGL, taking into account experience in analysis of milk for gamma emitters gained in studies from 1993 to 2003.

## **6.7 Foodstuffs**

A routine programme is in the process of being set up (see also 6.1). SGL has conducted analysis of infant food and cereals for gamma emitters (2004) and meat (2003 – 2004).

## **6.8 Meteorological stations**

Precipitation is measured by the radiation monitoring network as explained in 6.4. Other meteorological data such as wind speed, wind direction, atmospheric pressure, relative humidity and ambient temperature will be obtained from the Meteorological Service of Cyprus and from the Air Quality mobile stations operated by the Air Quality Section of the DLI.

## **7. THE FERTILISER FACTORY IN VASSILIKO; PHOSPHOGYPSUM SITE – NORM PLANT**

The former fertiliser factory is located on the coast at Vassiliko between Limassol and Larnaca and 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 was using 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, (MCIT) 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 liquid natural gas tankers.

A major issue is the "historical phosphogypsum lagoon" close to the sea. This part of the site shall be completely covered; it shall contain the facility for excess-gas burning. No other use is foreseen for this area.

The decommissioning methodology of the industrial facilities requested in the call for tender was the "dry methodology as far as possible". Radioactive waste resulting from decommissioning is foreseen to be disposed off abroad (budget for this is foreseen). At the moment of the verification an expert study was ongoing to identify all issues related to decommissioning.

Limits for dry and/or wet disposal will have to respect international standards. This will be imposed to the successful tenderer.

A specific study concerning the effects of the phosphogypsum lagoon on the sea next to it (water, plankton, fish, mussels etc; with collaboration of the University of Cyprus and Demokritos Institute, Greece is scheduled to start in June 2006 (see also 6.1). and will lead to an in-depth analysis of the

issue. The lagoon itself shall be covered before the energy centre starts operation. Its waterfront will be stabilised and a specific monitoring programme will be put into place.

The decommissioning of the factory, including the cleaning up and the decontamination of the area, has started (tendering process) and the Department of Labour Inspection (DLI), is conducting site inspection. DLI collaborates with MCIT and with other government departments in order to ensure that all decommissioning and waste management activities are conducted in compliance with the legislation in force. International guidance documents on NORM will be used.

DLI has also collaboration with the University of Cyprus (Radiochemistry laboratory of the Chemistry Department) which, in the past, has been conducting studies concerning the site. The results until now do not indicate any significant impact of the site onto the marine environment. In the future it is planned to operate a monitoring station for sea water, sea sediments and marine organisms by RICS, together with the University of Cyprus and the University of Athens/Demokritos Institute, Greece.

## **8. VERIFICATION ACTIVITIES - ENVIRONMENTAL MONITORING**

### **8.1 The Monitoring facilities of RICS and the TRMN network**

The team visited the Department of Labour Inspection, the recently established 'Radiation Inspection and Control Service' (RICS) in Lefkosia with a view to get an overview over the environmental radioactivity monitoring set-up and its implementation in Cyprus. At the premises the local station and the basic data centre of the automatic dose rate monitoring system were visited. While visiting the premises of DLI the team noted the existence of other equipment that is mainly related to labour inspection and radiological surveillance tasks.

The verification team noted that in the past several studies with regard to environmental radioactivity monitoring were performed in Cyprus, mostly in conjunction with the activities of RICS. At the time of the visit work on setting up a routine monitoring programme for environmental radioactivity was far advanced; this work was performed in close collaboration with SGL.

*The team strongly endorses the efforts of RICS to set up a detailed routine environmental radioactivity monitoring programme in close co-operation with SGL, taking into account the knowledge acquired from past measurement campaigns performed by different organisations in Cyprus.*

#### *8.1.1 The Telemetric Radioactivity Monitoring Network (TRMN) for ambient gamma dose rate*

##### 8.1.1.1 General aspects and data centres

The team verified six monitoring stations (Lefkosia, Larnaca, Limassol, Pafos, Paralimni, Polis) and the control centre at RICS.

