



Greek Atomic Energy Commission

# 2009 ANNUAL ACTIVITY REPORT





2009 ANNUAL ACTIVITY REPORT  
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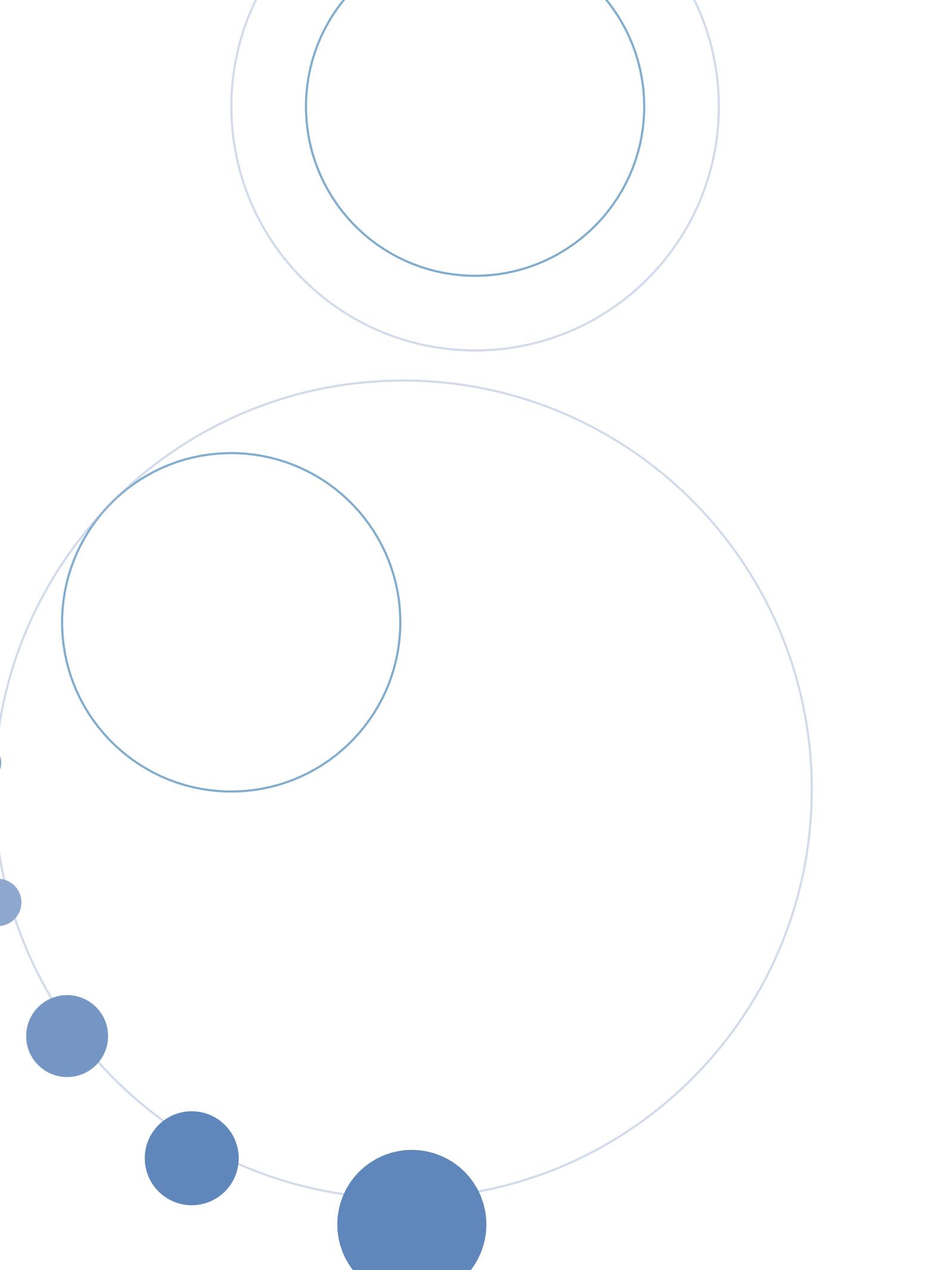
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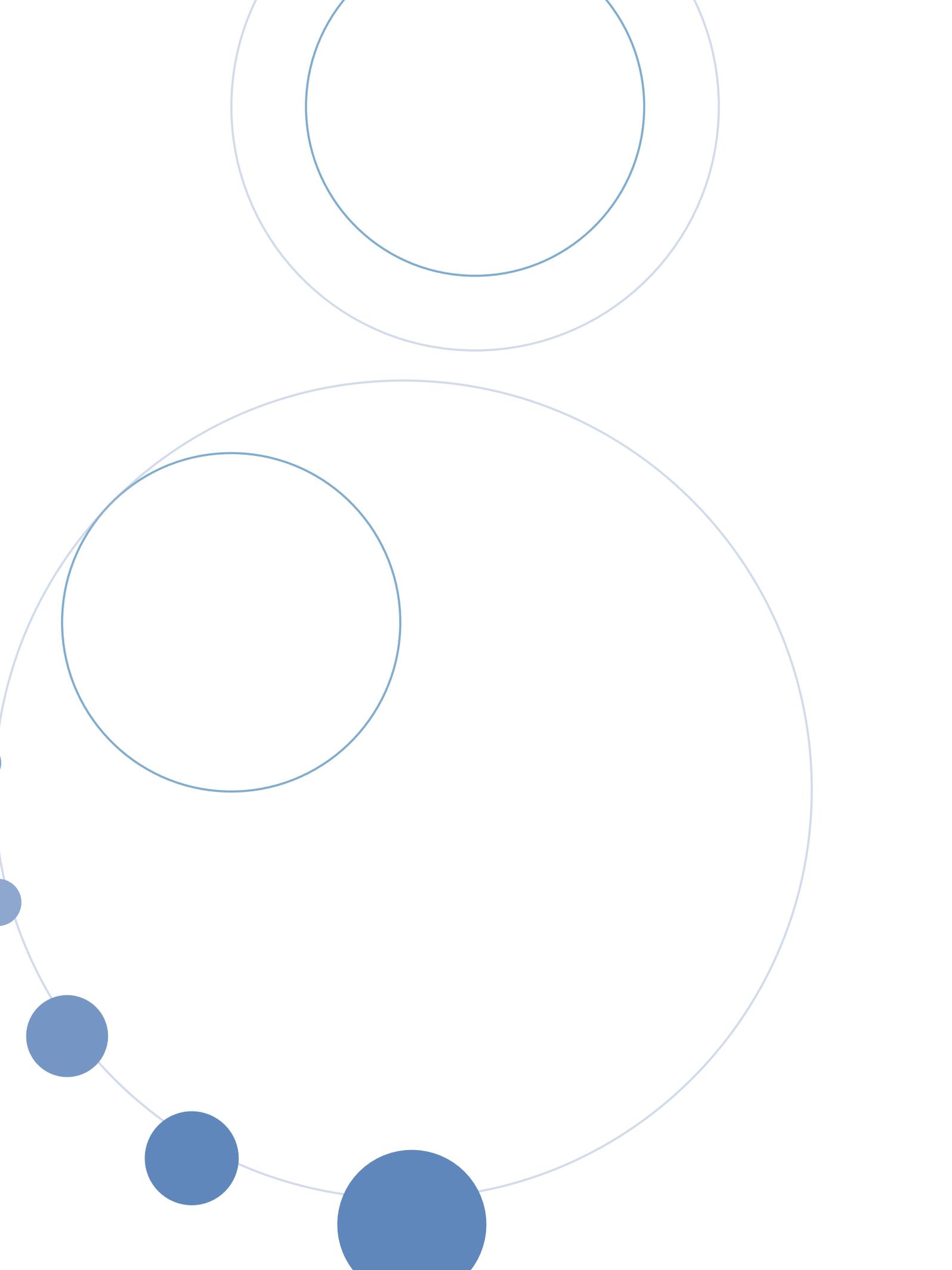
**Greek Atomic Energy Commission**  
**2009 ANNUAL ACTIVITY REPORT**

**Athens 2010**



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## Foreword

In the service of its remit, the Greek Atomic Energy Commission has been ensuring and strengthening the radiation protection and nuclear safety system in the country.

During 2009, GAEC established the criteria for competency certification in radiation protection for occupationally exposed workers (non medical staff) in the health sector; at the moment, an extensive training programme is in progress for these workers throughout Greece. This initiative renders education and lifelong learning a top priority for GAEC. Being acknowledged as one of the leading bodies for providing education in the fields of radiation protection and nuclear safety and security at European level, GAEC pursues the enforcement of radiological protection safety culture through education.

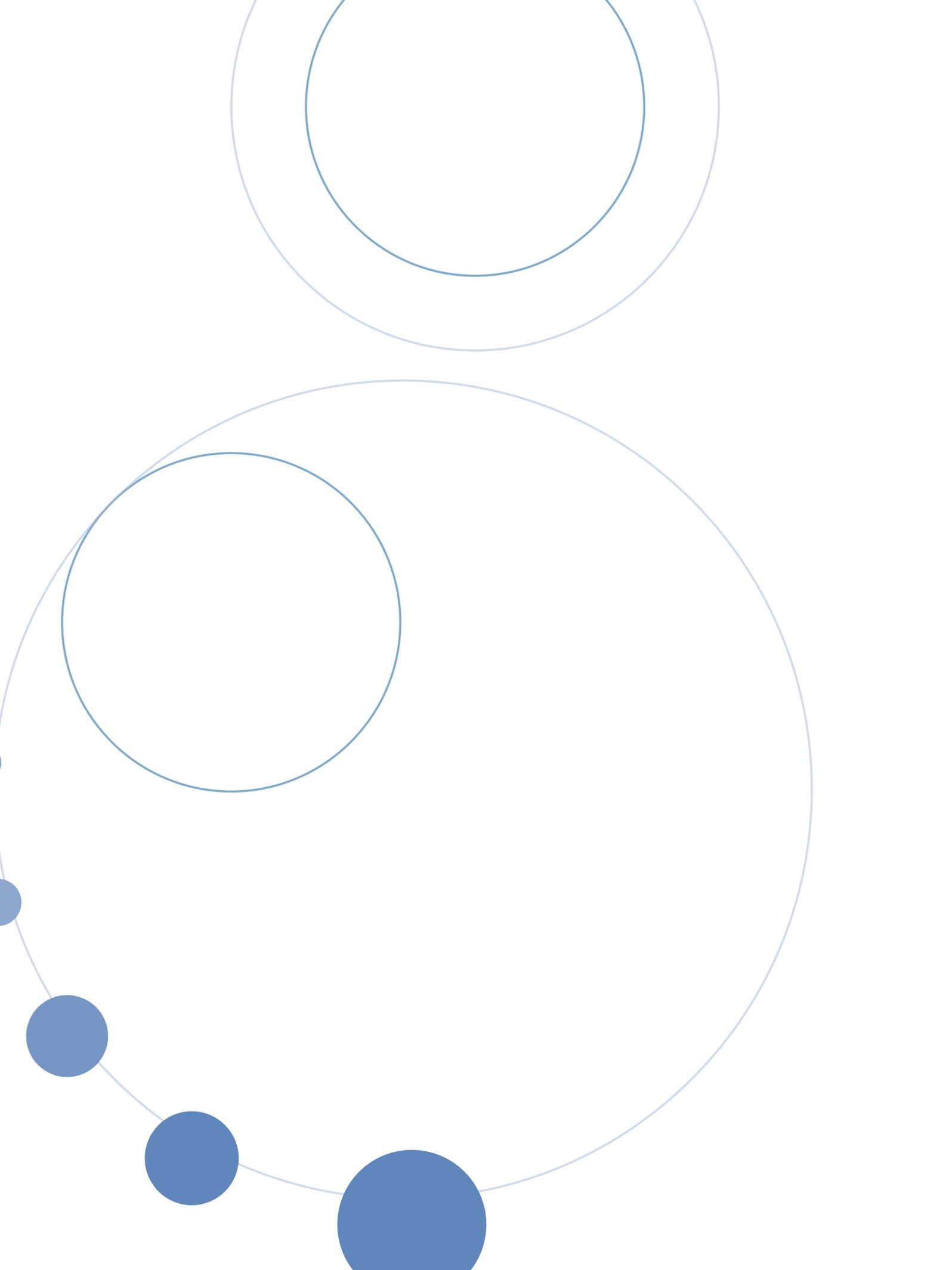
Furthermore, the legal framework that allows GAEC to authorize external work groups to perform electromagnetic radiation measurements was implemented through an international closed tender. This way, a high number of in situ inspections across the country was achieved (more than 1300 inspections were performed last year). At the same time, online access to measurement results through GAEC's website ensures citizens' direct information and inspections transparency.

GAEC status and operation is expected to be affected by the new EU legal framework for the safety of nuclear installations, published in 2009. According to this framework, the establishment at national level of an independent regulatory authority in the field of nuclear installations safety is required. GAEC has already begun the required preparations, as harmonization must have been accomplished by July 2011.

In 2009, the third review meeting of the Joint Convention on the Safety of Spent Fuel Management and on the Safety of Waste Management took place in Vienna, where GAEC presented successfully the national report.

GAEC's annual report offers its readers the opportunity to become aware of the role and achievements of our organization in the fields of inspections of ionising and non ionising radiation applications, monitoring of occupationally exposed individuals, environmental radioactivity levels monitoring, calibration of ionising radiation instruments, education and emergency preparedness. Common place and strategic goal in all these fields is the continuous improvement in the quality of the provided services through the incorporation of state-of-the-art science and the adoption of best practices internationally recognised.

