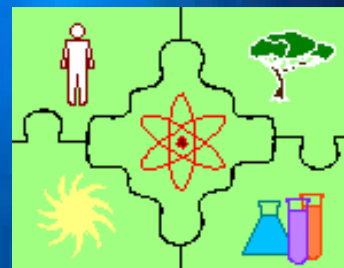


institute of  
**nuclear technology**  
and  
**radiation protection**

2004 annual report



demokritos national center for scientific research

**cover page:** cherenkoff radiation from the core of the institute's reactor

**INSTITUTE OF NUCLEAR TECHNOLOGY –  
RADIATION PROTECTION**

**ANNUAL REPORT 2004**

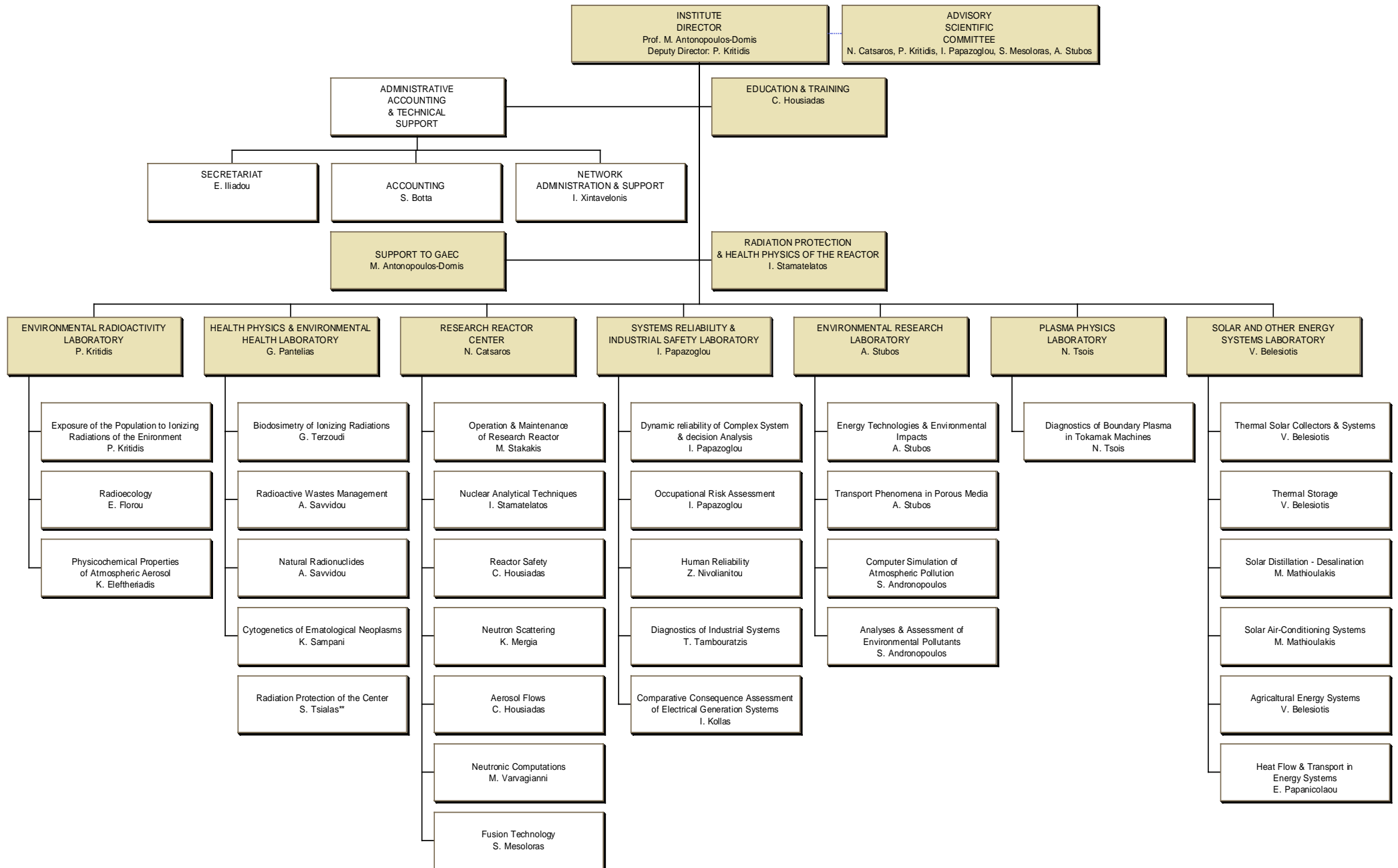


# ANNUAL REPORT 2004

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# ORGANISATIONAL CHART



\*Laboratory: Research, Development and Services reports to the Director of the Centre  
 \*\*reports to the Director of the Centre

## **2. ACTIVITY REPORT/ PERSPECTIVE**

### **2.1. ACTIVITY REPORT**

The activities of the Institute of Nuclear Technology – Radiation Protection (INT-RP) cover the following fields:

#### **I. Nuclear Technology & Radiation Protection (NT&RP)**

Despite the existence of a number of Greek University Laboratories with expertise and focused research on selected sub-fields of NT&RP, the INT-RP constitutes the sole centre of integrated know-how in the country on Nuclear Technology and Radiation Protection. Among the activities of the INT-RP, described in detail in other parts of this report, the following are worth mentioning. The INT-RP

- operates the sole Experimental Nuclear Reactor in Greece (5MW). This allows not only the accumulation of expertise in the field of nuclear reactor technology, but also the provision of services and applications such as radio-isotope and radio-medicine production, biological tissue disinfection/sterilization, trace element analysis via neutron activation and the irradiation of various materials for the European Fusion program.  
Within the objective of reactor exploitation
  - (a) by researchers from Greece, the wider Balkan area, and Europe, as well as
  - (b) for industrial and other applications,the installation of the neutron diffractometer began in 1998 and was completed in the end of 2001. The design, installation and operation of the neutron diffractometer were carried out exclusively by the personnel of INT-RP; only the necessary apparatus was purchased. The neutron diffractometer constitutes a large-scale technological achievement which is expected to become a centre of intense research activity in Greece and the Balkans; since its installation, it has been utilised for the solution of both research and technological problems by a significant number of users from other institutes of NCSR ‘Demokritos’ as well as from universities in Greece and the Balkans. The contribution of the neutron diffractometer has already been used for the study of the properties of materials in the framework of the European Fusion Programme and is expected to become significant in material science, especially concerning new materials.
- is the only integrated radiation protection sector in Greece, a fact that is of significance, considering the existence of a wide range of ionising radiation applications in industry and medicine in the country. The importance of the NT&RP expertise became obvious following the Chernobyl accident, whereby the contribution of the INT-RP for tackling the after-effects of the accident proved decisive. The INT-RP supports – both technically and scientifically - a large number of the activities of the Greek Atomic Energy Commission (GAEC). It is also worth mentioning that the national radiological emergency plan XENOKRATES as well as the greater part of Greek radiation protection safety regulations were developed by the personnel of the INT-RP. The majority of the scientific committee members of the XENOKRATES plan come from the personnel of INT-RP.
- is the sole centre in Greece with expertise and equipment for handling radioactive waste, whereby it constitutes the only unit in the country capable of providing and implementing solutions to the waste handling problem.
- encompasses the only integrated Laboratory of Environmental Radioactivity in Greece, with an extensive network of sampling/measuring/monitoring stations covering the entire country.
- is active in the field on nuclear fusion. Funded mainly by the European Union, INT-RP is the co-ordinator of the Greek Association of Fusion (GAF). The emphasis has been upon fusion technology, rather than on basic research, since
  - a wide range of the existing research potential and equipment that is not directly involved in nuclear technology can be utilized; for instance, the INT-RP – in collaboration with the Institute of Material Science, NCSR ‘Demokritos’ - performs tests on the strength of advanced materials following neutron irradiation at the Experimental Nuclear Reactor,
  - the European Union favours funding for the development of technology rather than for basic research.
- the laboratory of Health Physics and Environmental Health constitutes the sole Greek Laboratory with expertise in the field of overexposure to ionising radiation . It constitutes one of the

Laboratories selected by the International Atomic Energy Agency (IAEA) for prototyping the methodology of biological dosimetry.

Owing to the fact that no nuclear power plants have been constructed – or are planned to be constructed - in Greece, the INT-RP has long focused its attention on transferring know-how from nuclear technology to other fields which are of direct interest to the country. These activities fall in the areas of Environmental Technology, Energy Technology and Health Technology.

## **II. Environmental Technology**

A significant number of activities have already been developed in this area, involving a large (larger than the critical mass) number of researchers and specialised operators of the INT-RP. More specifically, the INT-RP is the sole research institute in the country with an integrated R&D approach to environmental matters combining the fields of diagnosis, prognosis, impact and pollution technology.

- The ensemble of activities of the Laboratory of Environmental Radioactivity concerns environmental technology in terms of both pure research and environmental quality evaluation studies. Furthermore, research on aerosols has become a subject of increased interest for the laboratory.
- The same is true of the largest part of activities of the Laboratory of Environmental Research, with its personnel specialising in (conventional and radioactive) pollutant dispersion.
- The Laboratory of System Reliability and Industrial Safety is mainly concerned with R&D in matters of risk analysis, including environmental pollution from large-scale industrial accidents. A number of case studies related to environmental pollution scenarios from chemical industries in Greece have been realised in the framework of the “Sevezo directive” of the European Union.
- The Laboratory of the Experimental Nuclear Reactor has the potential of detecting/identifying environmental contaminants (with a resolution capability of ppm) employing environmental sample neutron activation.
- It becomes clear, thus, that the INT-RP constitutes - by far - the most experienced and reliable consultant of the Greek public and private Greek sector in matters of environmental protection. This is demonstrated by:
  - Its contribution in guiding the environmental crises during the Chernobyl accident and the war at Yugoslavia (fear of depleted of uranium).
  - The increase in incoming funds – during the last five years - from the provision of services to the public and private sector in matters of environmental protection

## **III. Energy Technology**

- It is apparent that the areas related to (both fission and fusion) reactor technology fall into the more general area of energy technology.
- The Laboratory of Thermal Energy Systems receives considerable external funding and provides specialised services R&D in the related productive sectors. The reliability of the provided services is certified by the recently awarded EN45001 accreditation.
- The personnel of the laboratory of System Reliability and Industrial Safety investigates the environmental impact of conventional electricity production plants as well as matters concerning the programming of electrical energy production.
- The laboratory of Environmental Research has developed significant research activity in the areas of enhanced hydrocarbon recovery from underground reservoirs (the emphasis being on the simulation of fluid flow and dispersion processes), hydrogen technology for energy generation (the emphasis being on issues of safety and storage), and energy efficient separations (the emphasis being on membrane technology).