The team noted that:

At the time of the verification, the whole system was in a final test phase. It was installed, running and demonstrated and found to be fully functional. Several persons of DLI were in the process of being trained to monitor the system. Full certification by Medisell, the Cypriot partner of TechniData, was foreseen to take place within June 2006. After this certification and after training of the staff, the system is planned to be officially delivered to and accepted by the DLI as fully operational, at the latest in July 2006.

*The verification activities did show that the system is fully installed in all locations. The team acknowledges the fact that the mounting of the detectors on balustrades of large flat roofs is a compromise with regard to the necessity of early detection of contamination in a nuclear event and to the possibility of estimating radionuclide deposition. The system is working and measurement performance as well as its functionality was demonstrated. With one exception (Pafos – see 8.2.1.6 below) sitting is satisfactory. Official operationality could not be verified at the time of the visit since the system was not yet certified by the supplier and staff training was still ongoing. It can be assumed that in a few weeks the system will be officially operational.*

#### 8.1.1.2 Lefkosia - RICS premises

At RICS's premises a station of the telemetric network is installed on a terrace of the large, flat roof of the building, on a balustrade (effective detector height ca. 1 m). The site is surrounded by other – residential and office – buildings that are of lower height.

The data logger showed all status information ok and measurement ongoing.

*Verification activities do not give rise to particular remarks.*

#### 8.1.1.3 Larnaca – District Office of DLI

The automatic dose rate monitoring system is of the same type as in Lefkosia. At the date of verification it was installed and fully functional. The device is located on the large, flat roof of a low building near the sea, on a concrete balustrade (effective detector height ca. 1 m).

The data logger showed all status information ok and measurement ongoing.

*Verification activities do not give rise to particular remarks.*

#### 8.1.1.4 Paralimni – Civil Defence

The automatic dose rate monitoring system is of the same type as in Lefkosia. At the date of verification it was installed and fully functional. The device is located on the large, flat roof of a low building in the outskirts of the town on a central concrete structure (effective detector height ca. 1 m).

The data logger showed all status information ok and measurement ongoing.

*Verification activities do not give rise to particular remarks.*

#### 8.1.1.5 Limassol – District Office of DLI

The automatic dose rate monitoring system is of the same type as in Lefkosia. At the date of verification it was installed and fully functional. The device is located on the large, flat roof of a 7 story building in the downtown area on a concrete balustrade (effective detector height ca. 1 m).

The data logger showed all status information ok and measurement ongoing.

*Verification activities do not give rise to particular remarks.*

#### 8.1.1.6 Pafos – District Office of DLI

The automatic dose rate monitoring system is of the same type as in Lefkosia. At the date of verification it was installed and fully functional. The device is located on the large, flat roof of a 4 story building in the downtown area. However, it was not ideally mounted: directly on a wall – presumably of the elevator shaft. The detector location was determined by the equipment supplier

against the order given by the central authorities. These are aware of the problem and are going to improve the sitting.

The data logger showed all status information ok and measurement ongoing.

*The verification team suggests placing the probe on the outer balustrade.*

#### 8.1.1.7 Polis – Civil Defence

The automatic dose rate monitoring system is of the same type as in Lefkosia. At the date of verification it was installed and fully functional. The device is located on the large, flat roof of a 3 story building on a concrete balustrade (effective detector height ca. 1 m).

The data logger showed all status information ok and measurement ongoing.

*Verification activities do not give rise to particular remarks.*

#### 8.1.2 *Other equipment*

The verification team noted:

For use in the future radioactivity monitoring programme, two medium volume air samplers have been purchased (Derenda MVS6 and Leckel SEQ 47/50 LVS3 with filter changers and exchangeable heads; constant flow rate from 2,0 m<sup>3</sup>/h and 6,0 m<sup>3</sup>/h respectively using side channel blowers; filters with diameter of 47 and 50 mm respectively, temperature controlled and refrigerated).

For 2007 the purchase of a high volume air sampler has been foreseen.