**Dr. Christos Housiadas**  
**GAEC President**



# Introduction

During 2009, the Greek Atomic Energy Commission accomplished successfully its tasks, not only in terms of operational work, but also towards scientific and technological development. GAEC performs radiation protection inspections in laboratories using ionising radiation, ensures the monitoring of occupationally exposed workers, monitors environmental radioactivity levels throughout the country, calibrates the equipment used in ionising radiation laboratories, inspects the systems emitting electromagnetic fields and provides education and training. GAEC's staff continued to represent the country in committees and organizations dealing with issues of its competence.

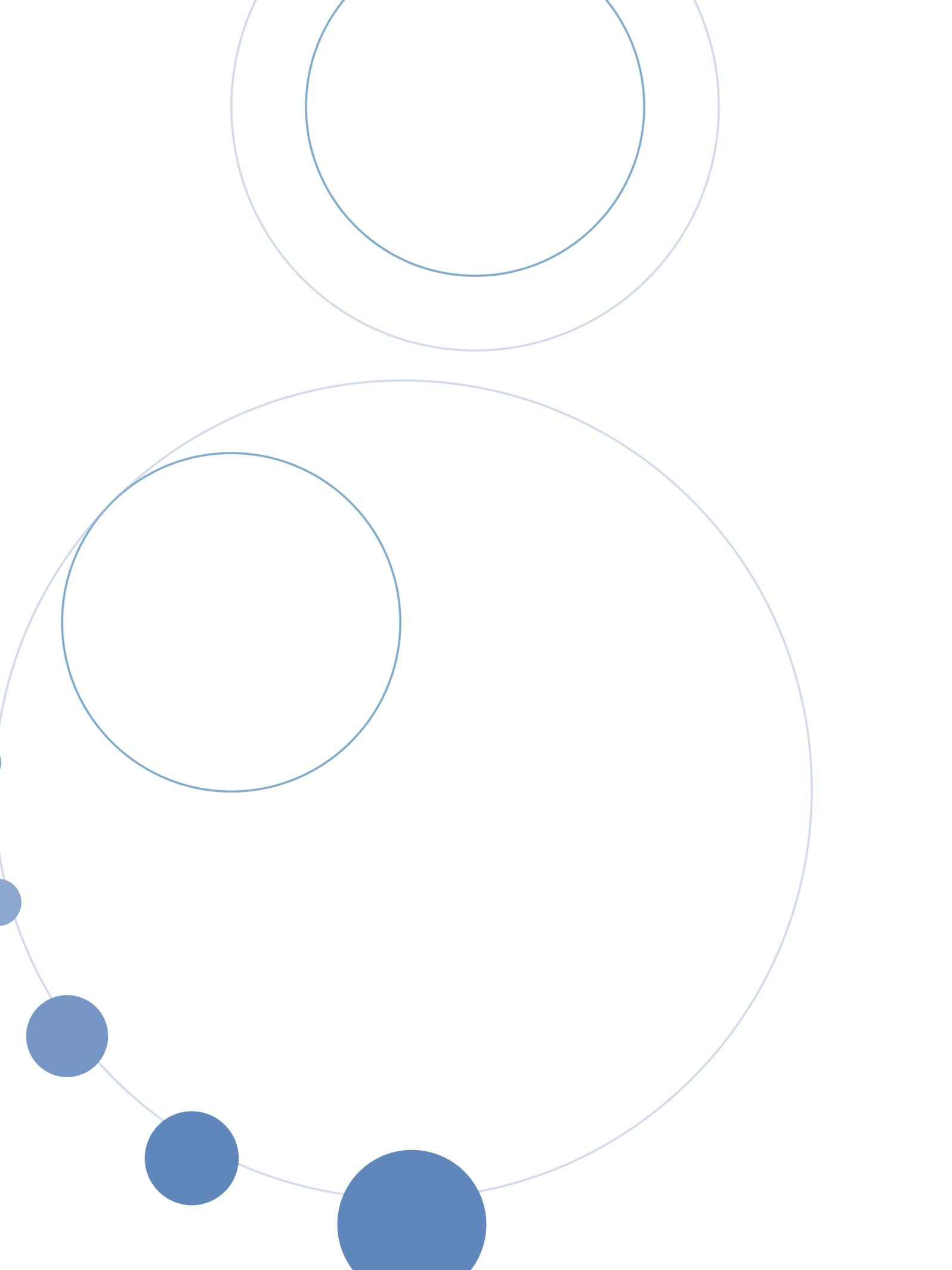
No accidents or radiological emergency situations have been recorded. The radioactivity levels recorded through the telemetric environmental radioactivity monitoring network (dose rate of total  $\gamma$  radiation in the air-ambient radiation) were normal.

GAEC made efforts to investigate thoroughly rumours regarding shipwrecks with radioactive waste in the Mediterranean Sea, in cooperation with the European Commission and other competent National Authorities. This permitted to obtain and provide reliable information about the issue to the Greek Authorities and the public.

In the field of research, ORAMED and COCAE projects, funded by the EU 7<sup>th</sup> Framework Programme, are in progress. In 2009, the EU-Trimer programme was successfully completed with the publication of the new European Technical Recommendations about the monitoring of occupationally exposed workers.

In 2009, GAEC has been placed under the Ministry for Education, Lifelong Learning and Religious Affairs, following a reform of the Ministries' responsibilities.

This activity report is issued both in Greek and English language. Full access to these files is provided at GAEC's website <http://www.gaec.gr>.



## GAEC at a glance

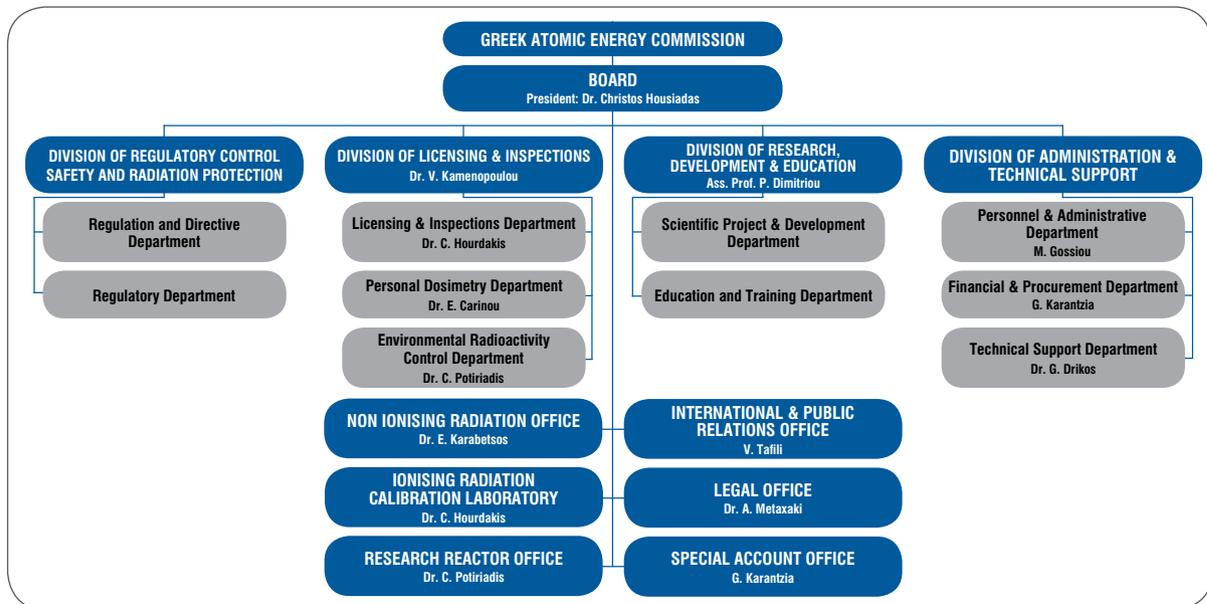
**The Greek Atomic Energy Commission (GAEC) is the competent National Authority, responsible for radiation protection and nuclear safety issues. GAEC was founded in 1954 and since 1987 it operates as a decentralized (independent) public service, supervised by the General Secretariat of Research and Technology. Its responsibilities are related to nuclear energy and nuclear technology issues, as well as radiation protection of the public, the workers and the environment from ionising radiation. GAEC is also responsible for the protection of the public from artificially produced non-ionising radiation.**

## Administration

GAEC is managed by a seven-member Board, chaired by the President. The Board composition is the following:

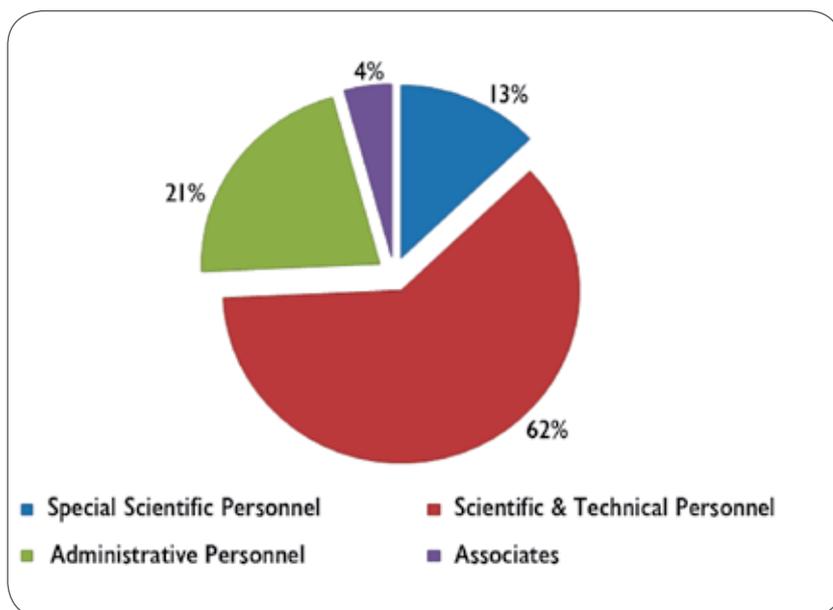
- President: Dr. C. Housiadas, Research Director, NCSR «Demokritos»
- Vice-president: S. Simopoulos, Professor, National Technical University of Athens
- Members: Th. Matikas, Professor, University of Ioannina  
 K. Strigaris, Associate Professor, National and Kapodistrian University of Athens  
 G. Nicolaou, Assistant Professor, Dimocritus University of Thrace  
 E. Georgiou, Professor, National and Kapodistrian University of Athens  
 Dr. G. Amanatidis, European Parliament, DG IPOL - Directorate A

**Diagram 1:** GAEC's organizational chart



## Human resources

GAEC is currently employing 70 persons. The high level of education background and scientific expertise characterize GAEC's personnel. Their continuous training and participation in scientific networks is encouraged in order to gain the knowledge and experience required for the fulfillment of their tasks. GAEC's employees are working under permanent and indefinite term contracts, as well as under fixed term contracts.

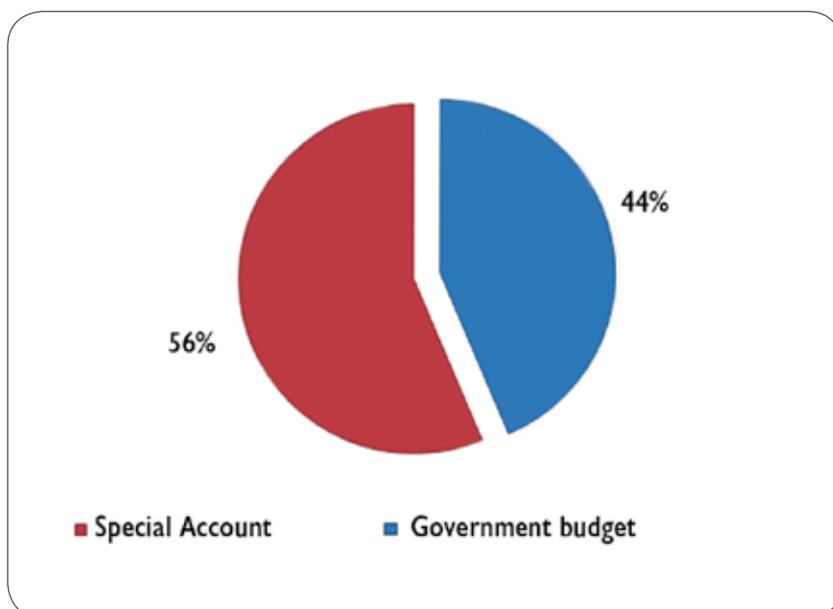
**Diagram 2:** Human resources

## Financial resources

GAEC is financially supported by two sources:

- government funds and
- services provision and funds coming from research and development projects (Special Account).

The ratio of these sources contribution to the GAEC's income account for the year 2009 was 44% and 56% respectively.

**Diagram 3:** Financial resources

The governmental financial support is used for the annual national contribution to the International Atomic Energy Agency and for some salaries and operative costs. Other type of expenses, such as new equipment acquisition, administrative costs and consumables are covered by GAEC's Special Account.

### **Information systems**

GAEC is equipped with up to date information systems, which play a supportive role to its activities. One of the most important systems is the National Radiation Protection Database containing:

- data regarding the laboratories using or producing radiation, such as equipment, shieldings, radiation protection inspections results and administrative issues (e.g. personnel)
- the inventory of the radiation sources used in the country
- the National Dose Registry Information System, where information related to occupationally exposed workers and the registered doses are kept. This database also includes data about the educational background of those working with ionising radiation
- the environmental radioactivity measurements' results
- the results from electromagnetic fields in situ inspections and measurements.