## **IV. Health Technology**

- Biological tissue disinfection/sterilisation (bones, skin, tendons) is performed in the Experimental Nuclear Reactor; these tissues are, subsequently, used in transplant operations.



- The Health Physics & Environmental Hygiene Laboratory gives proper and continuous recognition to problems related to all potential radiation induced health hazards. Specifically, the Laboratory provides operational health physics services related to the Radiation Protection Program in NCSR “Demokritos” and the evaluation of radiation overexposures and radiation accidents in general, by means of biological dosimetry methods. Its research activities involve the use of radiation cytogenetics, molecular genetics and radioisotope methodologies to study questions of basic and applied research in radiation protection, radiobiology and radioactive waste management. In addition, the Laboratory based on its expertise in radiation protection, radiation biology and cancer cytogenetics, offers specialized services for the calibration of radiation survey meters, for the development of individualized protocols for radiotherapy treatment, as well as for the diagnosis of preleukemic and leukemic diseases.
- Nuclear analysis techniques are under development for the in vivo and in vitro study of the structure/constitution of the human body.

## 2.2. ACHIEVEMENTS IN 2004 AND PERSPECTIVE

The strategic objectives have been, and will continue to be, to perform research, to develop products and to provide services.

Emphasis has been placed on (a) publishing in international peer reviewed journals, (b) winning R&D programmes, mainly from the EU and (c) providing high technology services. Research and development performance is reflected in the number (Fig.1) and quality of publications and externally financed programs (mainly from EU), Fig2. Commercial exploitation of research activity is reflected mainly in Fig.3, but also in a number of externally financed programs.

The Institute is financially healthy and has self-financed significant building and equipment infrastructures. In addition it finances the employment of a large number of scientific, technical and administrative personnel.

- The buildings and the infrastructure of the Institutes offices and laboratories were substantially upgraded. Funding was provided over the years 2003, 2004, by the Institutes income. Namely:
  - Following, the erection of an ISOBAU-ISOBAX building of 10 offices next to the reactor (1999) and completion of the new building (2001), the offices of the reactor building were renovated and equipped with contemporary furniture and equipment.
  - An ISOBAU-ISOBAX building of 5 offices was erected next to, and for the use of, the Environmental Research Laboratory (ERL). The renovation and equipment of the old offices of ERL was completed.
  - A road leading to the offices-labs of the Environmental Radioactivity Laboratory was constructed, in order to minimize the dust entering the lab. For the same reason the space outside the lab is being put into appropriate shape. The office and laboratories equipment was renovated. New office and laboratory space was erected.
- The physical protection system of the reactor was replaced by a modern one (funding by USA through IAEA).
- A new contemporary building, for handling and temporary storage of radioactive sources, was erected to international standards (funding by the ministry of Environment and Public Works and the Greek Atomic Energy Commission).

Mid term goals include

- The exploitation of the neutron diffraction layout of the reactor will continue, with an extensive range of applications in research and industry. The suggestion of the international scientific jury of the “Centre of Excellence Programme” (which is in agreement with the policy of the INT-RP) of giving priority to the operation of the neutron diffractometer will be developed.
- A neutron activation layout for the analysis of large samples in the thermal column of the Experimental Nuclear Reactor is under development. This novel layout will be used for industrial, environmental and medical applications.

- A novel layout for in-situ analysis of large samples with prompt- $\gamma$  neutron activation employing isotope neutron sources developed for body composition and material test studies. This layout will be used in environmental and bio-medical applications.
- The design and development of an experimental large-scale neutron-scattering layout has begun in the Experimental Nuclear Reactor, with applications in chemistry, biology and material science. Partial funding for the layout has been obtained from the "Centre of Excellence Programme" and IAEA.
- The installation of a high-temperature irradiation rig, at the Experimental Nuclear Reactor, for the purposes of the European Programme on Fusion, is under way.
- The installation of a time of flight reflectometer is expected to be completed by the end of 2005. It has wide applications in material science, chemistry and biology.
- Further exploitation of the neutron scattering facilities in a European level will be achieved through the IP "Materials at Extreme Environments" (1Meuros our participation funding).
- By mid 2005 a new small angle X-ray scattering apparatus will be operational with applications in nano-technology and advanced materials research.
- The development of a methodology for the evaluation of environmental quality, as related to conventional and radioactive pollution, is in progress at the ERL, based on the analysis of cytogenetic mutations in natural aquatic populations. Development of methodology for source identification and apportionment of atmospheric pollutants, by means of elemental and radioactive aerosol tracers.
- The HPEH is planning to develop and standardize methodologies for: (i) the identification of persons with increased radiosensitivity, (ii) the evaluation of mutagenic potential of genotoxic chemicals, detection of genetic predisposition to cancer, (iii) the elucidation of the mechanisms underlying the health effects caused by exposure to physical and chemical genotoxic agents.
- The SESL is planning to investigate new technologies for implementation on (i) solar thermal collectors and systems, solar cooling, solar desalination-distillation, (ii) thermal energy storage, (iii) mechanical drying systems and (iv) metrology.
- The EREL is planning to continue development on R&D in hydrogen technology (safety and storage), atmospheric dispersion simulation, R&D in hydrocarbon recovery from the soil and underground reservoirs (in collaboration with the petroleum industry), R&D in issues of porous material - and especially nano-material – structure characterisation, environmental (filters and gas separation membranes) and biomedical (controlled release systems) applications, as well as R&D issues of climatic change and urban pollution.
- The SRISL will develop optimum strategies for responding to Emergencies owing to major industrial accidents. (Previous peer review recommendation) and quantified risk models for various cases of work related accident extending the concept of risk assessment of major accidents to the smaller accidents involving individual workers (Participation to Large Programme by ministry of Labour and Social Affairs of the Netherlands). It will also continue R&D in risk assessment and management methodology and application on new technologies (e.g. nanotechnology) and assessment of the integrity of vital infrastructures. It will also develop models for integrating human factors in safety analysis of complex technological systems and continue work on Soft Computing.

Finally it should be noted that the importance – for the country, the protection of the environment and the health of the population - of maintaining a critical mass of researchers working in the area of NT&RP is self evident. Consequently, special emphasis has been given, and will continue to be given, in this direction.

<sup>2</sup> Definition of "good practice", as given by IAEA: "It is a proven performance, activity or use of equipment, which the team considers to be markedly superior to that observed elsewhere. It should have broad application to other facilities".

## 2.3 EDUCATION

The Institute provides, each year, a number of seminars and courses on the following topics

- (i) radiation protection
- (ii) nuclear technology

Lecture notes are available on these topics and are continuously being updated.

It is worth noting that the IAEA mission on Integrated Safety Assessment of the Research Reactor found that our reactor is a safe system, operated by experienced, well trained personnel with high standard of safety. The mission characterised as “good practice”<sup>2</sup>: (a) the personnel training (b) dosimetry and (c) the existence of a Probabilistic Safety Assessment in the Safety Analysis Report of the Reactor.

Over the last three years, thirty five (35) final year projects and eleven (11) Doctoral Dissertations have been completed. Work is in progress for twenty one (21) Doctoral theses.

## 2.4 PERFORMANCE INDICATORS

The average number of Researchers (R), including Functional Scientific Personnel (FSP) and Cooperating Researchers (CR), over the last five years (2000-2004) is 27,65. Over the same period, the average external income per year is 2.23 MEuro, the average number of publications in International refereed journals is 51,6 per year and the average number of publications in International conferences is 48,4 per year. Thus:

No of publications in refereed international journals	1.86 per year per person <sup>1</sup>
No of publications in conference proceedings:	1,73 per year per person
External income:	80650 Euro per year per person

It is to be noted that this external income per person exceeds by at least two to three times the yearly salary per person.

## 2.5 STAFF AVERAGE AGES

Laboratories	Average age		
	R+ESP+SSP	Technicians	Operators
RRL	46,00	40,75	45,20
HPEH	49,40	53,20	-----
ERL	53,50	52,00	-----
EREL	39,66	38,00	-----
SRIS	49,00	-----	-----
SESL	48,33	53,00	-----
Overall average	47,03	46,89	

**SSP: Special Scientific Personnel**

<sup>1</sup> “person” here is “R” or “FSP” or “CR”

## **2.6 Report of the Scientific Committee for the Evaluation of the Institute of Nuclear Technology and Radiation Protection (INT-RP) submitted to the Director of NCSR Demokritos**

The following scientific evaluation was prepared by a Committee composed of Prof. Marzio Marseguerra (Politecnico di Milano), Prof. Michel Giot (Université Catholique de Louvain), Dr. Michel Reocreux, (Institut de Radioprotection et de Sûreté Nucléaire - IRSN) and Prof. em. George Yadigaroglu (Swiss Federal Institute of Technology-Zurich - ETHZ).

The Committee has convened at the NCSR Demokritos on December 9 and 10, 2004 and evaluated the Institute of Nuclear Reactor Technology and Radiation Protection, following the instructions given to it by the Director of NCSR Demokritos. The evaluation is based on the written material provided to the Committee, including a “self assessment” prepared by the INTRP Director and Laboratories, as well as on fairly extensive visits to the various INTRP Laboratories and discussions with key staff members.

### **Activities of the Institute**

The activities of the Institute are devoted to two main research areas:

Environment, health and safety:

- Radiation protection
- Environmental radioactivity
- Health physics and radiobiology
- Radioecology
- Environmental pollution
- Reliability and risk analysis of industrial installations

Energy systems and materials for components:

- Solar-thermal energy applications
- Hydrogen storage
- Materials characterization for Fusion

The Institute operates the Research Reactor with main activities in the characterization of materials (high-temperature rig, neutron diffractometry, elastic scattering and activation analysis) and to support the research in the two areas of emphasis of the Institute.