Primarily for the use in labour inspection several instruments are available, e.g. three portable NaI(Tl) spectrometers (2 Canberra Inspector 1000, 1 Target Fieldspec), six gamma dose rate meters, one Genitron gamma dose rate probe, four electronic dosimeters and three alpha/beta contamination monitors. Also the presence of two Graetz X5 DE meters with telescopic probes used for measurements at long distances has been noted. Under certain circumstances these devices may also be used for special environmental monitoring tasks.

Electrical back-up is available.

*The verification team encourages the move to utilise a high volume air sampler and recommends contacting institutions abroad that may supply expertise in this field with regard to finding appropriate equipment.*

## 8.2 **The State General Laboratory (SGL)**

### 8.2.1 *Verification findings*

#### - General

The verification team noted that in the past several studies with regard to environmental radioactivity monitoring have been performed by SGL. At the time of the visit work on setting up a routine monitoring programme for environmental radioactivity was far advanced; this work was performed in close collaboration with RICS.

*The team endorses the cooperation of SGL with RICS in setting up a detailed routine environmental radioactivity monitoring programme taking into account the expertise of SGL in this field.*

- Laboratory equipment

The verification team visited the SGL laboratory 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 an electrical back-up system which provides full autonomy.

- Measuring equipment and calibration

The team noted that:

**With regard to gamma spectrometry:**

The 22% efficiency Canberra gamma-spectrometry system (addressed as the "old" gamma spectrometer) had a PC card problem and the maintenance company declared it as non repairable. However, laboratory staff managed to set up a provisional solution so that at the time of the visit the system was working.

The system has automatic spectral energy control. Calibration is performed with Amersham Mixed Radionuclide Sources in 1000, 500 and 250 ml Marinelli geometries, produced by Isotope Products Laboratories, USA (represented in Cyprus by Medisell). The team noted that no summing correction and no density correction is applied. For spectral energy control generally the sample's potassium-40 gamma peak is used. For resolution calibration cobalt-60 is used. For efficiency calibration control charts are drawn on an irregular basis and a recalibration is done if deemed necessary. Background spectra are collected and the background file is updated approximately every half year when indicated as necessary by trend analysis of the monthly background control measurements (option of the 'InterWinner' software).

Liquid nitrogen is delivered bimonthly for manual refilling of the HPGe detector dewars; refilling is recorded in a log book and signed.

*With respect to measuring equipment, the team endorses the purchase of an additional gamma spectrometer, to enable the laboratory to cope with the number of analyses to be measured in future.*

**With regard to alpha / beta counting:**

Calibration is done each time counting gas is changed using americium-241 and strontium-90 sources. Counting gas is Argon-Methane. Background measurements are done weekly. The radioactive sources for alpha / beta calibration come from the Czech Republic and are stored in a locked safe. The certificates were available for consultation during the verification, in the measuring room.

- Environmental samples and record keeping

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. The parameters and results of the treatment are 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.

*Verification activities with respect to sample preparation, measurements and record keeping do not give rise to particular remarks.*



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- Personnel

The team noted that there is a staffing issue. Only few people are available to perform all activities that the laboratory requires. In case of illness there is no staff back-up. Personnel are highly trained and motivated. Difficulties in the recruitment process due to the complicated procedure of contracting people have been discussed.

*The team suggests considering seriously the existing staff issue (too few persons for the projected workload).*

- Archiving

Since 2003 year Microsoft Excel® spreadsheets and Word® files are used for electronic storage of results, in parallel to the archived records on paper. Additionally, a new electronic template for reports has been created.

Samples (in the form supplied for measurement after pre-treatment) are stored at least for 5 years in order to ensure comparison and/or reference capabilities. From 2000 onwards measurement results have been archived on CDs and/or diskettes.

The team performed the tracing of a historical sample and its archiving. For this a milk powder sample with the registration number 12156/02 was chosen. The measurement data could perfectly be traced by the team and the archiving of the sample itself could be verified as well.

*Verification activities with respect to archiving do not give rise to particular remarks.*

- Quality control

The team verified records and preliminary results of SGL's participation in intercomparison exercises from 1995 (milk), 1999 (soil), and 2006 (milk).