# Operational, educational and research/development work

**The multidimensional monitoring and control of the ionising and non ionising radiation applications and activities is one of GAEC's main functional responsibilities.**

## **Ionising radiation**

In the field of ionising radiation, the national radiation protection programme includes:

- inspections and licensing of ionising radiation applications
- individual monitoring of occupationally exposed workers
- environmental radioactivity control
- calibration of instruments of ionising radiation
- emergency response.

## **Non ionising radiation**

In the field of non ionising radiation, GAEC inspects the systems emitting low and high frequency electric and magnetic fields. Its role is especially important and affects the licensing procedure and the operation of antenna stations.

## **Development - Research**

In order to fulfill its educational and research tasks, GAEC cooperates closely with international organizations, such as the International Atomic Energy Agency, the European Commission and well known scientific networks and associations.

In the following pages GAEC's activities are detailed.

## Licensing and inspections of ionising radiation applications

GAEC performs on-site inspections for radiation protection and quality assurance purposes. GAEC's inspections and radiation measurements aim to assure the radiation protection of the public, workers and patients. Compliance of construction, operation and quality of installations, systems and devices with the specifications and terms defined in radiation protection regulations is also checked. Moreover, GAEC is responsible for issuing certificates of compliance and/or licenses for medical, industrial, research and other applications of ionising radiation in Greece, for licensing the import, export, possession, use and transport of radioactive materials and for keeping the national inventory of all radiation sources.

Tables 1 and 2 present the number and type of laboratories and radiation systems operating in the country (2009 data).

**Table 1:** Laboratories using ionising radiation (2009)

Type of laboratory	Number
Radiology	1180
Dental <sup>(*)</sup>	4812
Nuclear medicine	181
Radiotherapy	22
Brachytherapy	13
Teletherapy <sup>60</sup> Co	9
Research	222
Industrial	312
Veterinary <sup>(*)</sup>	148
Isotopes production unit (F18 – FDG)	1
Sterilization unit	1
<b>Total</b>	<b>6901</b>

<sup>(\*)</sup> dental and veterinary laboratories that have been inspected and licensed by GAEC. GAEC's database includes data for these laboratories.

**Table 2:** Systems and sources of ionising radiation (2009)

Radiotherapy		Diagnostic Radiology		Nuclear Medicine	
Linear accelerator	36	Radiography units	753	PET system	4
<sup>60</sup> Co	10	Radiology units	647	γ-camera system	151
Stereotactic Systems	2	Fluoroscopy units	29	Scintigraphy	4
Brachytherapy <sup>125</sup> I	7	Angiography systems	108	β counter	8
Brachytherapy <sup>192</sup> Ir	8	Computer tomography unit	347	γ counter	202
Brachytherapy <sup>137</sup> Cs	2	Mammography unit	546		
Computer tomography simulator	12	Mobile radiographic unit	397		
Classical simulator	13	Mobile fluoroscopic unit	223		
		Bone densitometer unit	526		
Dental		Industrial		Research	
Dental <sup>(*)</sup>	4970	Sources	909	Sources & systems	1094
Orthopantomograph	455	Radiography	31	Blood Irradiator	9
Dental computer tomographer	6	Soil Texture	94		
<b>Total: 11601</b>					

<sup>(\*)</sup> dental systems that have been inspected and licensed by GAEC. GAEC's database includes data for these laboratories.

## During 2009:

- the total number of inspections performed was 646. Tables 3 and 4 present their allocation according to the type of laboratory/application.

**Table 3:** Inspections of radiation laboratories (2009)

	Public sector	Private sector	Total	% of the total
Radiotherapy	7	4	11	20%
Radiology	165	262	427	36%
Nuclear medicine	9	29	38	21%
Dental	5	49	54	--
Research	12	1	13	6%
Industrial laboratories	16	37	53	26%
Industrial radiography	1	5	6	
Industrial sources		17	17	
Veterinary		20	20	--
Other	3	4	7	--
<b>Total</b>	<b>218</b>	<b>428</b>	<b>646</b>	

**Table 4:** Inspections of sources and systems of ionising radiation (2009)

	Public sector	Private sector	Total	% of the total
Radiotherapy	19	8	27	19%
Radiology	439	505	944	23%
Nuclear medicine	73	67	140	21%
Dental	22	681	703	--
Research	78	4	82	7%
Industrial laboratories	32	102	134	19%
Industrial radiography	4	16	20	
Industrial sources	2	62	64	
Veterinary		3	3	--
Other				--
<b>Total</b>	<b>669</b>	<b>1448</b>	<b>2117</b>	

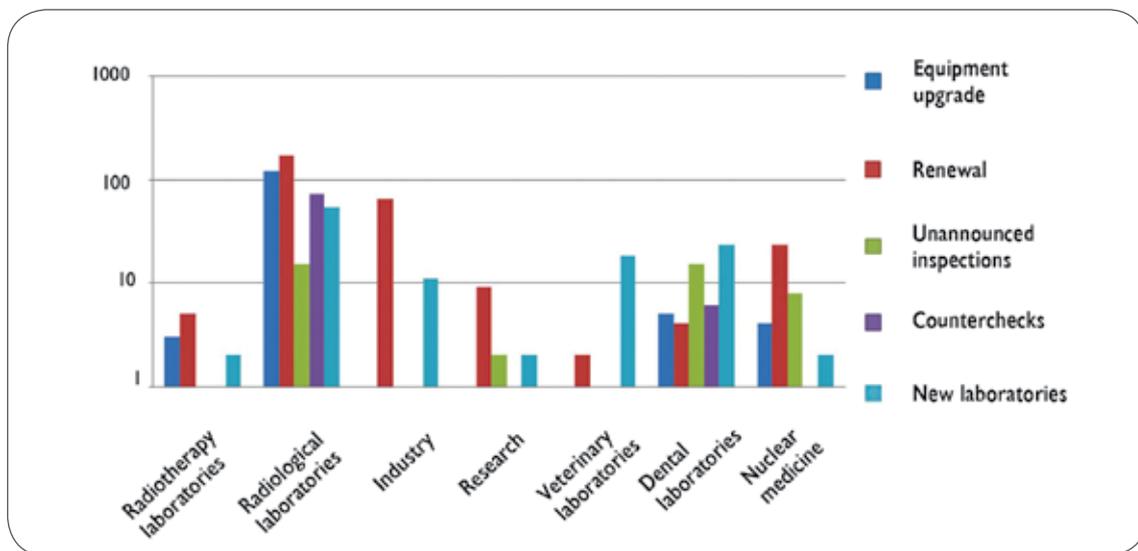
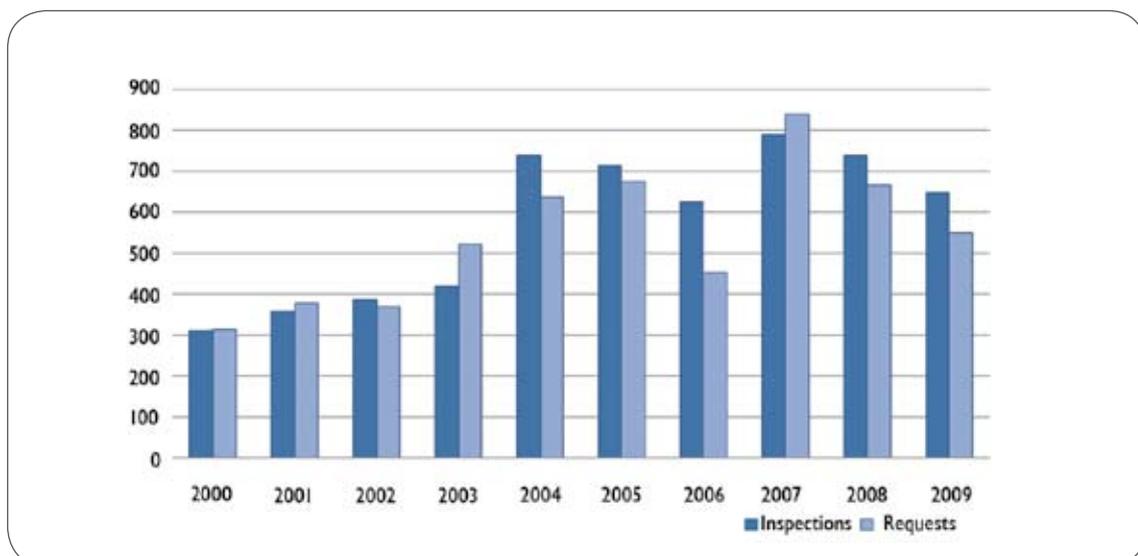
**Table 5:** Inspections to specific radiation equipment categories (2009)

Category	Inspections	% of the total
Linear accelerators	11	30%
<sup>60</sup> Co Teletherapy	3	25%
Brachytherapy HDR <sup>192</sup> Ir	2	25%
Radiotherapy simulators	7	28%
Radiology units	470	33%
Computer tomography unit	88	25%
Mammography unit	132	24%
Angiography systems	22	20%
Bone densitometer unit	132	25%
γ-camera system	32	21%
PET system	2	50%

- the unannounced inspections –mostly in diagnostic radiology medical centres– were intensified. Findings and recommendations of such inspections are communicated to the administration and the persons responsible for the laboratories who may need to take additional measures
- 68 pregnant women who were exposed to radiation for medical purposes contacted GAEC, in order to get information about the foetus dose, the probability of deterministic and stochastic effects and the probability of abnormalities and/or IQ index alteration
- in total 2815 documents were issued (Table 6).

**Table 6:** Number and type of documents issued in 2009

Document type	Number
Certificates of compliance	1069
Licenses to laboratories	109
Licenses for possession and use of radioactive sources	148
Radiation protection reports	197
Documents with recommendations for non-compliance appraisal	173
Licenses for isotopes use	293
Licenses for import/export/transport of sources	206
Other types of documents	620
<b>Total</b>	<b>2815</b>

**Diagram 4:** Type and number of inspections performed in 2009 per laboratory category**Diagram 5:** Progress in time of the applications number and the inspections performed

## Other activities

- a Quality Assurance Management System was prepared for the Licensing & Inspections Department activities, in compliance with the requirements of IEC/ISO 17020 standard and submitted to ESYD for obtaining accreditation; the first evaluation is expected to take place during 2010
- the isotopes supply license has been included in the compliance certificates and the operation license of Nuclear Medicine labs and the research applications using "open sources". The aim was to achieve greater flexibility and effectiveness of the licensing procedures.
- the on-line monitoring of radioisotopes and radiopharmaceuticals distribution and transport was improved in terms of the database access by multiple users, the introduction of multiple transports, as well as the immediate information of GAEC via electronic mail. This upgrade allowed for the activation of private transport companies already licensed for distribution/transport of radioisotopes, according to the legal framework
- a circular was issued under the title "Use of new technology mammography systems with W/Rh anodes" (July 2009)
- the inspection forms for dental laboratories were redesigned, in a way that all the data necessary for the evaluation of the radiological systems are described. The new forms help users avoid mistakes in their completion, which was the case in the past. Furthermore, certain parameters have been added to determine the Diagnostic Reference Levels in dental radiology activities. Overall, the new forms reflect fully the radiological protection parameters of dental laboratories
- a proposal for the approval of an applied research programme was submitted to the IAEA. The programme deals with the dosimetry of radiological systems of advanced technology, the applications in pediatric examinations and techniques high radiation doses to patients/examinants (IAEA Coordinated Research Project on the development of advanced dosimetry techniques for diagnostic and interventional radiology).

## Future actions

- minimization of time response to license renewal requests
- improvement and extent of the unannounced inspections in radiation laboratories
- inclusion of radioactive materials' importers into the radiological protection system
- inclusion of companies engaged in the installation, support and maintenance of ionising radiation systems into the radiological protection system
- participation in European and international development and research projects.

## Individual monitoring of occupationally exposed workers

GAEC monitors more than 12.000 workers who are occupationally exposed to ionising radiation throughout the country. GAEC's long experience in the field of radiation protection and monitoring of individuals, the upgrade of the provided services through the application of research results into daily practice, the modern equipment used, the quality assurance system (ISO 17025), as well as the well-trained personnel, contribute to the credibility of the measurements.

During 2009:

- 129.529 dosimeters were distributed; an increase of 5,6% was noted as compared to 2008 (Diagram 6). Since 2004, the number of distributed dosimeters is constantly rising each year
- the lowest percentage of the non-returned dosimeters has been achieved this year (2,52 %); this fact contributes to the prompt information of workers about the doses received, as well as to the reduction of the lost dosimeters and consequently the non recorded doses
- only a few complaints and notices of non compliance have been received referring to the laboratory quality assurance system (the overall assessment is positive).