### **Overall Institute Evaluation**

In relation to the total staff of the Institute and the number of permanently-employed Scientists (about 35), the Committee finds a very broad spectrum of activities.

The Institute has developed very positively the last decade. The motivation of the staff is very high. The Committee notes, overall, a very good level of scientific output and publications and very significant improvements in infrastructure. There is a satisfactory number of doctoral candidates working in the various laboratories, that could be still increased by enhanced collaborations with educational institutions, national and international.

However, the Committee notes that the activities of the laboratories depend very often on the particular interests and competences of single members and their capability to attract external funding. This results in some fragmentation and dispersion of the efforts.

As a consequence of the large number of projects, all laboratories complain about lack of personnel and some activities even face a possible collapse when key personnel leaves. The Committee recommends formal reinforcement of internal cooperation along priority lines. A detailed examination of programs and activities in relation to staff capabilities should be undertaken.

The Committee cannot but fully agree with the emphasis put by the Director on Research and Publications, which is in line with the goals and rules of the research environment in Greece. This should,

however, not hamper the institutional goals, the development of the most promising areas of competence and programs, and a more visible institutional response to national needs. Possible consequences on program fragmentation should be carefully looked after.

The Committee believes that the Institute responds to societal needs; however, the government has not provided sufficient basic funding to achieve this, putting the institute in a precarious position in the international scene.

The Institute was nevertheless successful in obtaining funding from external sources, mainly EU programs and from Industry, including foreign sources (testifying to its international reputation). This enabled the Institute to finance staff positions, as well as infrastructure and equipment.

In agreement with the Direction and the staff of the Institute, the Committee recognizes, however, the danger coming from significant reliance in certain areas on EU program funding and the vulnerability of related Institute programs to unpredictable EU research policies and priorities.

The staff of the Institute has been successful in marketing some of its capabilities and know-how for commercial purposes corresponding to national needs; the Committee feels that some professional help in this direction could be valuable in further enhancing such enterprises.

The various positive remarks made above, in particular with respect to enhancement of scientific activities, “marketing” of institutional know-how, rehabilitation and extension of facilities and buildings, etc. reflect very positively on the management of the Institute. Further efforts are recommended in clustering and streamlining research programs and teams.

Following this general assessment applicable to all the laboratories, the Committee, makes the following remarks and recommendations regarding the different laboratories of the Institute.

### **Research Reactor Laboratory (RRL)**

The RRL constitutes the core of the Institute and has the largest staff. The Committee notes with pleasure that the reactor safety has been reviewed by the IAEA positively (INSARR mission); that the facility is under refurbishment, its control system has been improved; and that its physical security has been drastically upgraded.

The Committee notes the utilization of the facility has been increased and appreciates the fact that new life has been given to the facility by the addition of new, scientific, up-to-date experimental activities that have been implemented or are planned for near-term implementation with substantial financial funding from Institute revenues.

However, the Committee notes that the full utilization of the new research equipment implies full-time operation of the reactor, but this in turn will necessitate additional operational staff in the future.

The Director and the highly qualified staff of the Institute are aware of the opportunity to use the RRL as a regional research reactor (user lab and services) and the Committee recommends further exploration of ways to achieve this.

### **Laboratory of Health Physics and Environmental Hygiene (HPEH)**

This laboratory covers the area of radio-biology that is completely absent in the Greek universities and requires cooperation in medicine, biology and physics. This research represents a buttonhole to be encouraged; the excellence of the laboratory in this area is recognized internationally; the laboratory belongs to the European network of excellence for leukemia.

In addition, the laboratory provides the Health Physics services to NCSR Demokritos and is the reference laboratory for the GAEC in biological dosimetry and the evaluation of absorbed doses in case of radiation accidents.

The services rendered to hospitals in hematology yielded substantial amounts of income, so that in the period 2001-2003, it has been possible to operate without matching funds.

In spite of the communicative enthusiasm of the head of the laboratory for the radio-biology research, there is a risk of discontinuation of this activity, as the head of the laboratory – that includes only three senior scientists – moves to new responsibilities. The decreasing number of publications is a sign in this direction. Maintaining the level of manpower available for scientific activity has to be considered.

### **Environmental Radioactivity Laboratory (ERL)**

The laboratory has a long history and made valuable contributions in clarifying the potential health impacts due to radiological pollution and impacts from the Chernobyl accident and, more recently, from the depleted-uranium releases in the former Yugoslavia, as well as from certain other activities. A core business of the laboratory is the management of the 40-station network of environmental radioactivity monitoring throughout Greece that complements the monitoring network operated by the GAEC. It is also providing financially rewarding services to companies in certifying the radioactivity levels in import/export goods. The ERL is the laboratory that traditionally reports radiological monitoring to the EU.

The research activity is in the field of radioecology in relation to the dynamics of radionuclides in ecosystems (conducted in collaboration with universities), which could be profitably merged with partly overlapping activities of other laboratories (HPEH and EREL). The ERL has a significant activity in aerosol-related environmental problems that is enhanced by cooperation with other laboratories (RRL, SESL).

The aging of the personnel has to be considered. The facilities of the ERL are in need of refurbishment. The Committee welcomes the wish of the laboratory to get more involved in educational programs.

### **Environmental Research Laboratory (EREL)**

The EREL uses its know-how and experience in Computational and Experimental Fluid Dynamics for the resolution of a diversity of environmental and energy-sector problems (e.g., hydrogen technology, atmospheric pollutant dispersion, simulation of underground reservoirs). It is a very dynamic and entrepreneurial young group that has international visibility and has been very successful in attracting projects and external funding, in particular EU funds and in publishing extensively in an impressive array of journals. One of their products, the computational package ADRIA-HF has become accepted for use in the EU for safety assessment of hydrogen applications. The EREL also possesses state-of-the-art equipment for on-site and off-site pollutant measurements.

In spite of its excellence, the laboratory is threatened by the volatility of EU funding and programs.

### **System Reliability and Industrial Safety Laboratory (SRISL)**

This laboratory has excellent international visibility and recognition and has been able to attract very important external funding (including funding from foreign governmental sources). It has provided very valuable services to two Greek ministries in relation to the Seveso directives and the risk assessment of very numerous industrial installations, namely chemical plants. The activity of the laboratory is strongly dependent on a few key persons, as illustrated in the past and more recently by the departure of one scientist. The Committee is recommending publication of the work of the laboratory in international journals and agrees with the future plans to apply the risk assessment and management technology to the integrity of vital infrastructures.

### **Solar and Other Energy Systems Laboratory (SESL)**

The Committee was told that this relatively small, well-networked, laboratory was the largest one in Greece in the area of Solar Energy applications. This may reflect the point of view that solar heating applications are a “mature technology” where the remaining activity is mainly commercial performance testing (for which the laboratory is the accredited center in Greece). Other areas of interest for SESL, such as the reduction of the optical impact of solar heaters, solar cooling, desalination/distillation, drying of

agricultural products and thermal storage need further R&D. In some of these areas, the highly educated staff of the laboratory could strive to develop in-depth research activities potentially leading to breakthroughs. The laboratory could also strive to make NCSR Demokritos an important energy center with a significant focus on renewable energies, an area where international financial and political support is certainly available.

### **Acknowledgments**

The Committee appreciates the interesting, open and frank discussions it had with the Director of the Institute and the heads and staff of the laboratories. It is grateful for the information collected and presented. The hospitality extended to the Committee made its mission also very pleasant.

Michel Giot

Marzio Marseguerra

Michel Réocreux

George Yadigaroglu

Aghia Paraskevi Attikis, December 10, 2004





### **3. Laboratories**

- **Research field**
- **Achievements**

## NUCLEAR RESEARCH REACTOR LABORATORY (NRRL)

Head: N. Catsaros

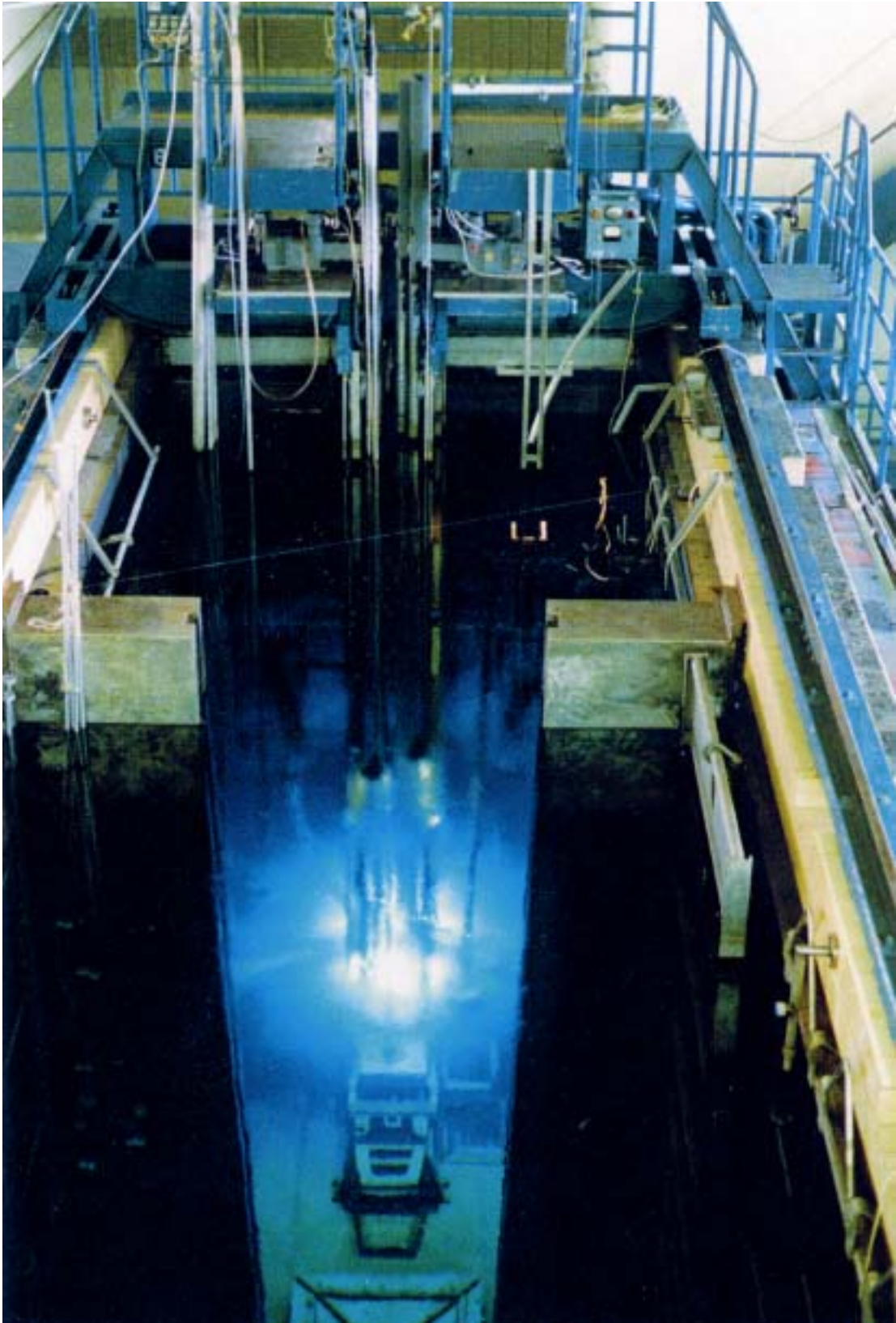
### Personnel

Researchers and Functional Scientific Personnel	5
Other Scientists:	4
Co-operating Researchers:	2
Scholarships:	3
Technicians:	13