SGL's radiation laboratory applies the same QA system (procedures, manuals etc.) as the already accredited laboratories and is in an advanced process of accreditation itself. The laboratory benefits from SGL's QA unit and its quality manager.

The laboratory used IAEA reference material for the development of sample preparation methods during the last years.

*The verification activities with respect to quality control do not give rise to particular remarks. The team fully endorses future participation in national and international intercomparisons. The team also encourages the foreseen full accreditation of the radiation laboratory according to ISO 17025.*

- Reporting

The verification team noted that results of environmental radioactivity measurements are reported by SGL to RICS on a regular basis. Final results are evaluated by RICS for compliance with the properly defined limits and for the assessment of exposure to ionising radiation; RICS updates and manages the national database and releases reports.

*The verification activities with respect to reporting do not give rise to particular remarks.*

### **8.3 The fertiliser factory and phosphogypsum site at Vassiliko ("NORM" plant)**

The verification team attended a presentation of the entire site, visited the disposal site of phosphogypsum situated close to the sea, and received detailed explanations concerning the future use

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and environmental monitoring of this area. It was informed about the approach to subcontract the decommissioning of the fertiliser plant to a specialised company through a call for tender.

*The team fully endorses the co-operation of RICS/SGL with the University of Cyprus and the University of Athens in the projected marine monitoring programme (in particular the part focussed on the Vassiliko site).*

## 9. CONCLUSIONS

All verifications that had been planned by the verification team were completed successfully. In this regard, the information supplied in advance of the visit, as well as the additional documentation received 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 newly installed or in an advanced stage of implementation or of planning. The Commission could verify the operation and efficiency of most of the facilities, even if not yet officially operational.
- (2) The team noted that current monitoring campaigns are not yet part of a well established routine programme, and it welcomes the efforts undertaken to set up such a routine programme in close collaboration between RICS and SGL.
- (3) A number of topical recommendations are formulated. These recommendations aim at improving some aspects of environmental surveillance in Cyprus. The recommendations do not discredit the fact that environmental monitoring in Cyprus is expected to be soon 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 with regard to the situation at the time of the verification. The full implementation of a routine environmental radioactivity monitoring programme, including the installation and functionality of all projected new equipment and of the recommendations issued by the verification team, will be verified by the Commission Services at the occasion of a follow up verification.
- (7) The verification team acknowledges the excellent co-operation it received from all persons involved in the activities it performed.

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**APPENDIX 1**

**VERIFICATION PROGRAMME**

**Monday 08 May**

1. Opening meeting: introduction and presentations at the Ministry of Labour and Social Insurance - Department of Labour Inspections <sup>(2)</sup>
2. Verification activities (ambient gamma dose-rate measuring system; environmental media sampling) in Lefkosia

**Tuesday 09 May**

3. Continuation of verification activities (ambient gamma dose-rate measuring system; environmental media sampling; foodstuff and feeding stuff sampling) at the Ministry of Health, State General Laboratory; in Lefkosia. Continuation of verification activities of the ambient gamma dose-rate measuring system in various locations of Western Cyprus

**Wednesday 10 May**

4. Continuation of verification activities (ambient gamma dose-rate measuring system; environmental media sampling; foodstuff and feeding stuff sampling) in Eastern Cyprus.

**Thursday 11 May**

5. NORM activities in Cyprus: verification of a fertiliser factory in Vassiliko and the associated phosphogypsum site. Monitoring/study project arrangements.

**Friday 12 May**

6. Closing meetings at the Department of Labour Inspections' premises and with the minister of Labour and Social Insurance in Lefkosia. Presentation of preliminary conclusions.

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<sup>2</sup> By those ministries and/or institutions that have statutory obligations with respect to national radiation monitoring and to site surveillance.