### Results from the statistical analysis of the measurements during 2009

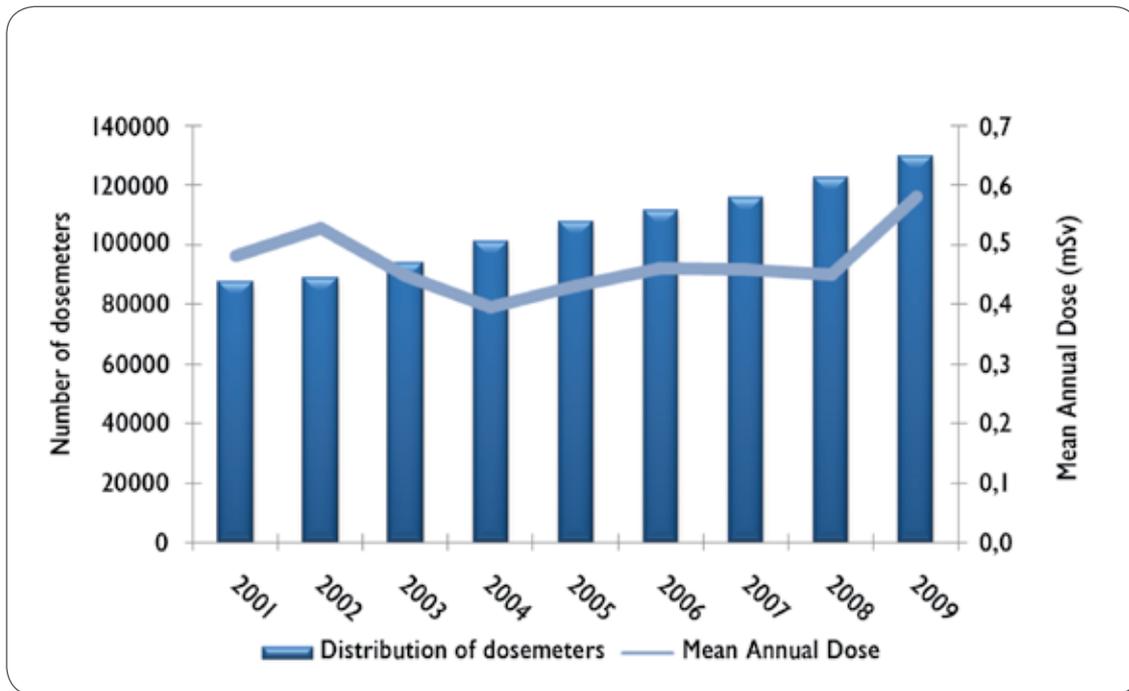
#### For the whole body dosimeters:

- the mean annual dose is 0,58 mSv, increased by 28% in comparison to the previous year (Diagram 6). The mean annual dose has been increased due to the change of system calibration. If zero doses are not considered, the mean annual dose of the occupationally exposed is 2,17 mSv, increased by 3% in comparison with 2008.

#### For the extremity dosimeters (wrist and ring):

- a decrease in the doses is observed in interventional cardiology and radiology sector; 12% and 27% for wrist and for ring dosimeters, respectively. Nevertheless, the doses in these two sectors still remain high
- a decrease in the doses (30%) recorded by the wrist dosimeters is observed in the category of nuclear medicine.

**Diagram 6:** Progress in time of the mean annual dose and the number of distributed dosimeters



## Overexposure cases

In 2009, the investigation level has been exceeded by 130 workers. In most of the cases the overexposure is due to the fact that the personal whole body dosimeter is worn above the lead apron in interventional radiology and cardiology departments. The doses were cancelled in 16 cases, because of the dosimeters' misuse (e.g. dosimeters placed by mistake inside the radiation field or dosimeters forgotten inside the radiation room).

## Other activities

- the dosimeter packing system has been improved. A bar code reader has been installed in order to check the sorting of the dosimeters before the monthly distribution. Appropriate software has been developed in order to support the order of controlling the dosimeters. By this way, if the sequence of the dosimeters is wrong or if a dosimeter is not in place, the packing procedure is automatically stopped by the software and a pop-up window indicates the error. Furthermore, an appropriate sensor has been placed in the packing machine and has been connected to the computer in order to warn the operator through the special designed software in case of a mechanical jam
- the calibration procedure has been changed. Due to this modification, the frequency of calculation of the  $K_{rem}$  factor (counts to dose factor) has changed. The monthly quality control has been abolished and the fading factor has been taken into consideration. Also, the criterion of the energy dependence algorithm has been re-evaluated
- 3000 new whole body dosimeters have been added in the dosimetry system; 2200 of them are new and 800 are recalibrated. Furthermore, approximately 100 new extremity dosimeters have been added in the dosimetry system (wrist and ring)
- the information leaflet entitled "Individual Monitoring" was updated and distributed to workers at the beginning of 2010. The new leaflet has an easy to use size and includes instructions for the proper use of dosimeters

- corrective actions have been taken for the use of extremity dosimeters in beta fields. More specifically, for the finger doses in mixed fields (photons and beta particles), a special dosimeter was designed which includes two pellets (MCP-N and MCP-Ns) placed behind a 0.02 mm thick aluminum foil. In order to study the response of these dosimeters, experimental measurements were carried out in beta fields ( $^{90}\text{Sr}$ ,  $^{85}\text{Kr}$  and  $^{204}\text{Tl}$ ), in photon fields with a variety of energies and in mixed photon – beta fields. The signals of dosimeters were analysed and appropriate algorithm was developed for calculating the doses
- GAEC has participated with three different types of dosimeters in an intercomparison exercise for extremity dosimeters organized by WG2 of the European Network EURADOS in 2009. The first group consisted of finger dosimeters which can be used in mixed fields of beta and gamma radiation. The second and the third group were wrist and finger dosimeters which can be used only in photon fields. For each group, 28 dosimeters were prepared according to the usual procedure (measurement, cleaning and packing). The dosimeters were irradiated at a secondary standard laboratory and then returned to GAEC, where they were measured according to the standard measurement protocol. The first dosimeter group showed the best response from all those examined in the exercise and the results were announced at the European Conference “Individual Monitoring of Ionising Radiation”, held in Athens from 8-12 March 2010. For the second dosimeter group, an overestimation of the doses was observed. Nevertheless, the results remain within the limits set by the European recommendations (RP 160). Finally, for the third dosimeter group there was no significant deviation between the actual and the measured value. GAEC’s participation in the intercomparison exercise is considered very satisfactory
- data relevant to the educational background of the occupationally exposed workers and their competency in radiation protection have been added to the National Dose Registry
- the accreditation of the laboratory was renewed according to the requirements of ELOT EN ISO/IEC 17025 standard (Certificate No. 117<sub>(2)</sub>).

### Future actions

- introduction of the new European Technical Recommendations (“Technical Recommendations for Monitoring Individuals Occupationally Exposed to External Radiation”, RP160) in the quality assurance system of the laboratory, replacing the previous one RP75 (quality controls, etc.)
- find a way to record information related to the workers’ data (name, surname, institution) at the back side of the dosimeter
- introduction of the new type of the ring dosimeter in the routine process
- correction actions for the dose estimation by neutron dosimeters.

# Environmental radioactivity monitoring

GAEC is monitoring radioactivity levels throughout Greece, activates the national emergency system in case of increased levels of radioactivity caused by a radiological or nuclear accident and updates the national database. The environmental radioactivity monitoring programme is based on the operation of the telemetric environmental radioactivity monitoring network, as well on the performance of laboratory measurements in samples of soil, food, drinking water, air filters etc.

## Telemetric environmental radioactivity monitoring network

The telemetric environmental radioactivity monitoring network consists of 24 dose rate monitoring stations, 4 river water monitoring stations in the northern part of Greece and 3 aerosol monitoring stations. These stations collect data for natural and artificial alpha, artificial beta and gamma radiation ( $^{137}\text{Cs}$ ,  $^{131}\text{I}$ ). Data are stored every ten minutes in a database connected with GAEC's website, where the mean daily values are announced, as well as with the European Radiological Data Exchange Platform (EURDEP).

## Upgrading aerosol monitoring stations

GAEC upgraded during 2009 the existing aerosol monitoring stations in order to optimize their operation. In detail:

- a new server was installed; its technical capabilities will allow for data uploading at GAEC's website (in progress)
- ADSL telephone lines replaced ISDN lines
- SMS information service will be available in case of alarm activation.

## Laboratory measurements

The laboratory measurements are performed by alpha and gamma spectroscopic analysis and total  $\alpha/\beta$  measurements in:

1. soil, water, food, air filters samples
2. air filters
3. foods for exportation
4. imported commodities
5. drinking water and especially samples from the public water supply system, tap water, mineral water and drill water
6. building materials and their basic components

7. samples from materials with increased levels of natural radioactivity (NORM)
8. samples from places with increased levels of natural radiation, such as radon concentration
9. materials with increased levels of radioactivity detected in the scrap metal loads
10. smear tests of radioactive sources.

The number of measurements performed by each method during 2009 is following:

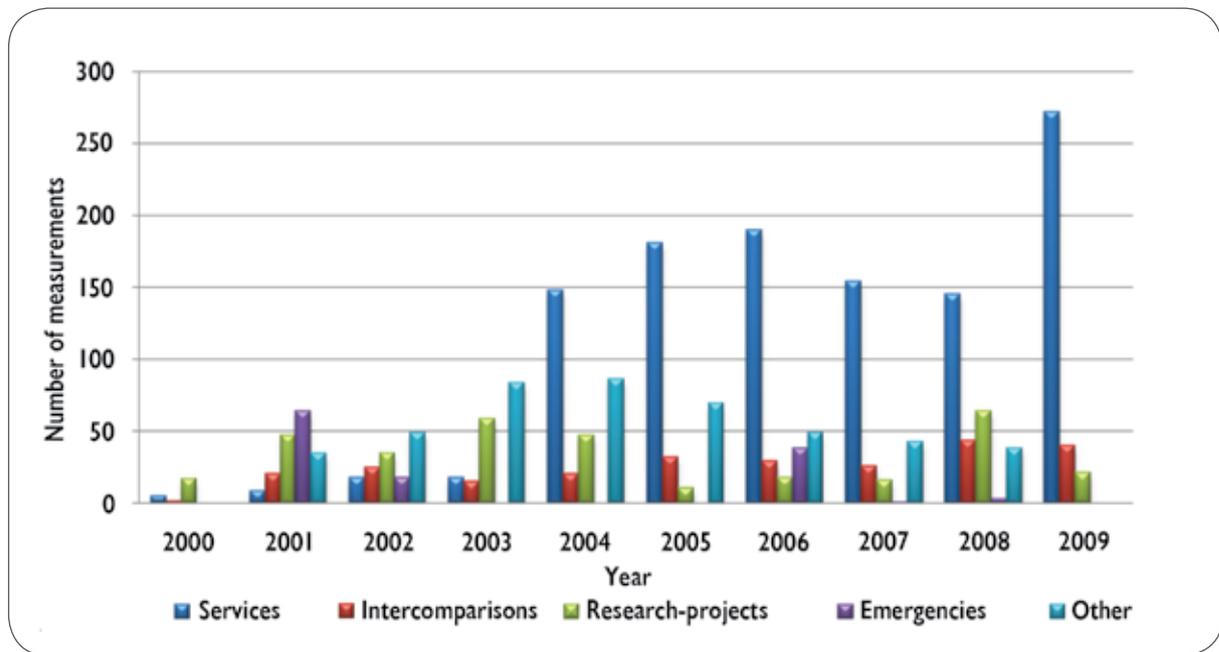
#### **$\alpha$ -spectroscopy**

212 measurements performed by means of  $\alpha$ -spectrometry, in order to determine the activity concentration of uranium isotopes, radium, plutonium, americium, curium, thorium and polonium.

#### **Total $\alpha/\beta$ radiation**

121 samples measured by means of total  $\alpha/\beta$  counting.

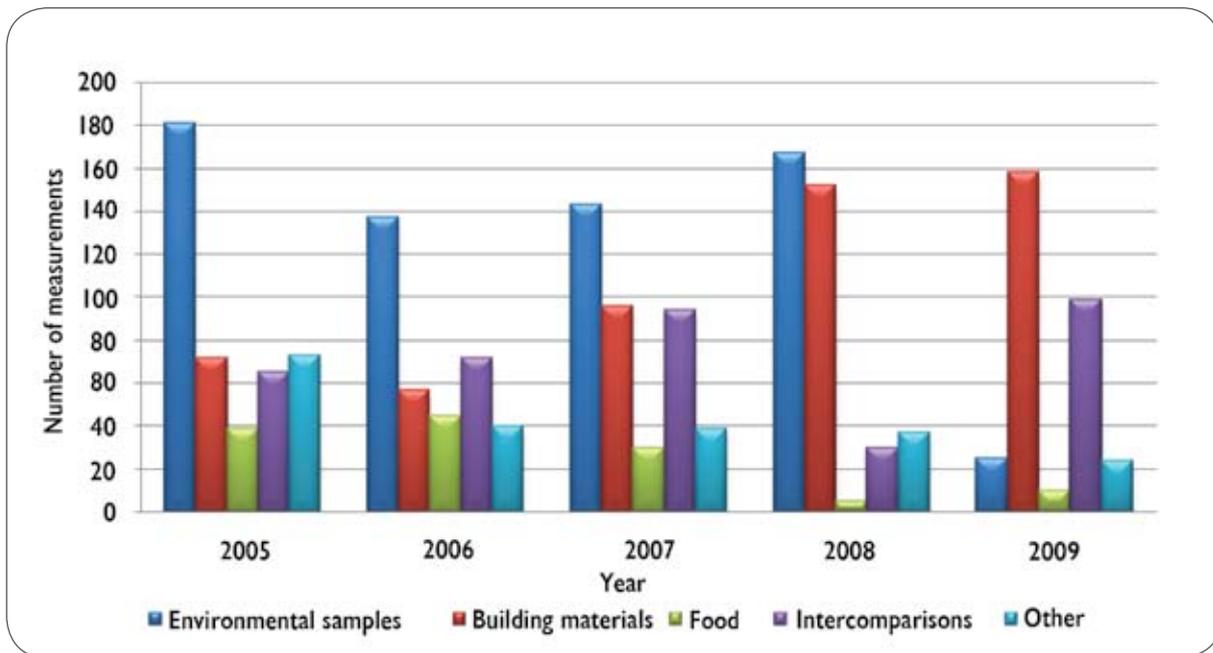
**Diagram 7:**  $\alpha$  and  $\alpha/\beta$ -spectroscopy measurements during the years 2000-2009



#### **$\gamma$ -spectroscopy**

$\gamma$ -spectrometry was performed in 316 samples.