### Subject:

The Research Reactor (GRR-1) operates at a nominal power of 5 MWth. Its neutron flux and its  $\gamma$ -radiation field are used in the frame of R&D Projects of the Institute of Nuclear Technology – Radiation Protection, other Institutes of the NCSR “Demokritos”, other Research Centres, Organizations, Universities and Technological Institutions. The NRRC is active in the fields of Neutron Activation Analysis, Material Studies using neutron scattering, Reactor Physics, Thermal-Hydraulic Analysis, Analysis and Modeling of Airborne Particle Dynamics, Atmospheric Dispersion of Pollutants, Radiation Protection, Analytical Techniques for studying the human body composition, Radioisotope production, Bone sterilization and Training of University students.

GRR-1 operates actually with a mixed core, containing both high (HEU) and low (LEU) enrichment fuel assemblies. The reactor core evolves towards a pure LEU configuration.



*Research Reactor*

## ENVIRONMENTAL RADIOACTIVITY LABORATORY (ERL)

Head: P. Kritidis

### Personnel

Researchers and Functional Scientific Personnel	4
Other Scientists:	-
Co-operating Researchers:	-
Scholarships:	1
Technicians:	4
Post-doc fellows:	2
Graduate students (diploma):	3

### Subject

The scientific subject of ERL is the environmental radioactivity (soil radioactivity, indoor radon, marine radioactivity, aerosol radioactivity). ERL operates also a network of 40 sampling and measuring stations across the country, which is a key part of the National routine network. ERL is also engaged with radiological certification of imported and exported foods and materials.

### Activities

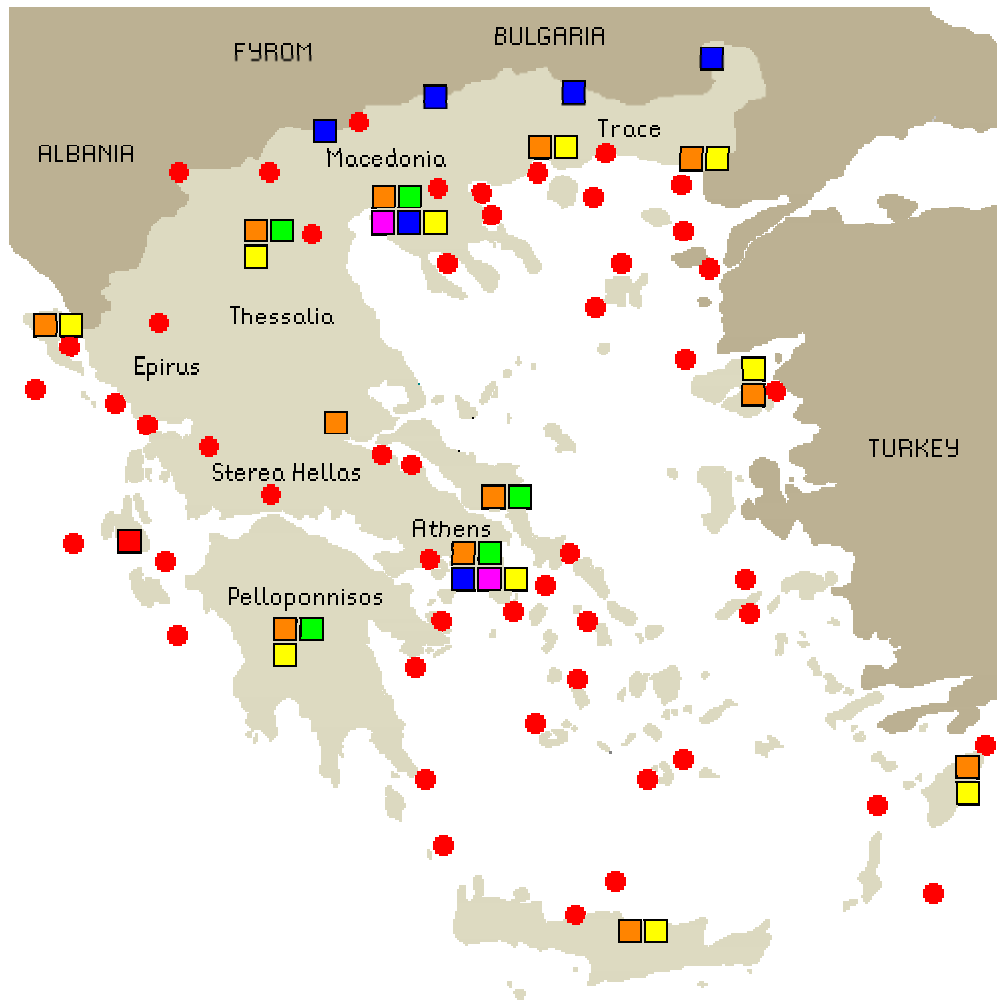
1. Research projects in collaboration with other scientific teams from research centers and universities, local authorities and international organizations.
2. Applied research projects related to the radiological and conventional impact of human activities.
3. Control of radioactivity in various environmental media and food radioactivity control, in accordance with the frame program REM of DG XI / EU and the national obligations related to it. The routine monitoring network includes 40 stations for sampling of air, radioactive deposition, surface and drinking water, soil and food. The routine monitoring is performed according to assignment of the Greek Atomic Energy Commission.
4. Technical studies and measurements on demand of third parts.

ERL is a part of the REM network of DG XI / EU (Environmental Radioactivity of the European Community). The services provided are of approximately 75 000 Euro per year and include:

- Analysis of radionuclides in food and other samples and issuing of related certificates to Greek and foreign enterprises and persons.
- Radiological studies in regions of enhanced natural radioactivity, after the request of private enterprises or governmental organizations.
- Analysis of heavy metals in environmental and other samples.

The scientific staff of ERL provides expert services in national and/or international committees (EU, IAEA, Greek ministries). They are also engaged in educational activities (supervising of PhD fellowships, diploma works, participation in university post-graduate studies and seminars, EU and IAEA seminars e.a.).

## The sampling network:



The **red circles** represent areas where marine radioactivity studies have been performed **occasionally**.

- Total beta activity in air
- Radioactive deposition
- Total beta activity of surface and drinking water
- Gamma-ray intensity
- Specific radionuclides in milk and mixed diet

## HEALTH PHYSICS & ENVIRONMENTAL HYGIENE LABORATORY (HPEHL)

Head: G. Pantelias

### Personnel

Researchers and Functional Scientific Personnel	3
Other Scientists:	1
Co-operating Researchers:	-
Scholarships:	1
Technicians:	4

### Overview

Since the early days of its foundation in 1960 the Health Physics & Environmental Hygiene Laboratory of the Institute of Nuclear Technology & Radiation Protection, gives proper and continuous recognition to problems related to all potential radiation induced health hazards. Specifically, the Laboratory provides operational health physics services related to the Radiation Protection Program in NCSR “Demokritos” and the evaluation of radiation overexposures and radiation accidents in general, by means of biological dosimetry methods. Its research activities involve the use of radiation and cancer cytogenetics, molecular genetics and radioisotope methodologies to study questions of basic and applied research in radiation protection, radiobiology, cancer genetics and radioactive waste management. In addition, the Laboratory, based on its expertise in radiation protection, radiation biology and cancer cytogenetics, offers specialized services for the calibration of radiation survey meters, for the development of individualized protocols for radiotherapy treatment, and for the diagnostic and follow-up cytogenetic evaluation of patients with hematological neoplasms.