<b>LEGISLATION</b>
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**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 Euratom Treaty

**2 GUIDANCE DOCUMENTS**

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

<b>DOCUMENTATION</b>
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**1° LOCAL AUTHORITIES AND OTHER RELEVANT WEBSITES**

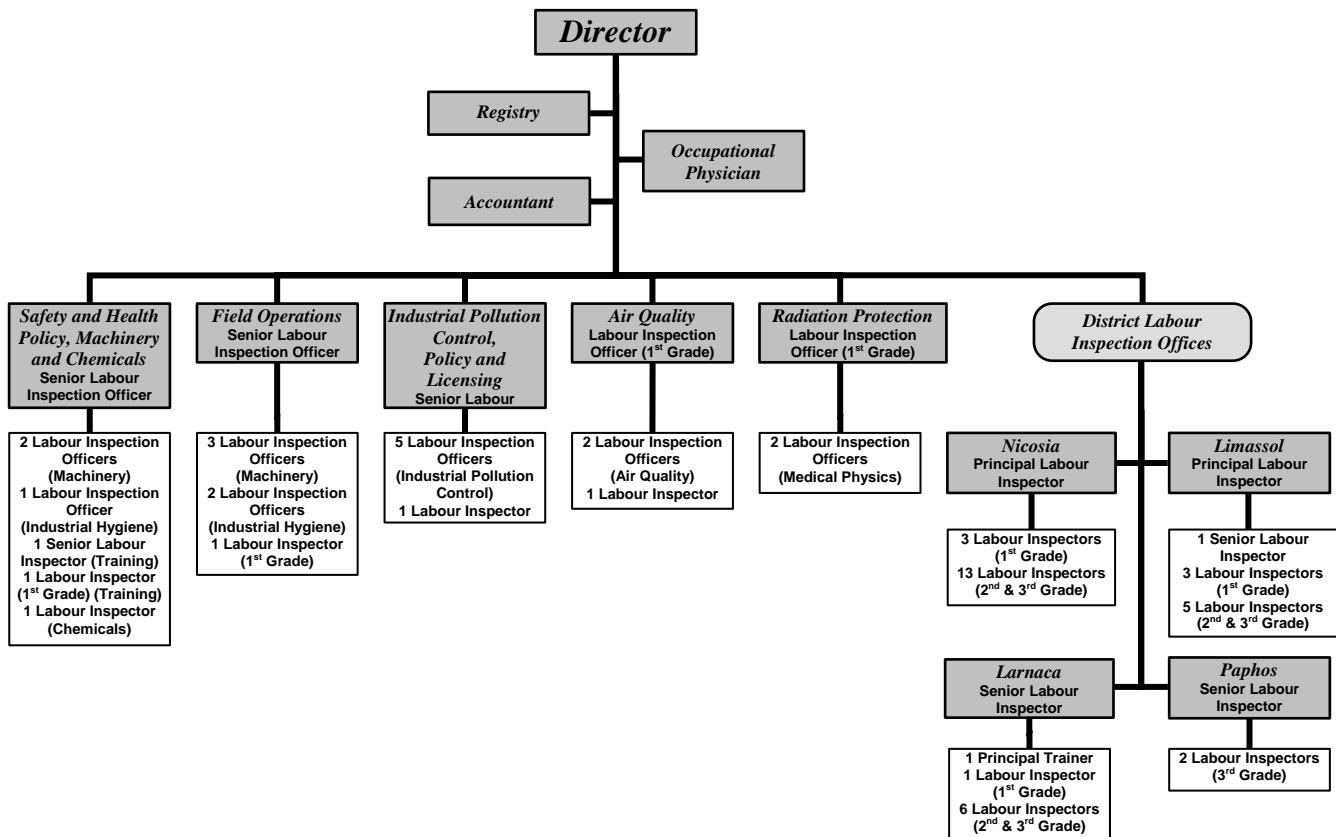
- 1) University of Cyprus  
<http://www-np.ucy.ac.cy/>
- 2) Ministry of Labour and Social Insurance, Department of Labour Inspections  
[http://www.mlsi.gov.cy/mlsi/dli/dli.nsf/dmlindex\\_en/dmlindex\\_en?OpenDocument](http://www.mlsi.gov.cy/mlsi/dli/dli.nsf/dmlindex_en/dmlindex_en?OpenDocument)
- 3) Legislation concerning radiation protection  
[http://www.mlsi.gov.cy/mlsi/dli/dli.nsf/dmllegislation\\_New\\_en?openform&p=9&t=f&e=](http://www.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](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/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](http://www.technidata.de)