**Diagram 8:**  $\gamma$ -spectroscopy measurements during the years 2005-2009



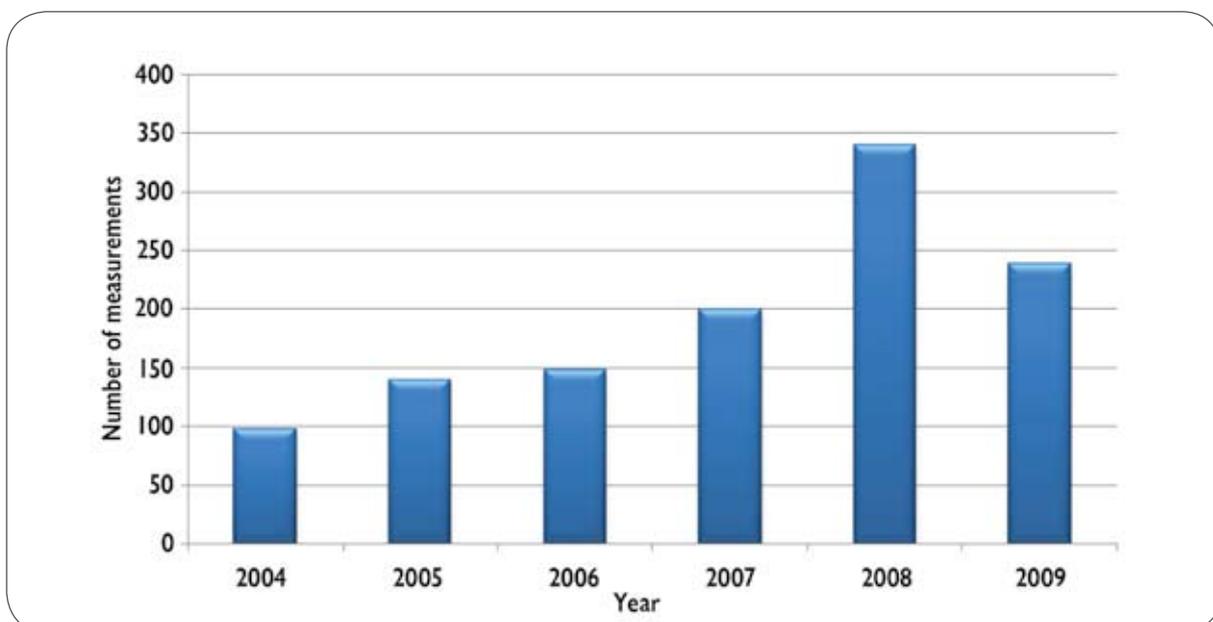
### Furthermore, during 2009, GAEC performed the following measurements:

#### Radon measurements

Radon was measured in 29 dwellings and 68 workplaces. Additionally, 100 measurements performed to calibrate the new measurement system. Additionally, electret detectors were used in 42 measurements.

GAEC in cooperation with the Medical Physics Laboratory of the University of Athens distributed 600 radon dosimeters in Cyprus for radon measurements in dwellings.

**Diagram 9:** Radon measurements during the years 2004-2009



### Whole body measurements

6 journalists travelling to Kazakhstan were submitted to whole body measurements. Furthermore, radiation protection advices and equipment were provided to them.

### Liquid scintillation counter measurements

More than 200 measurements of tritium  $^3\text{H}$  were performed for calibration reasons using the low background liquid scintillation counter.

### In situ inspections

42 in situ inspections were performed by means of absorbed dose rate measurements in dwellings and imported scrap metal loads. The total number of radioactivity certificates for imported scrap metal issued was 335. The fixed radiation detection systems' alarms were activated twenty times.

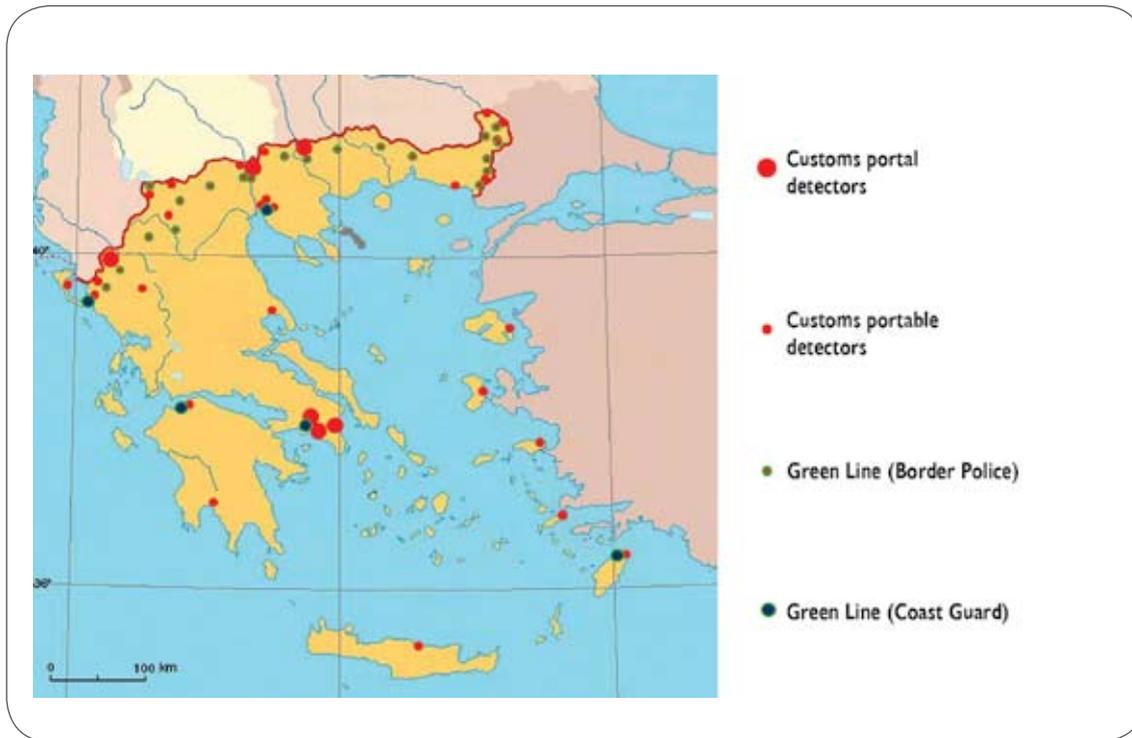
### Other activities

- participation in intercomparison exercises performed by  $\alpha$ - and  $\gamma$ - spectrometry (IAEA-CU-2009-04 "Proficiency test on determination of radionuclides in air filters", IAEA-CU-2009-03 "Proficiency test on determination of radionuclides", National Physical Laboratory "Environmental radioactivity Proficiency test exercise 2009", BfS, Procorad)
- the technical infrastructure was upgraded, since a new automatic system for measurements of radon dosimeters (trach-etch detectors) was installed
- contribution to the establishment of a legal framework regarding the terms of operation for therapeutic springs and spa centers, as well as the documents needed for acquiring a special operation license
- contribution to the establishment of a legal framework concerning the characterization of natural springs
- organization of the second phase of a national intercomparison exercise that had begun in 2006 and aimed at the preparedness improvement of the laboratories network collaborating with GAEC in emergency situations. During the second phase of the intercomparison exercise, measurements of natural radioisotopes in fly ash samples were performed. Announcement of results is anticipated during 2010
- accreditation of measurements performed with  $\gamma$ -spectroscopy was renewed according to the requirements of the ELOT EN ISO/IEC 17025 standards (Certificate No. 117<sub>(2)</sub>).

### Combating illicit trafficking in radioactive materials

Aiming at the prevention of illicit trafficking in radioactive materials, the country's entrance points have been equipped with radioactivity detectors. In detail, fixed systems of radioactivity detection are installed at six customs offices. Portable radioactivity detectors have been distributed to 26 customs offices, 20 border police stations and 5 coast guard offices. GAEC monitors all radiological incidents in cooperation with customs authorities; in case of emergency it activates its response plans and updates the IAEA Illicit Trafficking Database respectively. Following the terms of the official agreement between the Ministry of Economy and GAEC regarding the maintenance and calibration of the customs offices' radiation detection systems, the portable radioactivity detectors used by customs officers were calibrated. Maintenance of these systems is performed on a monthly basis.

**Photo 1:** Check points throughout Greece



### Future actions

- the development of methods for  $\alpha$  and  $\beta$  radiation measurements using the low background liquid scintillation counter (Quantulus)
- the accreditation according to ISO 17025 standard in more measurement fields
- development of a radon measurement method in water using electrets.

## Response to emergency situations

GAEC, as the competent authority for responding to radiological or nuclear emergencies, participates in the General Plan for Civil Protection "Xenokritis", as well as in the National Emergency Plan for Nuclear, Radiological, Biological and Chemical (NRBC) threats. Furthermore, GAEC is connected with the early notification systems ECURIE and ENATOM of the European Commission and the IAEA respectively.

During 2009, GAEC supported with its participation an initiative coordinated by the General Secretariat for Civil Protection aiming at drafting a national plan for response to Nuclear, Radiological, Biological and Chemical (NRBC) threats. A similar effort is in progress at European level too; GAEC's personnel represent the country in European Commission working groups assigned with the drafting of a similar European emergency plan.

Last year GAEC participated in the following exercises:

- **International exercise ConvEx – 2b**  
ConvEx-2b exercise was organized by the International Atomic Energy Agency on May 26, 2009. According to the exercise scenario, there were rumours for a nuclear power plant accident in a neighboring country. As a result, GAEC activated the network of collaborating laboratories.
- **ECURIE exercise**  
As a member of ECURIE early notification system, GAEC planned and implemented an exercise on November 12, 2009. According to the exercise scenario, high radioactivity levels were detected on a Greek island. The actions necessary for responding to this kind of radiological emergencies were simulated.

No accidents or radiological emergency situations have been recorded during 2009.

In February 2009, steel products of Indian origin, contaminated with radioactivity, were located in Europe, setting in alert the radiation protection authorities in European countries. The EU member states were notified via the ECURIE early notification system. At national level, GAEC performed radioactivity measurements and asked the customs offices authorities, where radiation detections systems are installed, to be in alert too. At the same time, GAEC cooperated with other European authorities for information exchange. After inspections and measurements performed, the use of contaminated steel in Greece was not confirmed.

Furthermore, efforts were made to investigate thoroughly in cooperation with the European Commission and other authorities rumours regarding shipwrecks with radioactive waste in the Mediterranean Sea. This way could provide credible information about the issue to the Greek authorities and the public opinion.

# Calibration of ionising radiation instruments

The Ionising Radiation Calibration Laboratory (IRCL) is a secondary standard dosimetry laboratory that has developed and maintains the national standards of Gy, Sv, Cb/kg (for  $\gamma$ , X and  $\beta$  radiation). IRCL provides calibrations in terms of Air Kerma, Absorbed Dose in water, Personnel Equivalent Dose Hp(10) and Hp(0,07), Ambient Dose Equivalent H\*(10) in the fields of radiotherapy, diagnostic radiology and radiation protection. IRCL is the national metrology laboratory and has an official partnership with the National Metrology Institute.

## During 2009:

- the IRCL calibration fields were accepted by BIPM and were published at BIPM - CIPM MRA Appendix C Calibration and Measurement Capability (CMC) Declarations database. CMCs describe the offered services, mutually recognized by all the metrology laboratories around the world. CMCs include data regarding the dosimetric quantities and units, quantitative data for measurement range and uncertainty, the standards followed and data for the services provided. IRCL CMCs are presented at the BIPM website <http://kcdb.bipm.org/appendixC/>. The accuracy and traceability of the dosimetric quantities and units are confirmed by intercomparisons supporting each CMC. The IRCL CMCs are supported by EURAMET (European Metrology), IAEA and European Accreditation intercomparison projects, as well as by official collaborations.

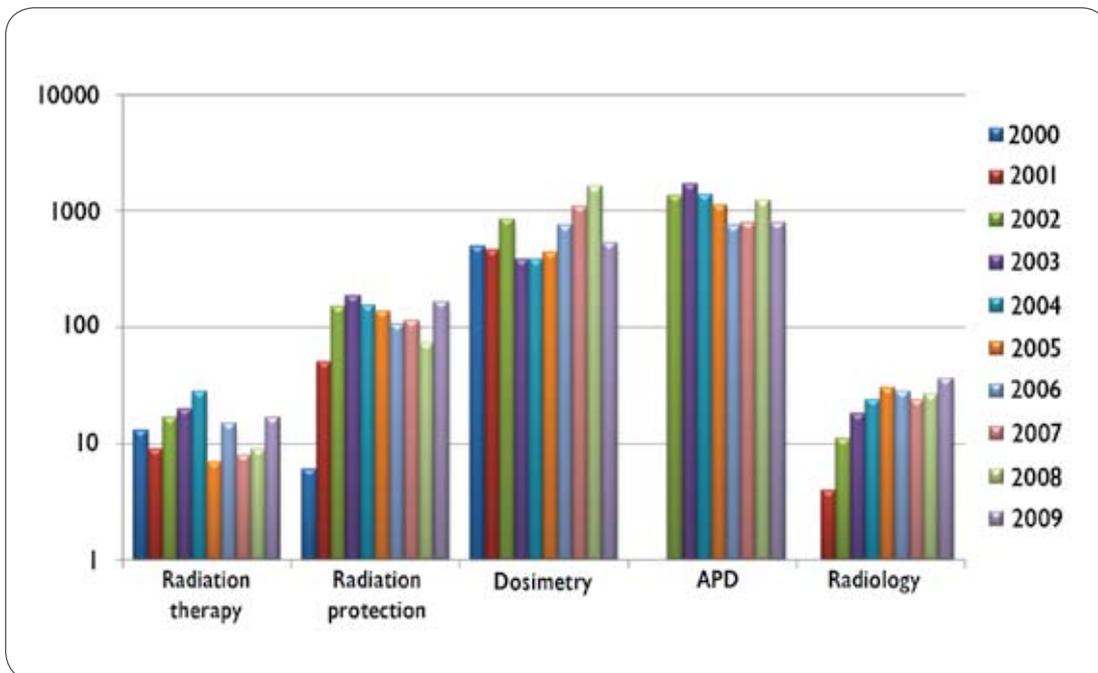
The evaluation of the CMCs by all Metrology Organizations in America, Asia, Africa, Europe and Australia is a prerequisite for their approval. Publication of CMCs in BIPM databases ensures credibility and reliability of the metrology services provided by IRCL/GAEC-NMI at global level and the services provided are officially disseminated.