### Achievements

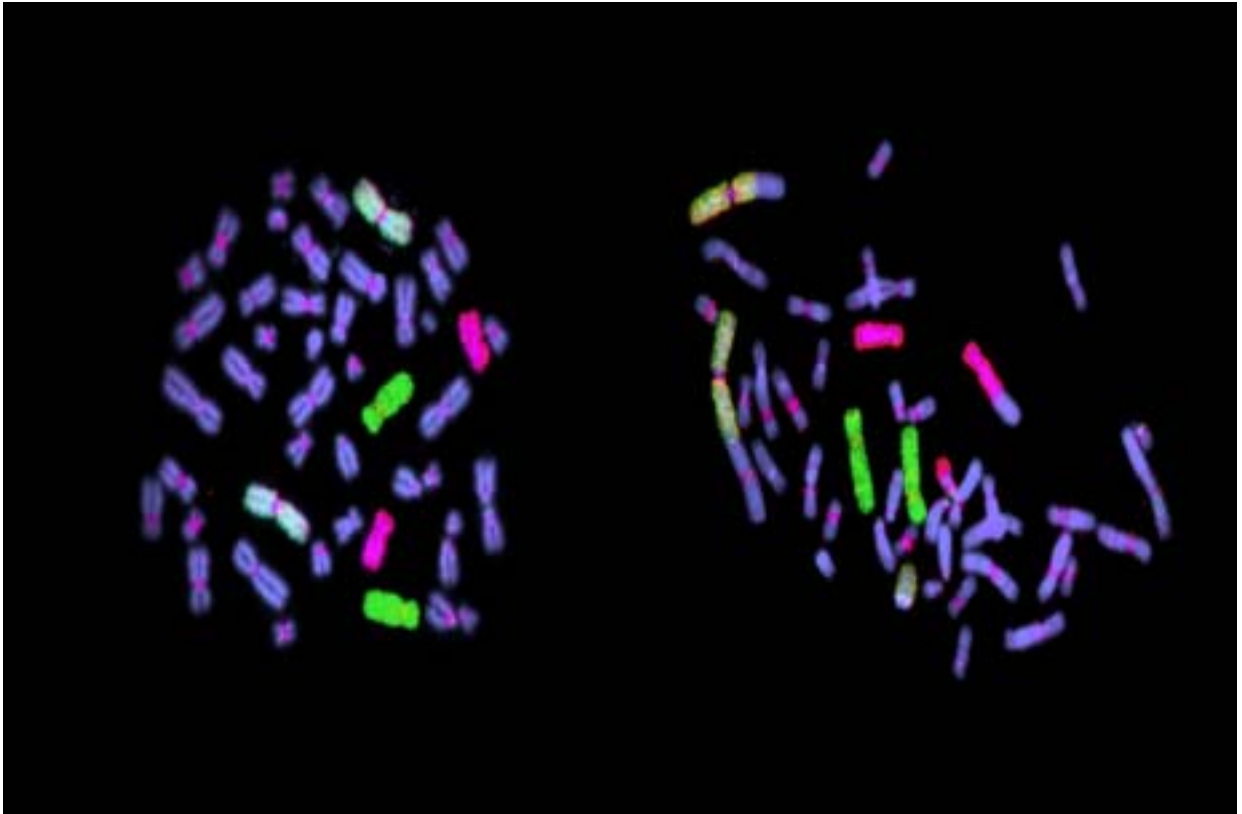
The Health Physics & Environmental Hygiene Laboratory has been the reference laboratory of the Greek Atomic Energy Commission and the International Atomic Energy Agency (IAEA) for biological dosimetry studies and the evaluation of absorbed doses in cases of radiation accident, as well as for standardization of state of the art methodologies applied for biodosimetry purposes. The Laboratory belongs to the “European Network of Excellence for Leukemia” (supported from the FP6 Program of the European Community) and it is the National Reference Laboratory for the cytogenetic characterization of myelodysplastic syndromes (nominated by the Hellenic Society of Hematology).

Specifically, the research activities of the Laboratory contributed essentially to the:

- Elucidation of the mechanisms underlying the biological effects of ionizing radiation at the molecular, chromosomal and cellular level.
- Development of cytogenetic methodologies in combination with molecular DNA-probes for biomonitoring purposes and the development of reliable and sensitive biological dosimeters for the estimation of absorbed radiation doses and cancer risk.
- Development of cytogenetic methodologies for the identification of persons with increased radiosensitivity and genetic predisposition to cancer, and the individualization of radiation therapy treatments.
- Study of the role of stable reciprocal translocations and chromosomal rearrangements in the mechanism of radiation induced carcinogenesis.
- Development of cytogenetic methods for the evaluation of mutagenic and carcinogenic potential of genotoxic chemicals.

- Molecular cytogenetic analysis of hematological neoplasms: characterization of genomic rearrangements, amplification of specific genes, exploration of genetic recombinations for the identification of critical mechanisms involved in leukemogenesis.
- Interindividual differences in susceptibility to leukemia: polymorphisms of genes involved in the detoxification of xenobiotic compounds after genotoxic exposures.

Specialized scientific services offered to major hospitals and private clinics for the improvement of diagnostic and prognostic evaluation of leukemic diseases. During the year 2004, bone marrow biopsies obtained from 2.342 patients were analyzed and characterized using cytogenetic methodologies.



*Cytogenetics of hematological neoplasms*

## ENVIRONMENTAL RESEARCH LABORATORY (EREL)

Head: Dr. A. Stubos

### Personnel:

Researchers and Functional Scientific Personnel	2
Other Scientists:	5
Co-operating Researchers:	0,25
Scholarships:	2
Technicians:	3

### Objectives:

EREL with its 20-years experience and its highly specialised scientific staff is one of the leading environmental research laboratories in the country with strong scientific links with many Research and Academic Organizations worldwide. The general aim of EREL is the production of scientific know-how and innovative tools for research and provision of services in the fields of environment and energy. The Laboratory is equipped with modern facilities for the measurement of air pollution and powerful computing equipment and provides high-level services in the areas of air quality and environmental impact assessment as well as in a wide range of issues related to environment and energy. In line with current international trends, EREL places emphasis in R&D activities relevant to hydrogen technology, simulation of atmospheric pollutant dispersion in realistic conditions, diagnostic and prognostic meteorological modelling, contribution of anthropogenic and biogenic pollutants to global warming and urban pollution, simulation of underground hydrocarbon and water reservoirs and characterization of nanoporous materials for environmental (gas separations, storage of CO<sub>2</sub> and H<sub>2</sub>) and bio-medical applications (controlled release systems, drug transport through the skin).

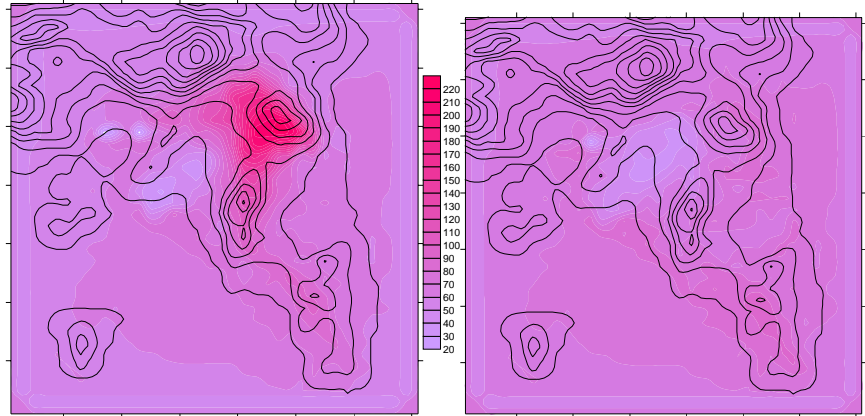
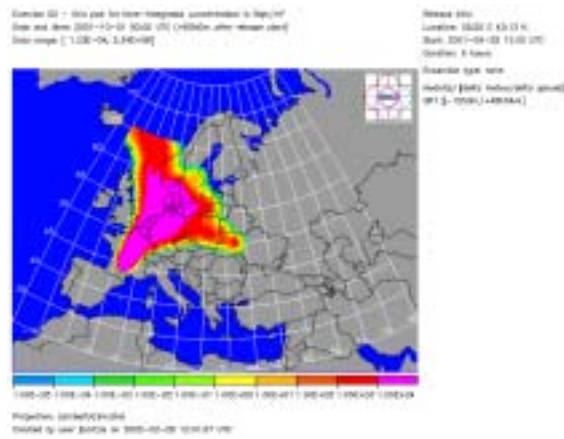
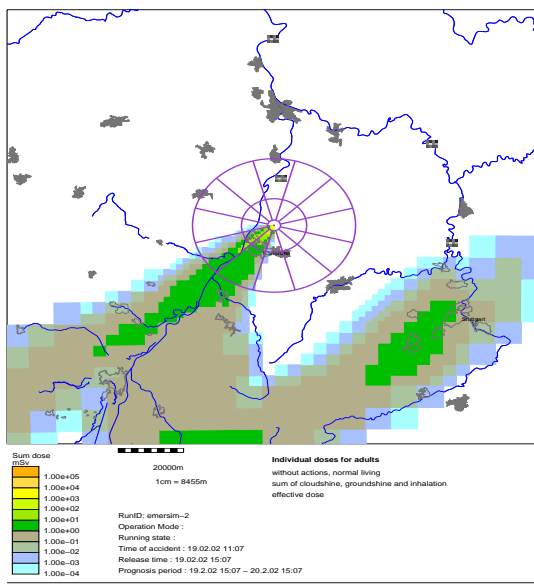
### Achievements:

The Laboratory has been accredited according to ISO 9001 for software development and use in atmospheric applications. EREL carries out several research projects with substantial external funding (mainly from EC), in several of which (five) acts currently as coordinator of European consortia of research institutions and industries. In the frame of these activities, EREL has developed a broad range of cooperation with Public and Private Organisations both within and outside Greece, while actively participating in international scientific networks. In parallel, EREL continues to produce and publish original methods and results in the wider area of computational fluid mechanics, with applications in pollutant dispersion, influence of meteorology and pollutant sources distribution in urban pollution, tropospheric ozone concentrations due to anthropogenic and biogenic pollutants in the Mediterranean area, turbulence simulation, transport phenomena in porous media, and flow and mass transport in multiphase systems. In brief, the main achievements of the Laboratory include the following:

- Development of state-of-the-art software for diagnostic and prognostic meteorological simulations, atmospheric dispersion of pollutants (toxic, radioactive, flammable, photochemical, heavier or lighter than air) in complex terrains
- Development of software for the simulation of sorption, flow and diffusion in porous materials
- Development of computational and experimental methods for the characterization of nanoporous materials
- Development of a novel methodology based on the combination of NMR and Neutron Scattering techniques for the structural and dynamic characterization of biological systems (stratum corneum, lipid membranes, gene delivery systems)
- Fully equipped laboratory for organic pollutant measurements with high sensitivity analytical chemistry devices (GC/FID/FPD, GC/MS with Thermal Desorption Unit, HPLC)
- Highly specialised unit for field measurements of atmospheric pollutants



- Development and use of RODOS (Real-time On-line DecisiOn Support for nuclear emergencies in Europe) system
- Participation in the “Nuclear Technology” Group of the Emergency Plan of the Greek Atomic Energy Commission
- Active collaboration with a large number of Greek and European Laboratories and Industries
- National representation in COST Senior Official Committee and in Advisory Committee for Radioactive Waste Management (ACPM) of EU.
- Participation in the following scientific networks:
  - ◇ EREL represents NCSR Demokritos in ENERO (European Network of Environmental Research Organizations).
  - ◇ Founding member of the network “Harmonisation of dispersion models in Europe”.
  - ◇ Member of ERCOFTAC (European Research Community on Flow, Turbulence and Combustion).
  - ◇ Member of the Board of “Mediterranean Scientific Association for Environmental Protection” (MESAEP).