**2° DOCUMENTS RECEIVED**

- 8) 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 08-12 May 2006.
- 9) Survey of Soil radioactivity in Cyprus, P. Kritidis, St. Michaelidou, P. Kaestner, Ch. Vandecasteele, F. Vosniakos, P. Misaelides
- 10) University of Cyprus, Faculty of Physics, Department of Nuclear Physics, 'Analyse and specifications of the environmental radioisotopes in different regions of Cyprus'. Final report of the research plan for 45/2001. - University of Cyprus, University of Athens, Greece and General Hospital of Lefkosia, Cyprus.
- 11) State General Laboratory, Presentation folder, 2002

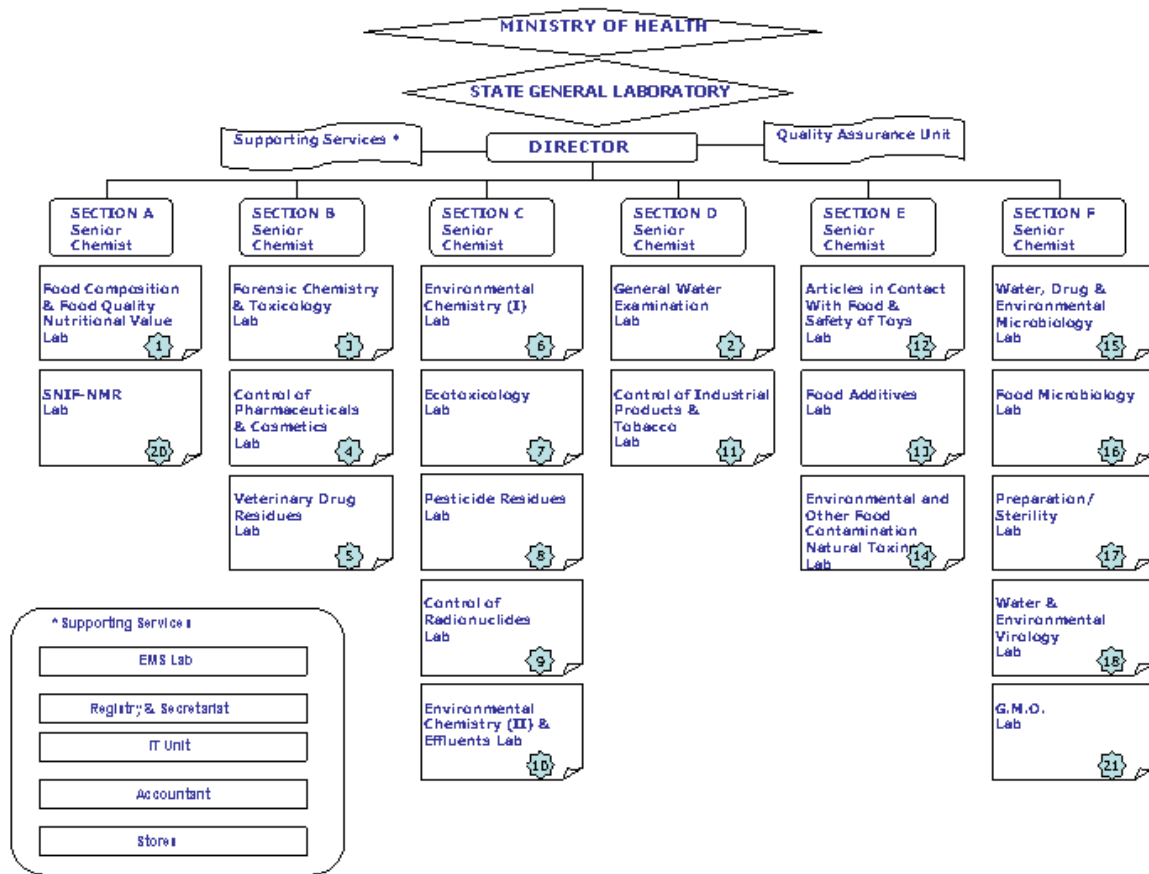
**APPENDIX 4**

**ORGANIGRAMME – DLI**



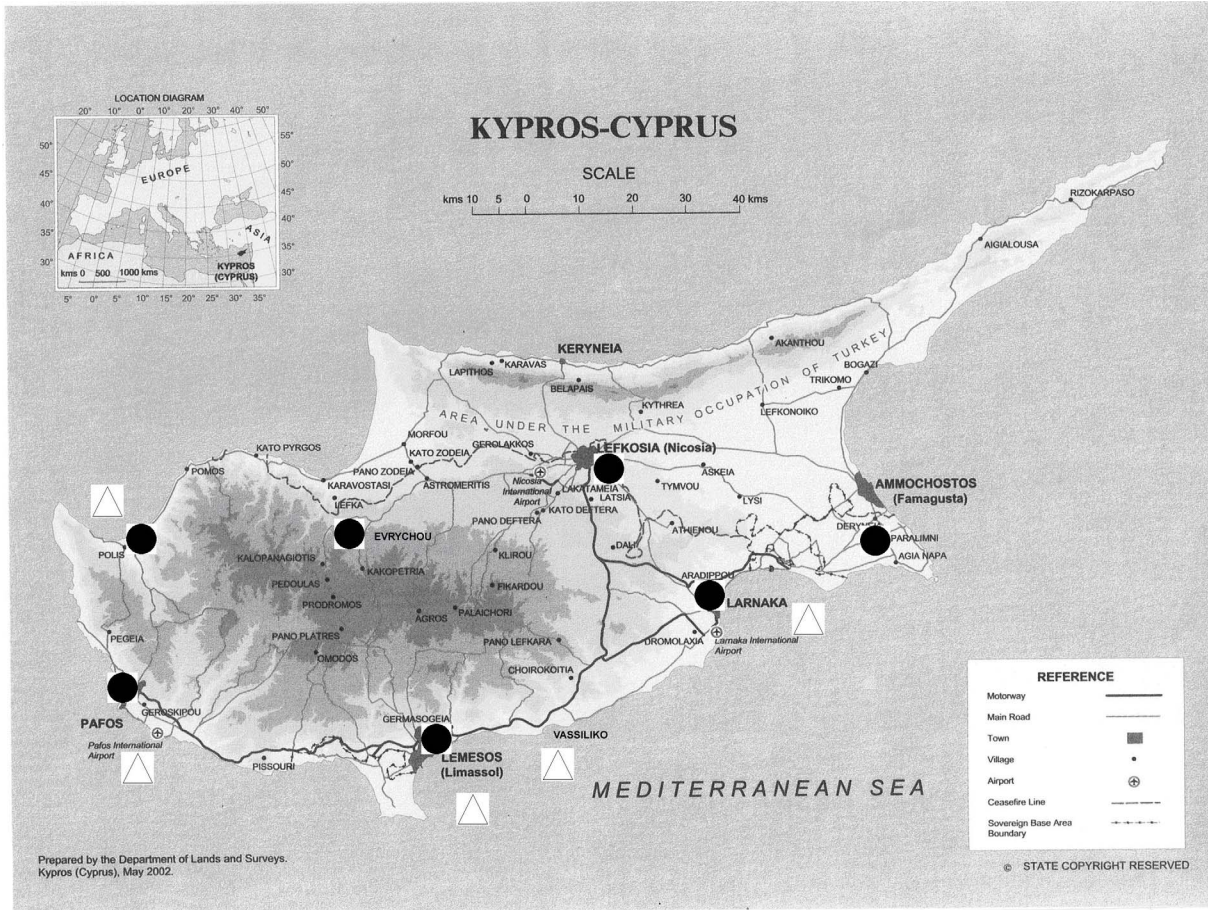
**APPENDIX 5**

**ORGANIGRAMME – SGL**



APPENDIX 6

**Cyprus Radioactivity Monitoring Network: dose rate measurement and marine sampling locations**



- Dose rate monitoring
- △ Marine samples