- IRCL provided calibration services in radiotherapy, brachytherapy, diagnostic radiology, radiation protection, individual monitoring. In total, 110 certificates were issued
- during the quality control and quality assurance programme of the IRCL, more than 350 check points were measured and compared to the baselines. This kind of control is performed regularly (monthly, bimonthly, biannually, annually), as well as after recorded deviations or amendments to the equipment used.

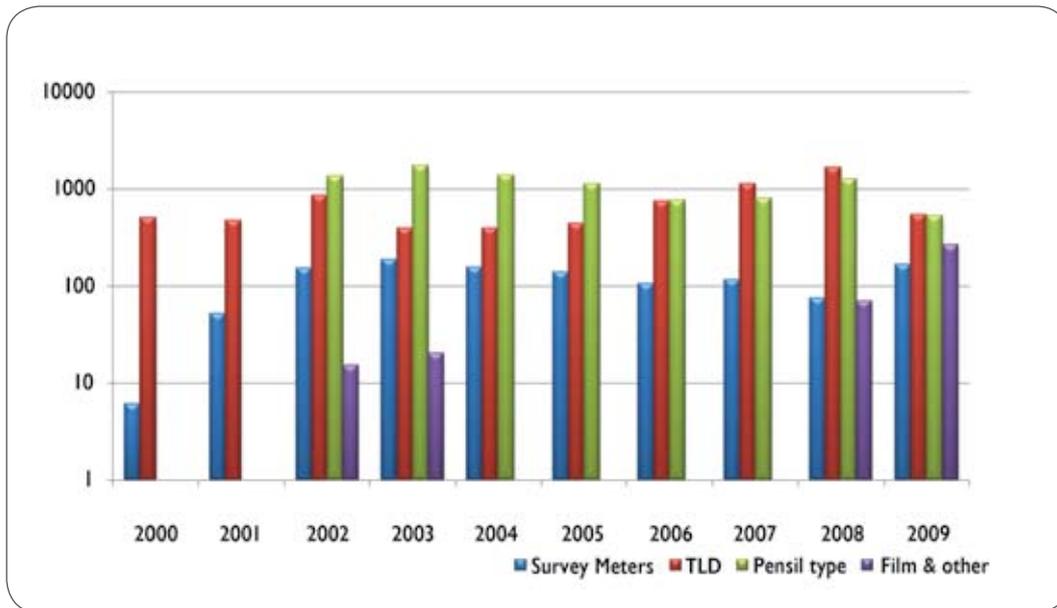
**Table 7:** Number of calibrations (2009)

Field	Number of instruments
Radiotherapy ionization chambers – electrometers	17
Brachytherapy ionization chambers – well type ( $^{192}\text{Ir}$ & $^{137}\text{Cs}$ )	3
Diagnostic radiology dosimeters	24
Non invasive kVp meters, timers and multimeters used in diagnostic radiology	12
KAP meters – calibrations at IRCL	2
Survey meters	167
TLD irradiations	536
Pencil type dosimeters –APD	790
Custom offices - Survey meters	81
Custom offices - Pagers	198

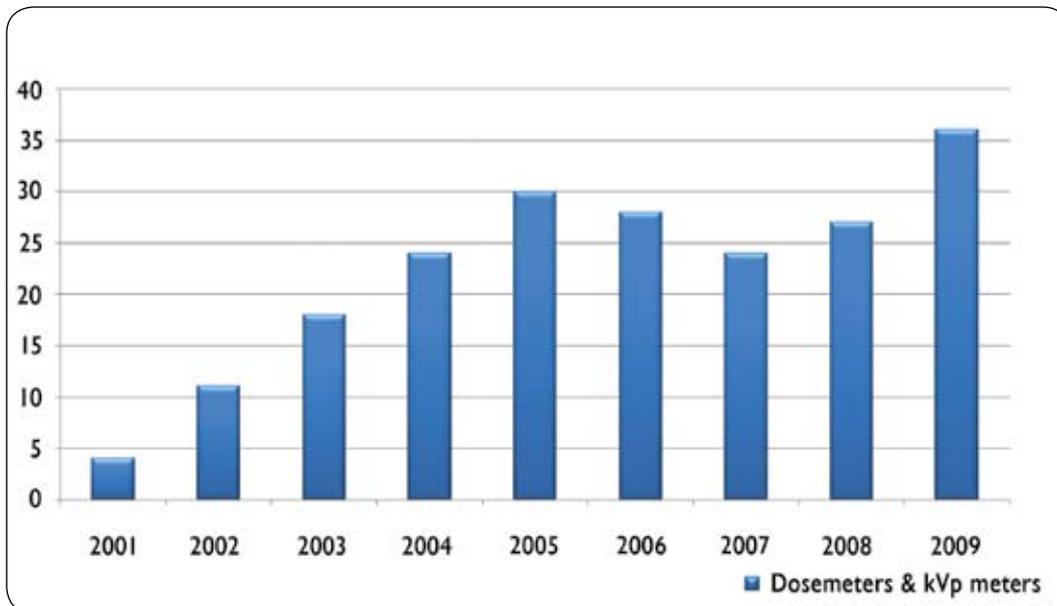
- customer satisfaction from calibration services was 4,7 (scale 1-5). The questionnaire used for the IRCL evaluation concerns technical sufficiency, results, support, communication and the help offered
- ICRL participated in the IAEA intercomparison project entitled: "IAEA TLD audit in radiotherapy". From 2000 to 2009 ICRL has participated in 20 international and European intercomparisons in the fields of radiotherapy and radiation protection, organized by the IAEA and the EURAMET network. The results from the participation in these intercomparisons were satisfactory.

**Diagram 10:** Calibrations during the period 2000 – 2009

**Diagram 11:** Calibrations in radiation protection during the period 2000 – 2009



**Diagram 12:** Calibrations in diagnostic radiology



## Other activities

- a new radiological CONTROL-X system was installed in the laboratory. The system consists of a high frequency generator 30 kHz and operates as a radiography (50 – 800 mA), as well as a fluoroscopy system (< 5 mA), producing 50 – 150 kV X-rays. Suitable filters have been placed into the system to achieve RQR beams. The Quality Assurance Programme is applied for this system too, and is used for kV-meters and diagnostic radiology dosimeters calibrations. Also, the calibration methodology of the laboratory mammography system was upgraded

- an international closed tender for the replacement of the  $^{60}\text{Co}$  source of the radiotherapy system PICKER was announced. The tender was not fruitful and is going to be repeated during 2010 based on the same technical specifications and terms
- a calibration programme for the radioactivity detection equipment (survey meters και pagers) used by border guards and customs offices personnel was implemented in 2009. In total, 81 survey meters and 198 pagers were calibrated
- the accreditation for measurements performed for calibrations in radiation therapy, diagnostic radiology, radiation protection and individual monitoring was renewed according to the requirements of ELOT EN ISO/IEC 17025 standard (Certificate No. 116).

### **Future actions**

- revision of computer tomography chambers calibrations according to new standards (2010)
- reduction in the time required for calibration/results certificates issuing.

# Electromagnetic fields inspections

GAEC is responsible for the protection of the general public and the environment from artificially produced non-ionising radiation (electromagnetic fields) and provides relevant information to any interested party. GAEC's control activities include high frequency electromagnetic fields, as well as low frequency electric and magnetic fields.

## High frequency electromagnetic fields

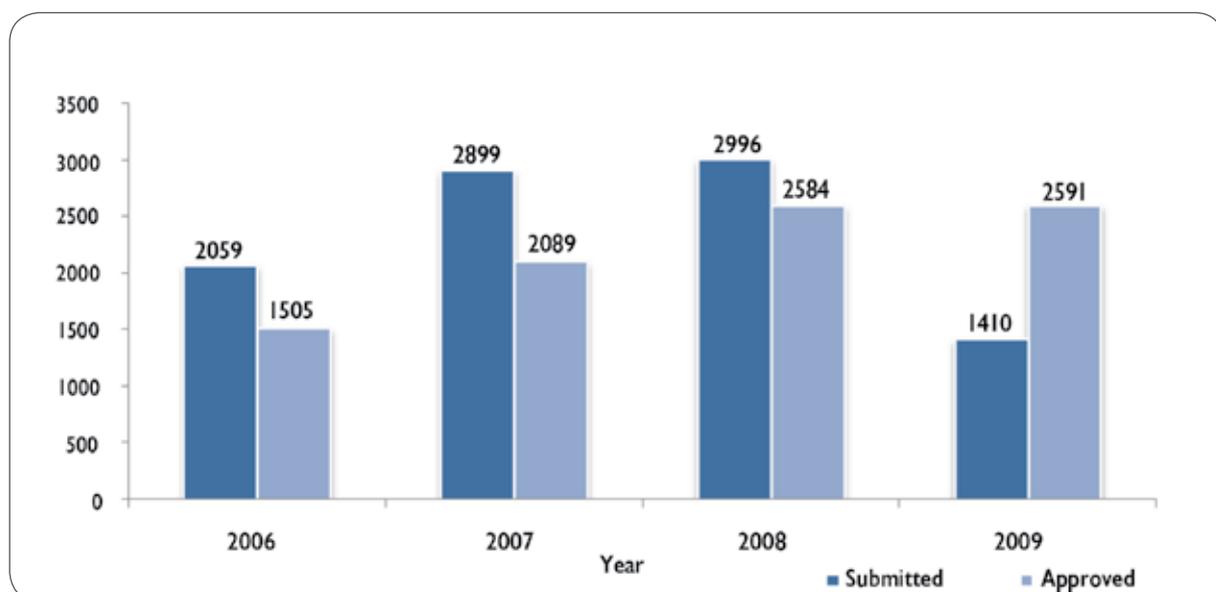
GAEC participates in the licensing procedure of telecommunications base stations, by examining the submitted electromagnetic emissions and environmental impact technical studies/reports and providing its expert opinion. Furthermore, it performs in situ inspections and measurements in places in the vicinity of antenna stations in order to certify their compliance with the general public exposure safety limits.

Specifically:

### Electromagnetic emissions studies – issuing of expert opinions

In 2009, 1410 new electromagnetic emissions studies were submitted to GAEC. After their examination, 2591 expert opinion certificates were issued. As presented in diagram 13, the number of studies submitted during 2009 was smaller in comparison with previous years, while the number of expert opinion certificates was the same as in 2008.

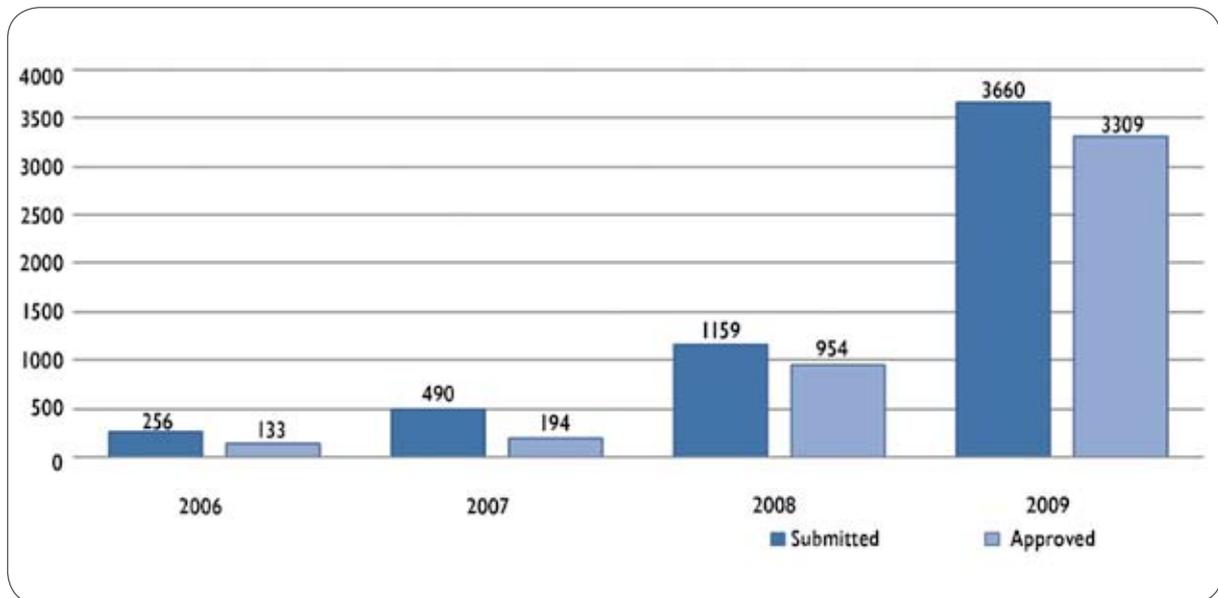
**Diagram 13:** Progress in time of the electromagnetic emissions studies number submitted to GAEC and the expert opinions number issued by GAEC during the years 2006 – 2009



### Environmental impact studies / reports

In 2009, the General Secretariats of each Region sent to GAEC 3660 environmental impact studies, a number increased by three times as compared to the year 2008. GAEC approved 3309 studies, a number significantly increased in comparison with the period 2006 -2008. As was the case in previous years too, a number of studies examined were characterized as incomplete and corrections / additions were necessary.