*Prediction of maximum ozone concentrations in Athens area for the years 1990 (left) and 2004 (right)*

## **SYSTEM RELIABILITY AND INDUSTRIAL SAFETY LABORATORY (SRISL)**

**Head: Ioannis A. Papazoglou**

### **Personnel**

#### Researchers and Functional Scientific Personnel: 5

Dr. Ioannis A. Papazoglou (Director of Research)

Dr. Ioannis Kollas (Director of Research)

Dr. Tatiana Tambouratzis ( Researcher)

Dr. Zoe Nivolianitou (Researcher)

Ms. Vana Synodynou (ELE C)

#### Other Scientists: 1

Dr. Olga Aneziris (Chemical Engineer)

### **Objectives**

Development of methodology and associate software tools in the areas of:

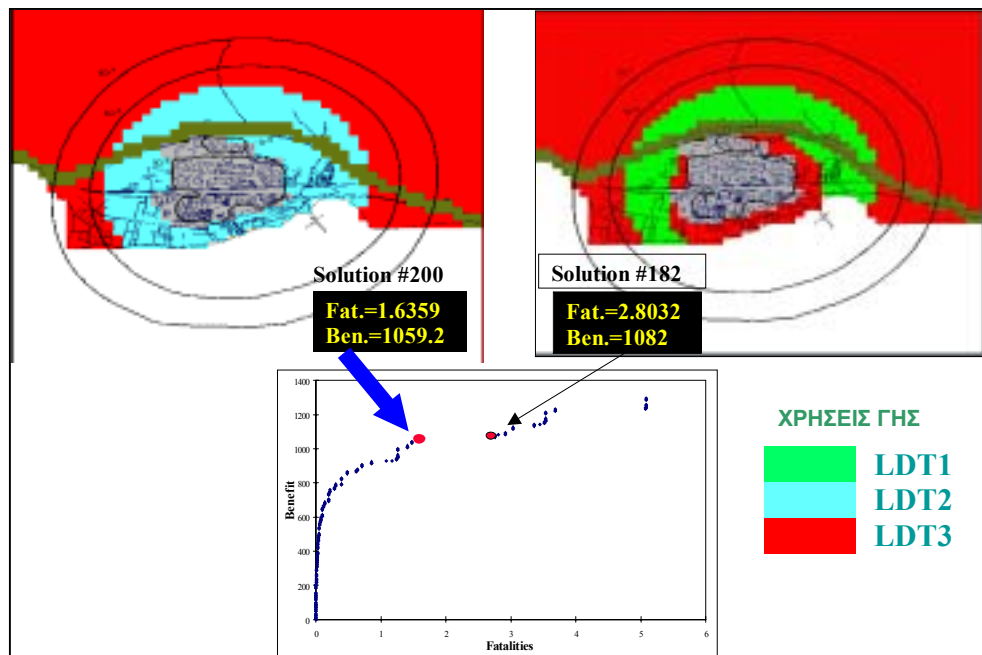
- Reliability of large systems with complex stochastic behavior
- Quantitative Risk Assessment of complex technological systems
- State Identification of Complex Systems
- Health and Environmental Consequence Assessment of alternative Electrical Power generating systems

Recently research and development has been focused in the:

- Methodology development for the calculation of the dynamic reliability of systems incorporating the interaction of the stochastic behavior of control and safety systems and the dynamic physical phenomena characterizing the processes that these systems control and/or protect.
- Quantification of uncertainties about the models simulating technological systems, physical phenomena and processes.
- Optimization Algorithm development in discrete decision spaces with multiple criteria
- Decision Support System development for risk management as well as emergency response policy selection in major hazard accidents in nuclear and chemical installations.
- System-state diagnostics using soft computing (artificial neural networks, genetic algorithms, fuzzy expert systems) and novel signal processing techniques (e.g. wavelets).
- The effect of meteorological parameters on energy system design/validation.

### **Achievements**

The laboratory for System Reliability and Industrial Safety (SRISL) was founded in 1988, with initial objective the development of an integrated capability for the quantitative risk assessment of large nuclear and non-nuclear systems. During the last fifteen years the laboratory has contributed to the state-of-the art of system reliability, quantified risk assessment, the development of Decision support systems with multiple criteria and under uncertainty and system diagnostics. Furthermore, the laboratory has developed an integrated methodology and the associated computer tools for the safety analysis and the quantification of uncertainty in installations handling hazardous material.



*Decision Support System (DSS) for land use planning around major hazard facilities. This DSS allows the user to partition the area into smaller cells of arbitrary shape, on a Geographic Information System, and to determine various Land Development Types for each cell. The DSS evaluates the efficient policies, by taking into consideration various criteria. Finally the DSS allows the user to simultaneously examine various efficient alternatives both in terms of the consequences and in terms of the corresponding actions.*

These achievements were accomplished through the active participation in the framework programmes of the European Commission in the area of Major Industrial Hazards and Risk Assessment (1 project in Framework Programme II, 1 project in Framework Programme III, 3 projects in the Framework Programme IV, 2 projects in Framework Programme V). In these projects SRISL has collaborated with leading European organizations paving the way to the introduction of new risk based approaches to the regulatory framework for installations handling hazardous materials and subject to the SEVESO directive. Such organizations are: the Health and Safety Executive of the UK, The Ministry of Environment and the ministry of Labor of the Netherlands (VROM, SZW), and the Joint Research Center at Ispra of the EC.

Based on the developed methodology and the associated tools the SRISL in collaboration with the above and other European research organizations focused its research efforts in problems addressing the support of decisions concerning the management of risk, the land use planning around dangerous sites, and the evaluation of the role of the organizational and management system of a company on the safety of the installations. These two elements constitute the fundamental changes incorporated in the second updated version of the SEVESO directive (SEVESO II).

The SRISL is one of the main consultants of the Greek ministries of Environment and Development in issues concerning the regulation of Greek chemical installations subject to the SEVESO directive and it has reviewed and reassessed the safety cases of half the Greek industry with respect to the external risk, and almost the totality of the Greek industry with respect to the frequency assessment of the major accidents.

In the area of reliability analysis SRISL's work has resulted in a number of methodological developments in the assessment of the reliability of dynamic systems, the mathematical foundation of the Event Tree approach and other results published in international scientific journals.

## SOLAR & OTHER ENERGY SYSTEMS LABORATORY (SESL)

Head: V. Belessiotić

### Personnel

Researchers and Functional Scientific Personnel	3
Other Scientists:	-
Co-operating Researchers:	-
Scholarships:	1
Technicians:	3

The Laboratory started its activities in 1980 and has ever since been pursuing applied research and technology development in the fields of solar collectors and systems, thermal storage, solar desalination, drying of agricultural products and solar cooling. It is equipped with excellent measurement facilities and along with experimental investigations it uses as basic analytical tools the Metrology of Energy Quantities and Numerical Simulation, Computational Fluid Dynamics in particular. The aforementioned activities, financed to a great extent by third means have had as a result a wide field of technical accomplishments. The Laboratory is organized and has been accredited according to the EN ISO/IEC 17025 standard, having developed a Quality Assurance System for performing testings based on ISO and EN standards

### AREAS OF APPLIED RESEARCH

#### ■ Solar Collectors and Systems

Improved collector designs, new materials, heat pipe collectors, development-valuation of testing methods, mathematical simulation, integrated design tools

#### ■ Thermal Storage

Underground storage tanks with non-metallic walls, phase-change materials (PCM), analytical and experimental study of transient flow and thermal fields, determination of heat losses

#### ■ Solar Distillation – Desalination

Determination of yield, numerical simulation and experimental verification, design of new types of stills, hybrid systems

#### ■ Solar Cooling

Absorption and desiccant systems, Energetic optimization of relevant installations-pilot units

#### ■ Agricultural energy systems

Design and development of industrial drying chambers, optimization of drying processes. Experimental and analytical methods

### SPECIALIZED SERVICES

■ Efficiency and qualification tests for solar collector and systems according to European and International Standards (EN 12975-2, EN 12976-2, ISO 9806-1, ISO 9806-2, ISO 9459-2) and certification of prediction of annual collector energy output

■ Measurements of optical properties of materials (ASTM E 424, ASTM E 408)

■ Rating and performance tests for non-ducted air conditioners and heat pumps according to international standards (ISO 5151)

■ Characterization tests for lead-acid starter batteries (EN 60095-1 standard)

■ Determination of the thermal resistance of thermal insulation and construction materials (ISO 8302, DIN 52615) and of the density of cellular plastics and rubbers (EN ISO, ISO 2896845)

- Specialized studies and consulting in the areas of optimal energy design, manufacturing processes for solar collectors and systems, design and development of new products, energy savings, development and organization of specialized laboratories, metrology
- Modelling of energy systems and processes



*View of the special specifications building of the laboratory*



*General view of the outdoor measurement and testing facilities*

#### 4. Personnel over the last nine years

	1996	1997	1998	1999	2000	2001	2002	2003	2004
<b>Researchers and Functional Scientific Personnel</b>	30	27	27	27	25	24	24	26	22
<b>Co-operating Researchers</b>	1	1	6	6	5	3	4	2	2,25
<b>Technicians</b>	31	30	27	26	23	23	25	25	27
<b>Under contract</b>	28	28	21	29	33	38	31	30	38
<b>Administrative</b>	6	6	2	4	6	4	2	2	2
<b>Other Scientists</b>	5	5	4	5	6	5	15	15	11
<b>Scholarships</b>	14	14	21	19	11	8	11	11	8
<b>TOTAL</b>	<b>115</b>	<b>111</b>	<b>108</b>	<b>116</b>	<b>109</b>	<b>105</b>	<b>112</b>	<b>111</b>	<b>110,25</b>

TABLE I

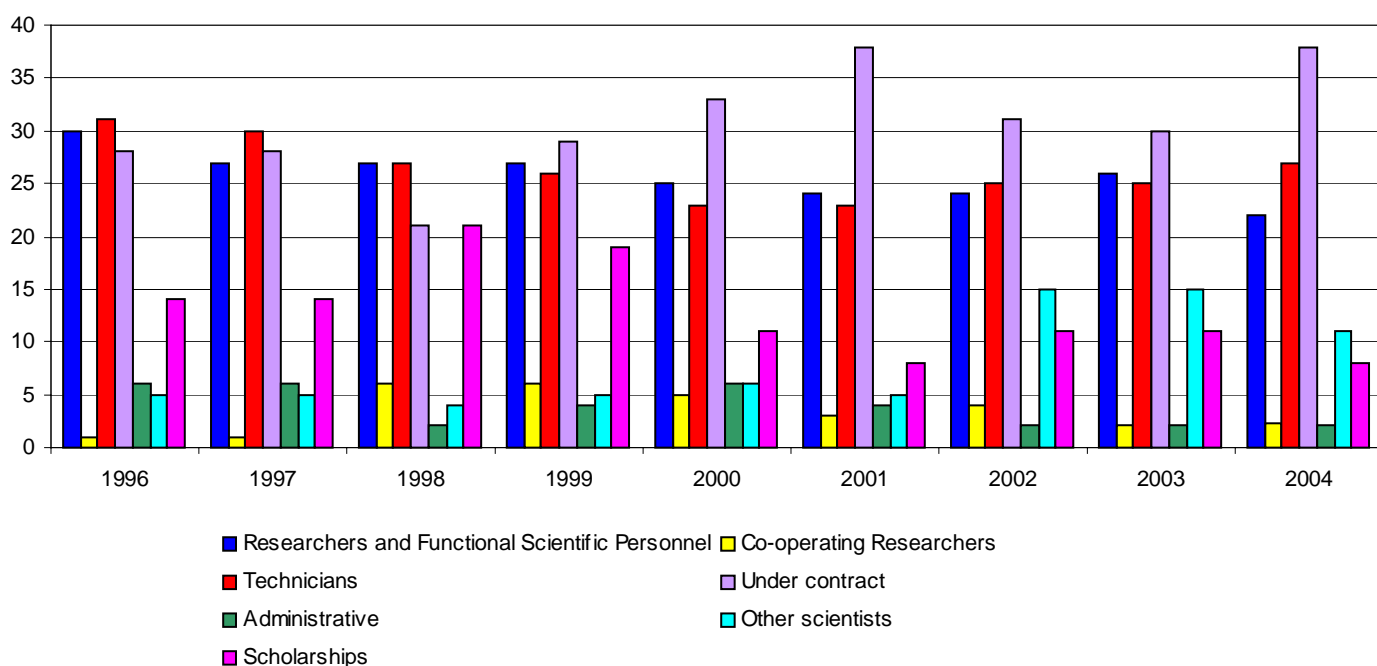
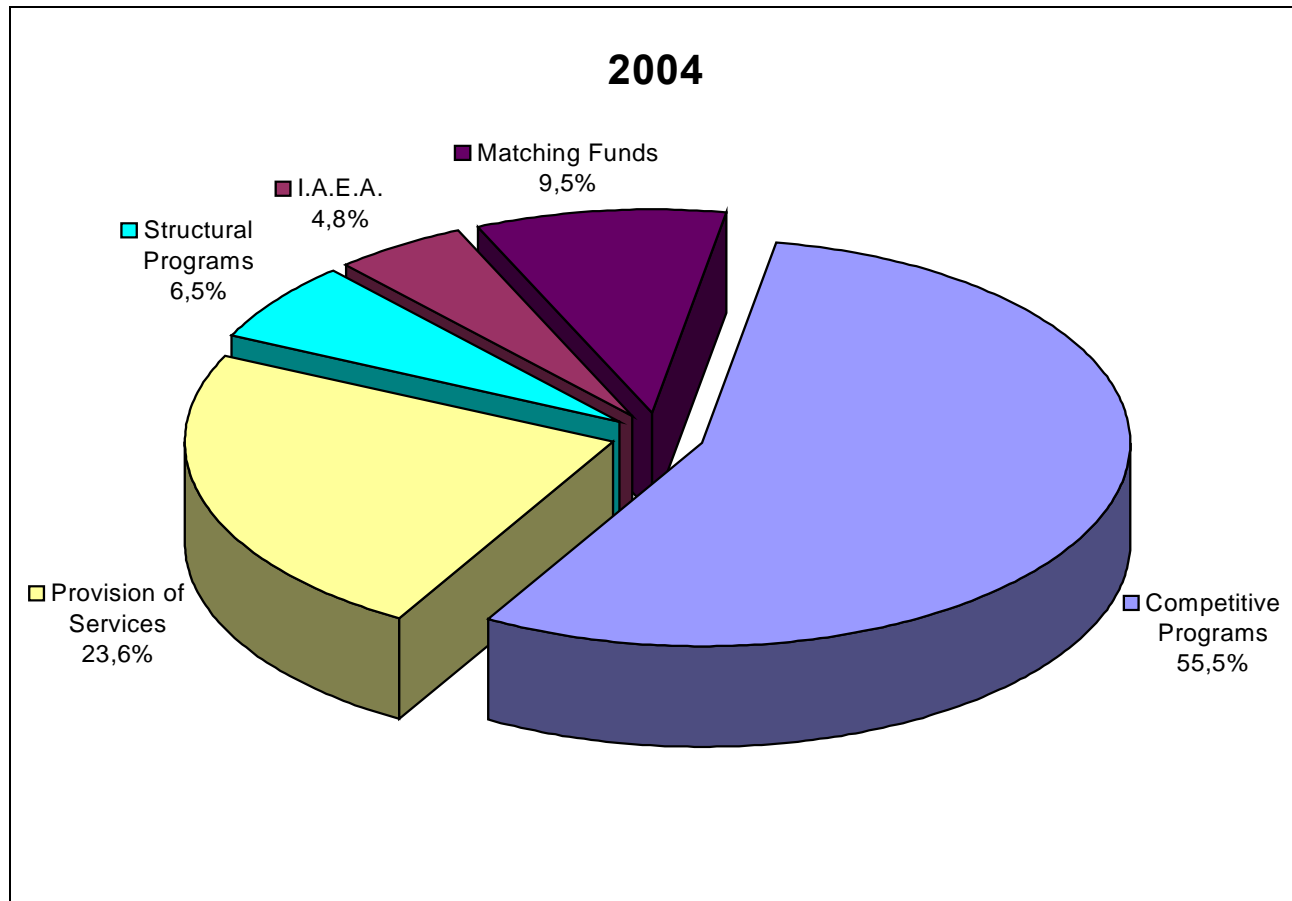


CHART I

## 5. FUNDING 2004

Laboratories	Funding (in Euro)					
	Competitive Programs	Structural Programs	Provision of Services	I.A.E.A	Matching Funds	Total
Nuclear Research Reactor	213.973,25	0	46.251,81	102.000,00	295.000,00	<b>657.225,06</b>
Environmental Radioactivity	63.935,00	0	130.005,00	0	5.600,00	<b>199.540,00</b>
Health Physics & Environmental Hygiene	70629,65	0	196.366,68	0	0	<b>266.996,33</b>
Environmental Research	518.642,37	0	31.203,60	0	483412,71	<b>1.033.258,68</b>
System Reliability & Industrial Safety	165.511,85	0	0	0	0	<b>165.511,85</b>
Solar & other Energy Systems	137.532,45	137.159,00	94.030,47	0	15.946,00	<b>384.667,92</b>
Plasma Physics						
<b>Total</b>	<b>1.170.224,57</b>	<b>137.159,00</b>	<b>497.857,56</b>	<b>102.000,00</b>	<b>799.958,71</b>	<b>2.707.199,84</b>