**Diagram 14:** Progress in time of the number of environmental impact studies and the number of expert opinions issued by GAEC during the years 2006 – 2009



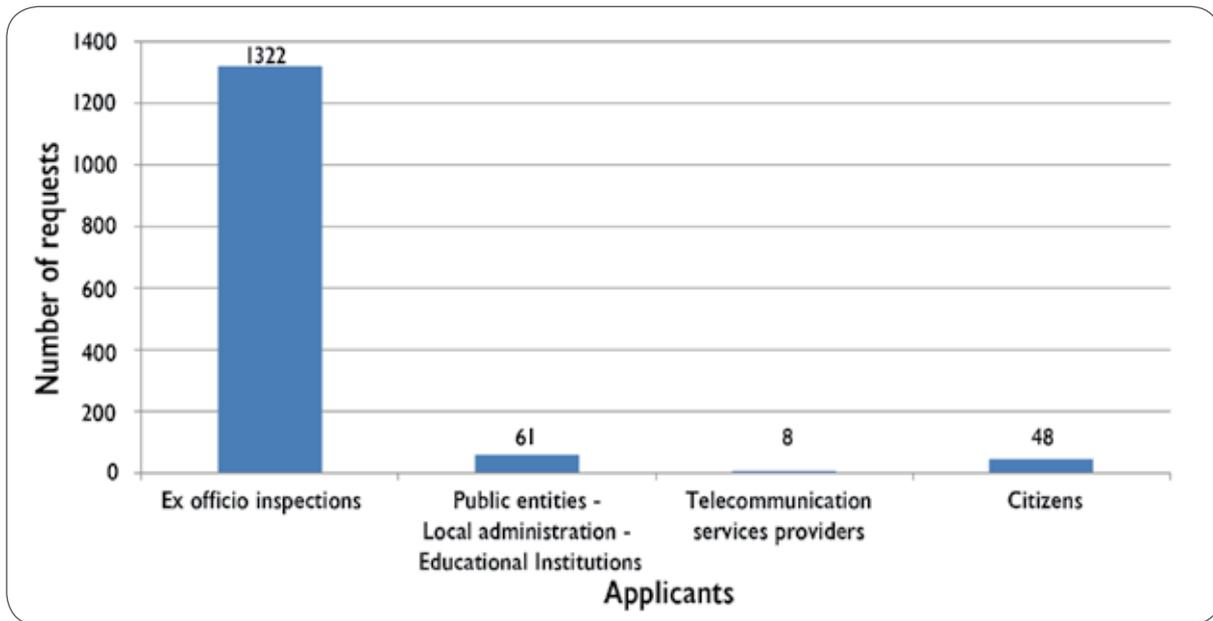
### In situ inspections and measurements

GAEC performs in situ inspections and measurements in all kind of antenna stations, in order to certify their compliance with the general public exposure safety limits. Measurement requests are processed within a twenty working days period.

#### During 2009:

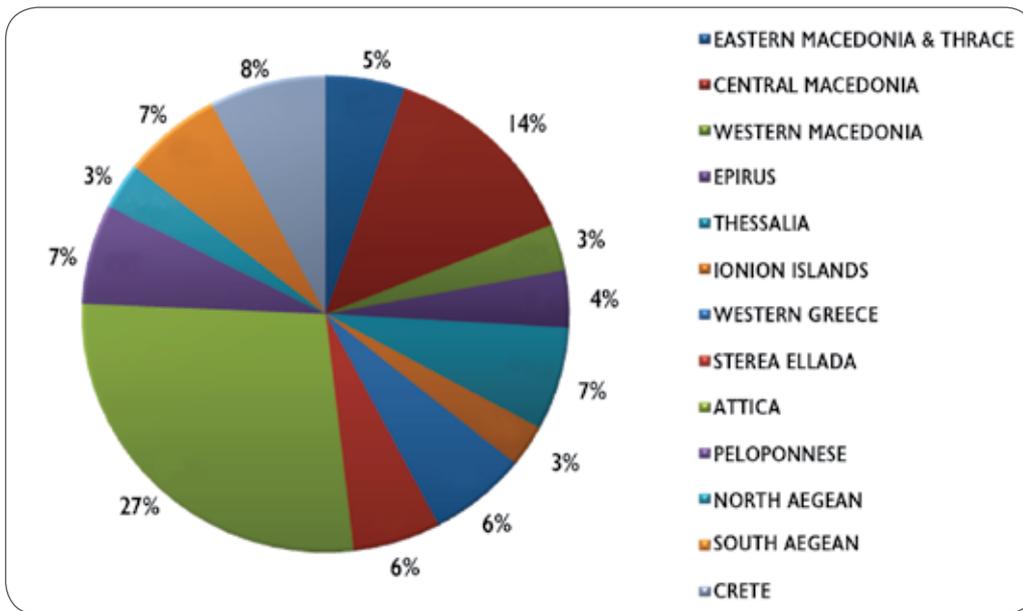
- the total number of in situ inspections was 1439
- the vast majority of high frequency measurements was performed in the vicinity of mobile phone base stations (92,92 %), while a few measurements were performed in the vicinity of fixed telephony base stations (7,01 %) and radio and TV antenna stations (0,07 %)
- the ex officio inspections amounted for almost 92% of the total number of inspections performed in the vicinity of antenna stations. GAEC is obliged to inspect ex officio, on a yearly basis at least 20% of the licensed antennas in urban areas
- the 27,52 % of measurements were performed close to antenna stations located in the Prefecture of Attica. Measurements have been performed in every Prefecture of the country. The total number of measurements does not include the radio and television antennas, located in antennas parks across the country, as well as radars
- GAEC's scientists performed several inspections in antenna stations, following court orders.

**Diagram 15:** Number of requests and inspections performed



#### Examples of electromagnetic field (EMF) measurements performed in a great number of premises upon request

- high frequency EMF measurements in antenna stations located at the Municipality of N. Filadelfeia and the Municipality of Mykonos
- high frequency EMF measurements in antenna stations of the company OTE S.A.
- low and high frequency EMF measurements in antenna stations located at TRAINOSE S.A. facilities
- high frequency EMF measurements in antenna stations located at military installations upon a request made by the Headquarters Command of Eastern Mediterranean
- high and extremely low frequency EMF measurements in school facilities
- extremely low frequency EMF measurements in hybrid cars.

**Diagram 16:** Geographic allocation of inspections

### Extremely low frequency electric and magnetic fields

In 2009, 60 measurements of extremely low frequency fields were performed, either on request or ex officio.

### Cases of non compliance with the general public exposure safety limits

As a result of the in situ measurements performed in the vicinity of all kinds of antenna stations providing telecommunication services throughout the country, GAEC found out three cases of non compliance with the general public exposure safety limits. All three cases concerned places outside urban areas in antenna parks, where a large number of antennas offering all kind of telecommunication services (e.g. radio, television) are located.

GAEC, following the legislated procedures, informed at once the licensing authority for each one of these cases, in order to ensure that the necessary measures for the protection of the public will be taken.

### Other activities

- GAEC announced an international closed tender for the assignment to work groups with a specific number of in situ electromagnetic field measurements in the vicinity of antenna stations all over Greece. The contractor performed EMF measurements in the vicinity of 850 licensed base stations located in urban areas
- a large scale project of measurements of the exposure to high and extremely low frequency electromagnetic fields with personal meters use was completed. The project concerned special workers groups, such as physical therapists and surgery staff

- two World Health Organization's fact sheets were translated into the Greek language ("Electromagnetic fields and public health-Exposure to extremely low frequency fields", No 322, June 2007 and "Electromagnetic fields and public health-Base stations and wireless networks", No 304, May 2006). The translated documents were published at GAEC and WHO websites ([http://www.eeae.gr/gr/index.php?menu=3&fvar=html/president/\\_info](http://www.eeae.gr/gr/index.php?menu=3&fvar=html/president/_info))
- GAEC participated in a one-day meeting entitled "Exposure to Electromagnetic Fields from Wireless Systems". The meeting was organized by the Ministry of Infrastructure, Transport and Networks, in cooperation with the International Telecommunication Unit (ITU)
- GAEC participated in the International Advisory Committee of the International EMF Project of the World Health Organization, as well as in the International Committee on Electromagnetic Safety of I.E.E.E. At national level, it participated in two ELOT committees regarding the protection of people from exposure to electromagnetic fields
- the accreditation for in situ EMF measurements was renewed according to the requirements of ELOT EN ISO/IEC 17025 standard (Certificate No. 117<sub>(2)</sub>).

### Future actions

- development of the national observatory for electromagnetic fields
- further authorization of external work groups to perform EMF measurements
- further development of the project aiming at the assessment of workers exposure to extremely low and high frequency electric and magnetic fields by the use of personal meters
- increase of the personnel number.

## Education

GAEC provides education and training to radiation workers in the field of radiation protection. The educational activities are fully supported by the experienced scientific personnel and state of the art technical infrastructure.

In the context of providing continuing education and training to workers in several applications of ionising radiation, to organizations involved in the national emergency plan, to customs offices, where audits for illicit trafficking of radioactive sources are performed, as well as to workers involved in the transportation of radioactive material, GAEC organized the following seminars:

- training seminar for safety advisors in the safe transport of dangerous goods, class 7
- training seminar for fire workers involved in airplane fire extinguishment after airplane accidents where radioactive material is involved
- training seminar for customs officers involved in the prevention of illicit trafficking in radioactive materials. 201 customs officers were trained during 10 two-day seminars organized in custom offices around Greece (El. Venizelos airport, Piraeus port, Kakavia, Evzono).

The Inter-University Postgraduate Course in Medical-Radiation Physics, as well as the international Postgraduate Educational Course on Radiation Protection and the Safety of Radiation Sources, were not organized this year.

### **Certificates of knowledge competency in radiation protection issues for the non medical staff of ionising radiation laboratories**

GAEC's Board established the criteria for certifying competency in radiation protection for occupationally exposed workers (non medical staff), as a result of a long lasting effort for the training of medical staff. The acknowledgement of competency in radiation protection requires the attendance of seminars, planned to take place during 2010. These seminars will be organized (by GAEC) in cooperation with other organizations (e.g. universities, hospitals).

## One-day meeting on “Radiation Protection and nuclear safety”

The Department of Labour Inspection of the Ministry of Labour and Social Insurance of the Republic of Cyprus organized in cooperation with GAEC a one-day event on “Radiation protection and nuclear safety” (November 28, 2009). The meeting was held in the context of the bilateral agreement for scientific and technical cooperation in the fields of radiation protection and nuclear security.

Radiation protection and nuclear safety system in Greece and Cyprus, the current trends in the field of protection from ionising radiation, as well as relevant research issues were the main thematic areas covered during the meeting.

## Sponsorships

GAEC sponsored the following educational actions: (a) the “Summer School” organized by the NCSR “Demokritos”, (b) the publication of educational material entitled “Radiation protection lessons for operators of ionising radiation medical equipment”, (c) the organization of a meeting entitled “Unification of nuclear spectrometries: integrated techniques as a new tool for material research”, (d) the organization of the conference “1st International Conference on Micro Pattern Gaseous Detectors”.

## E-learning application

Recognizing the e-learning applications role in modern educational environment, an e-learning software platform (Course Management System, Moodle) was installed. The e-learning application is planned to support GAEC’s educational work.

## Research and development

GAEC participates in research programmes, taking advantage of European financial sources (e.g. 7th Framework Programme) and opportunities of cooperation within European scientific networks. The current research activities focus on the radiation protection of medical staff and the development of state of the art equipment for the detection of radioactivity.

### **Completion of the programme “Establishment of European Technical Recommendations for Monitoring Individuals Exposed to External Radiation” (EU-Trimer), European Commission, DG-TREN**

The EU-Trimer programme, aiming at the harmonization of individual monitoring methodologies and the establishment of European and international standards, started in April 2007. It was assigned to GAEC in cooperation with the European network EURADOS. The new European technical recommendations about the monitoring of occupationally exposed workers were the outcome of cooperation of a seven experts' team. The textbook approved by the EURATOM Article 31 Group of Experts was published by the European Commission DG Energy in 2009 (EC, Radiation Protection 160).

### **Continuation of the research programme “Optimization of Radiation Protection of Medical Staff” (ORAMED), European Commission, FP7- EURATOM (<http://www.oramed-fp7.eu>)**

The European research programme “Optimization of Radiation Protection of Medical Staff” (ORAMED), FP7 – EURATOM, EC (2008-2011), started in February 2008. GAEC participates in this project among 12 European partners, specialized in radiation protection and dosimetry fields. Measurements and simulations have been performed as required. Up to the moment, 67% of measurements and the total number of simulations have been completed. The statistical analysis with the use of parametrical methods (ANOVA test) is in progress.

### **Continuation of the research programme “Cooperation across Europe for Cd(Zn)Te based security” (COCAE), European Commission, FP7- Security**

The European research programme “Cooperation across Europe for Cd(Zn)Te based security” started in October 2008. GAEC participates to this programme among nine European partners. The project aims at the development of a portable spectroscopic system based on Cd(Zn)Te crystals. This system will be capable of performing more efficient spectroscopic analyses in comparison with NaI detectors, providing information about the spatial distribution of radioactive contamination. A series of simulations were performed in order to test the detector's energy response, to estimate its efficiency as photons' energy outcome and to evaluate the algorithms used for the photons' direction reconstruction. Also, the expected angular resolution measurement for parallel photon beams was estimated. The measurements were performed with PID350 detectors, consisting of 8000 pixels and using Am-241 and Cd-109 sources. The results of two different electronic systems were compared. The first was developed by AJAT company and the second by NCSR “Demokritos”. The data were analyzed with the use of software developed by GAEC based on ROOT programme.

## Publications

A. Clouvas, G. Takoudis, S. Xanthos, C. Potiriadis and M. Kolovou, «Indoor radon measurements in areas of Northern Greece with relatively high indoor radon concentrations», *Radiation Protection Dosimetry*, 2009, Vol.136, No. 2, pp.127-131

Mastoris M., Donta-Bakoyianni K., Nikopoulou-Karayianni K., Kamenopoulou, V. «Absorbed radiation doses and effective dose estimation during panoramic radiography: a human phantom study», *Hellenic Dental Journal* 2008-2009, 18-19:43-48

Tsapaki Virginia, Ahmed Nada A, AlSuwaidi Jamila Salem, Beganovic Adnan, Benider Abdelkader, BenOmrane Latifa, Borisova Rada, Economides Sotirios, El-Nachef Leila, Faj Dario, Hovhannesyan Ashot, Kharita Mohammad Hassan, Khelassi-Toutaoui Nadia, Manatrakul Nisakorn, Mirsaidov Ilkhom, Shaaban Mohamed, Ursulean Ion, Wambani Jeska Sidika, Zaman Areesha, Ziliukas Julius, Zontar Dejan, Rehani Madan M., «Radiation exposure to patients during interventional procedures in 20 countries: initial IAEA project results», *American Journal of Roentgenology* 2009, Vol. 193(2), pp. 559-569

Hourdakis C.J., Boziari A. and Koumbouli E. «The effect of compression paddle on energy response, calibration and measurement with mammography dosimeters using ionization chambers and solid state detectors», *Phys Med Biol* 2009; 54(4): 1047-1059

J.G Alves, P.A. Ambrosi, D.T. Bartlett, L. Currivan, J.W.E. van Dijk, E. Fantuzzi, V. Kamenopoulou, «Revision of European Commission technical recommendations on individual monitoring of external radiation exposure», *Radiation Protection Dosimetry*, 2009, Vol. 133, No.3, pp. 127-129 (editorial)

Takoudis G., Xanthos S., Clouvas A., Antonopoulos-Domis M., Potiriadis C., Silva J. "Spatial and spectral gamma ray response of plastic scintillators used in portal radiation detectors; comparison of measurements and simulations", *Nuclear Instruments and Methods in Physics Research, Section A: Accelerators, Spectrometers, Detectors and Associated Equipment* 599 (1), pp. 74-81 (2009).

## Conference oral/poster presentations

E. Papadomarkaki, I. Mavroeidis, "Distance Education of Interventional Cardiologists on Radiation Protection. Examination of Learning Styles and Specifications of E-learning Model", *Proceedings of the 5th International Conference in Open and Distance Learning*, Athens, November 2009

M. Ginjaume, E. Carinou, F. Vanhavere, I. Clairand, G. Gualdrini, M. Sans-Merce, X. Ortega, "Optimizing radiation protection in medical practice", *4th International Conference on Education and Training in Radiological Protection*, 8 - 12 November 2009, Lisbon, Portugal (oral presentation)

S. Seferlis, C. Potiriadis, V. Kamenopoulou, P. Dimitriou, "Implementation of the Legislative Framework for Exemption and Clearance", *6th International Symposium "Release of Radioactive Material from Regulatory Requirements – Provisions for Exemption and Clearance"*, Wiesbaden, Germany, 21-23 September 2009 (poster presentation)

F. Vanhavere, E. Carinou, G. Gualdrini, I. Clairand, M. Sans Merce, M. Ginjaume, "The ORAMED project: Optimisation of Radiation Protection for Medical Staff", *Medical Physics and Biomedical Engineering World Congress 2009*, Munich, Germany, 7-12 September 2009 (oral presentation)

I. Clairand, J-M. Bordy , J. Dures, J. Debroas, M. Denoziere, L. Donadille, M. Ginjaume , C. Itie , C. Koukorava, A-L. Lebacq, P. Martin, L. Struelens, M. Sans Merce, M. Tomic, F. Vanhavere, " Use of active personal dosimeters

in interventional radiology: a systematic study in laboratory conditions”, Medical Physics and Biomedical Engineering World Congress 2009, Munich, Germany, 7-12 September 2009 (oral presentation)

C. Koukorava, E. Carinou, J. Domienik, J. Jankowski, S. Krim, D. Nikodemova, L. Struelens and F. Vanhavere, “Extremity and eye lens doses of the staff during interventional radiology procedures – First results”, Medical Physics and Biomedical Engineering World Congress 2009, Munich, Germany, 7-12 September 2009

B. Spyropoulos, G. Manousaridis, M. Varvatos and K. Tsiklakis, “Spectra determination for a cone beam computed tomography system through the employment of a CdTe detector”, Medical Physics and Biomedical Engineering World Congress 2009, Munich, Germany, 7-12 September 2009

C. Pafilis, V.Kamenopoulou, A. Maltezos, Th. E. Matikas, S. Seferlis and P. Dimitriou, “ Education and Training on Nuclear Security in Greece”, International Conference on Advancements in Nuclear Instrumentation, Measurement Methods and their Applications, Marseille, France, 7-10 June 2009 (oral presentation)

C. Pafilis, V. Kamenopoulou and P. Dimitriou, “National views on the recognition and mutual recognition concerning the RPE and RPO”, 3rd EUTERP Platform Workshop “Competence, roles and duties of the Radiation Protection Expert (RPE) and Radiation Protection Officer (RPO) as a basis for Education & Training and (Mutual) Recognition”, Antalya, Turkey, 16-18 April 2009 (oral presentation)

S. Seferlis, S. Xanthos, V. Koukouliou, C. Potiriadis “Establishment of national system for the surveillance and control in the recycling of metallic materials”, International Conference on control and management of inadvertent radioactive material in scrap metal, 23-27 February 2009, Spain.

# International relations

## GAEC represents Greece:

- to 26 European Union committees. Indicatively: European High Level Group on Nuclear Safety and Waste Management, EURDEP - European Radiological Data Exchange Platform, ECURIE - European Community Urgent Radiological Information Exchange, EURATOM Scientific and Technical Committee, EURATOM Treaty Art. 31, 35, 36, 37
- to 21 IAEA committees. Indicatively: Technical Cooperation Group of Experts, Joint Convention on Waste Management, Steering Committee for Educational Training, Early Notification and Assistance Convention
- to 12 committees of Nuclear Energy Agency and OECD. Indicatively: Steering Committee for Nuclear Energy, Committee on the Safety of Nuclear Installations, Committee on Radiation Protection & Public Health
- to 7 international joint committees
- to European scientific networks. Indicatively: European ALARA Network, European Radiation Dosimetry Group (EURADOS).

Moreover, GAEC is the National Contact Point for EURATOM special programme of the EC 7th Framework Programme.

## During 2009:

- the 3<sup>rd</sup> Review Meeting of the Joint Convention on the Safety of Spent Fuel Management and on the Safety Waste Management took place. GAEC presented the national report regarding good practices, the challenges and the actions needed for safety improvement. The conclusions of the meeting confirm the fact that Greece is in full compliance with the Joint Convention requirements; however suggestions regarding the typical compliance with these requirements are included
- GAEC submitted a formal request to the International Atomic Energy Agency to be evaluated in terms of radiation protection and nuclear safety (Integrated Regulatory Review Service Mission, IRRS). At this stage, there is in progress the first phase of assessment, based on the use of specific software provided by the IAEA (IAEA SAT-Self Assessment Tool)
- GAEC prepared the organization of the European Conference "Individual Monitoring of Ionising Radiation" (Athens, 8-12 March 2010).

## Public information

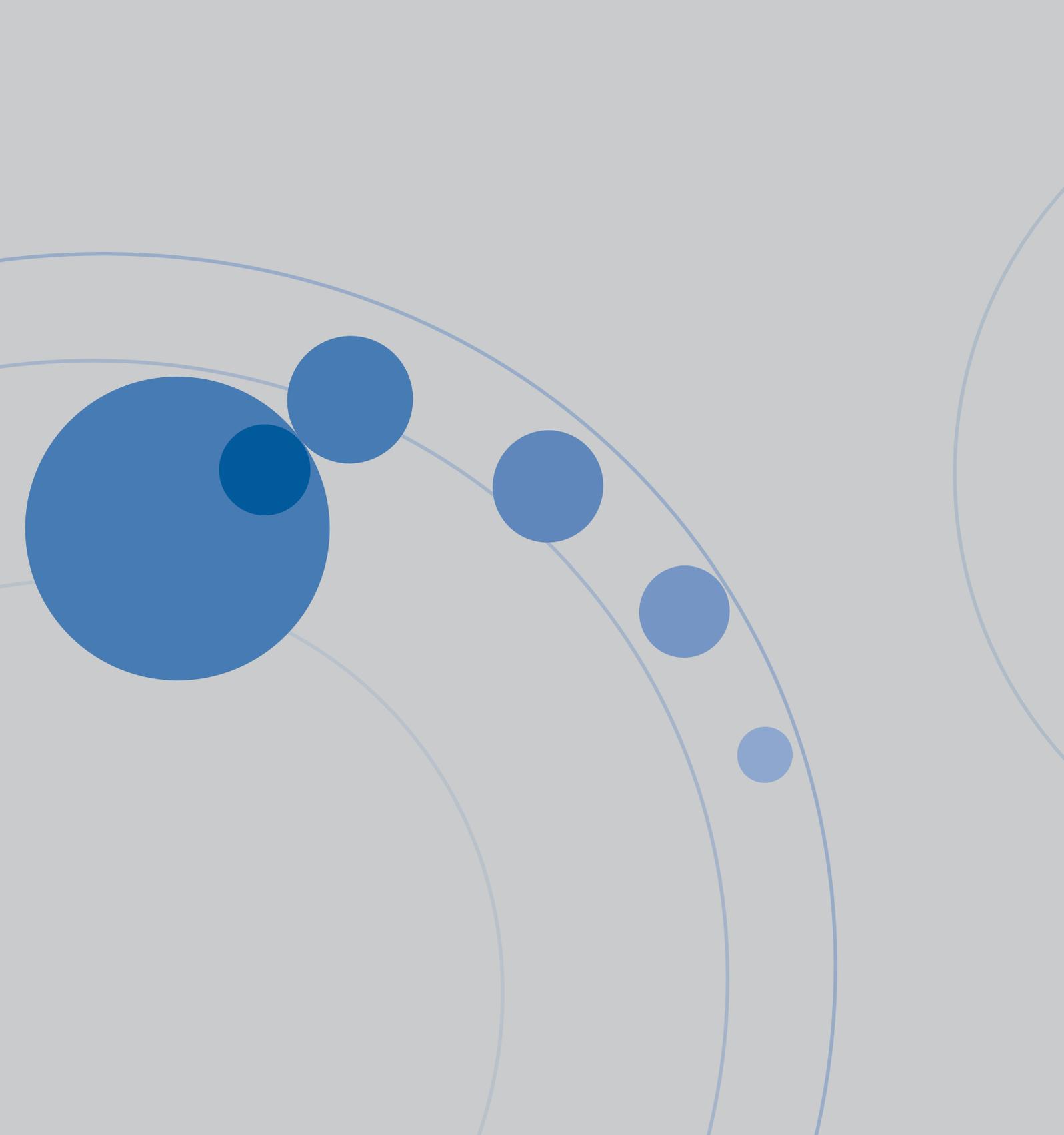
Aiming at increasing public awareness about radiation issues and GAEC's role, several information actions were implemented. In specific:

- one press release was issued in the light of news reports and rumours concerning radioactive shipwrecks in the Mediterranean Sea
- the series of GAEC's information material on the daily use of radiation was updated and extended. In detail, the information leaflets "Radon" and "Pregnancy and ionising radiation" were updated. Moreover, new leaflets concerning radioactive sources were issued. These leaflets were distributed to workers using radioactive sources or are involved in their detection
- emphasis was given to the constant update of GAEC's website content, in order to achieve the direct access of citizens to information related to GAEC's responsibilities (e.g. electromagnetic fields measurements results, research programmes' calls etc.)
- specific actions towards the upgrade of GAEC's website ([www.gaec.gr](http://www.gaec.gr)) utility were implemented, as the RSS service and the adjustment of GAEC's website to the international accessibility standards (guidelines WCAG, W3C – priority 1) were implemented. The visits at GAEC's website were 232.719, following an increasing tendency during the whole year
- the website of the European conference "Individual Monitoring of Ionising Radiation" ([www.gaec.gr/im2010](http://www.gaec.gr/im2010)) was designed
- response to 19 information requests submitted in the context of parliamentary audit. These requests concerned the operation of systems emitting electromagnetic fields, administration issues etc
- participation in the event entitled "The contribution of Research Centers in Research, Technological Development and Innovation" (1<sup>st</sup> April 2009).









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