**TABLE II**



**CHART II**

# FUNDING 1996-2004

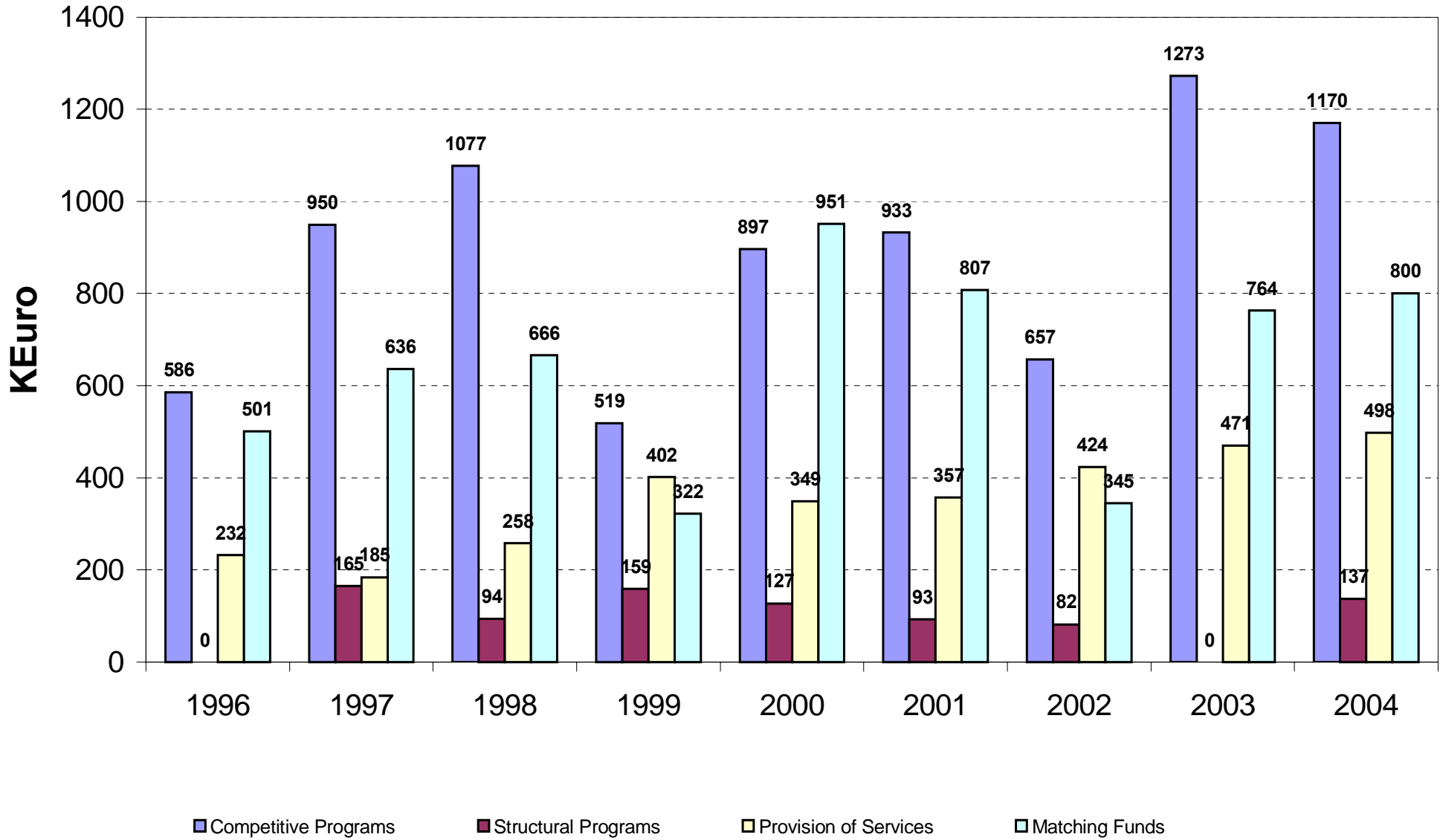


CHART III



## 6. Institute Account – Expenditure 2004

Category	Amount	Total of Category	%
Consumables		<b>30.491,37</b>	<b>12,4</b>
General Expenses		<b>15.888,52</b>	<b>6,5</b>
Work Overtime		<b>5.313,58</b>	<b>2,2</b>
Employment on contract		<b>20.434,35</b>	<b>8,3</b>
Travel & others			
<b>Travel expenses</b>	660,35		
Conferences	5.035,04		
Education	1.450,00		
Invitations, Committees, etc.	50,00		
<b>Category total</b>		<b>7.195,39</b>	<b>2,9</b>
<b>Infrastructure</b>			
Electrical and other works	13.215,48		
Furniture	19.241,00		
Maintenance	81.432,52		
<b>Category total</b>		<b>113.889,00</b>	<b>46,2</b>
<b>Equipment</b>			
Instruments	33.143,88		
Computers and software	19.807,54		
<b>Category total</b>		<b>52.951,42</b>	<b>21,5</b>
<b>General total</b>		<b>246.163,66</b>	<b>100 %</b>

## 7. PUBLICATIONS 2004

### IMPACT FACTOR – 2004

LABORATORY	PUBLICATIONS		IMPACT FACTOR
	Papers (in refereed Scientific Journals)	Papers (in Conference Proceedings)	
<i>Nuclear Research Reactor</i>	21	13	8,500
<i>Environmental Radioactivity</i>	6	6	
<i>Health Physics &amp; Environmental Hygiene</i>	4	2	9,403
<i>Environmental Research</i>	21	27	28,142
<i>System Reliability &amp; Industrial Safety</i>	7	8	3,700
<i>Solar &amp; Other Energy Systems</i>	4	2	2,540
<i>Plasma Physics</i>	-	1	
<b>Total</b>	<b>63*</b>	<b>59**</b>	

\* 4 of them are quoted by four laboratories

\*\* 2 of them are quoted by three laboratories

TABLE IV

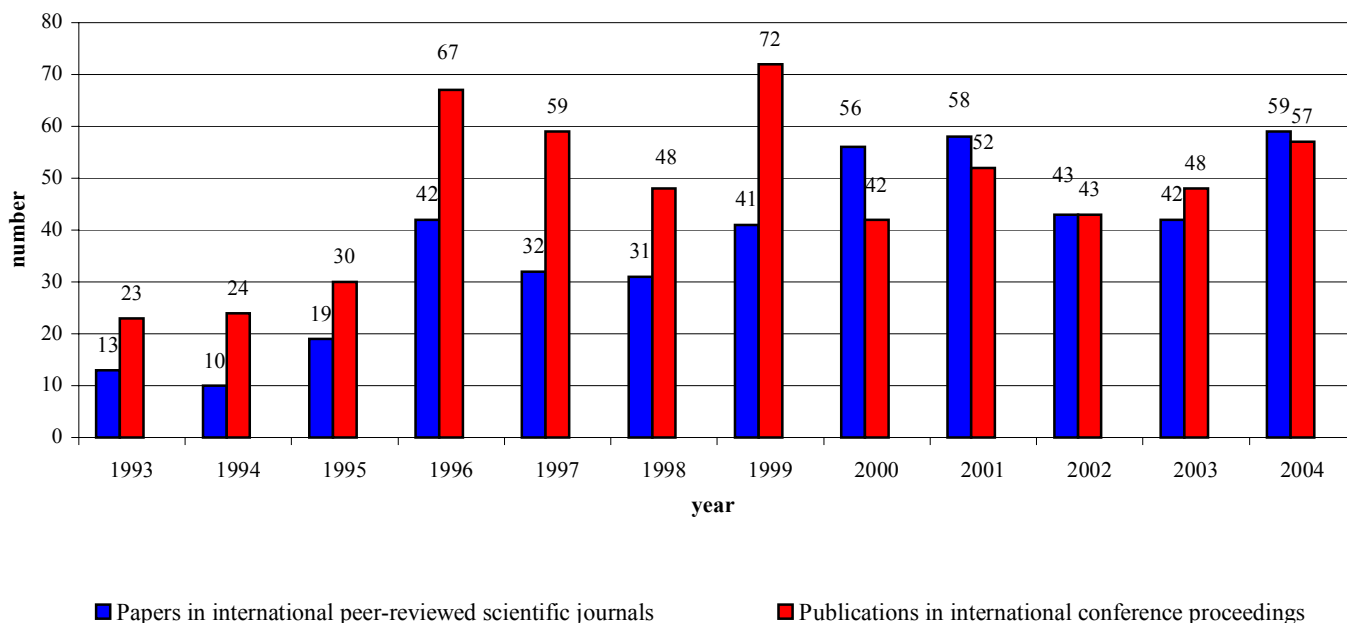


CHART IV

## PUBLICATIONS 2004

### 1. Research Reactor Laboratory (RRL)

#### 1. PEER-REVIEWED JOURNALS

1. Housiadas, C., Drossinos, Y., Lazaridis, M., "Effect of small-scale turbulent fluctuations on rates of particle formation", *J. Aerosol Sci.*, 35, 545-559, 2004.
2. Aneziris, O.N., Housiadas, C., Stakakis, M., Papazoglou, I.A., "Probabilistic safety analysis of a Greek research reactor", *Ann. Nucl. Energy*, 31, 481-516 (2004).
3. Stamatelatos I.E., Mergia K., Lefkopoulos G. and Forrest R. Impurities and evaluation of induced activity of SiCf/SiC composites. *Nuclear Instruments and Methods B*, 213 511-514 (2004).
4. Tzika F. and Stamatelatos I.E. Thermal neutron self-shielding correction factors for large sample instrumental neutron activation analysis using the MCNP code. *Nuclear Instruments and Methods B*, 213 177-181 (2004).
5. Stamatelatos I.E., Kasviki K., Green S., Gainey M., Kalef-Ezra J. and Beddoe A. Prompt-gamma neutron activation analysis facility for in vivo body composition studies in small animals. *Analytical and Bioanalytical Chemistry*, 379 192-197 (2004).
6. Tzika F., Stamatelatos I.E., Kalef-Ezra J. and Bode P. 2004. Large sample neutron activation analysis: Correction for neutron and gamma attenuation. *Nukleonika*, 49, 115-121 (2004).
7. A. -A. F. Tavassoli, A. Alamo, L. Bedel, L. Forest, J. -M. Gentzbittel, J. -W. Rensman, E. Diegele, R. Lindau, M. Schirra, R. Schmitt, H.C. Schneider, C. Petersen, A.-M. Lancha, P. Fernandez, G. Filacchioni, M.F. Maday, K. Mergia, N. Boukos, Baluc, P. Spatig, E. Alves, E. Lucon, "Materials design data for reduced activation martensitic steel type EUROFER", *Journal of Nuclear Materials*, 329-333, 257-262, (2004)
8. P. Pankowski, L. T. Baczewski, T. Story, A. Wawro, K. Mergia, S. Messoloras, "Magnetic properties of ultra-thin epitaxial V/Gd bilayers", *Physica Status Solidi*, 1, 405-408 (2004)
9. K. Mergia, A. Salevris, S. Messoloras, "The new neutron powder diffractometer at Demokritos research reactor", *Physica B*. 350, 162-165, (2004)
10. "Efficient Treatment of Complex Geometries For Large Eddy Simulations of Turbulent Flows". D. G. E. Grigoriadis, J. G. Bartzis, A. Goulas. *Computers and Fluids*, vol. 33, issue 2, pages: 201-222. 2004
11. "Modeling of combined aerosol and photooxidant processes in the Mediterranean area", M. Lazaridis, A. Spiridaki, S. Solberg, G. Kallos, T. Svendby, F. Flatøy, I. Drossinos, C. Housiadas, J. Smolik, I. Colbeck, M. Varinou, F. Gofa, K. Eleftheriadis, V. Zdimas and P.G. Georgopoulos, *Water Air Soil Poll. Focus*, 4, 3-21, 2004.
12. "Impact of indoor household activities on the size distribution of fine aerosol number concentration and case specific calculated inhaled dose", K. Eleftheriadis, S. Vratolis, C. Mitsakou, I. Colbeck, C. Housiadas, M. Lazaridis, *J. Aerosol Sci.*, 35, Suppl. 2, 849-850, (2004).
13. "Simulation of laminar flow reactor with an 1-D sectional aerosol model", D. Mitrakos, C. Mitsakou, C. Housiadas, *J. Aerosol Sci.*, 35, Suppl. 2, 895-896, (2004).
14. "Extrathoracic and thoracic deposition of inhaled hygroscopic particles", C. Mitsakou, C. Helmis, C. Housiadas, *J. Aerosol Sci.*, 35, Suppl. 2, 1127-1128 (2004).
15. "Dose assessment based on realistic exposure scenarios in Oslo", V. Aleksandropoulou, C. Mitsakou, C. Housiadas, M. Lazaridis, *J. Aerosol Sci.*, 35, Suppl. 2, 1213-1214, (2004)
16. La<sub>2</sub>Hf<sub>2</sub>O<sub>7</sub> high-kappa gate dielectric grown directly on Si(001) by molecular-beam epitaxy, Dimoulas, A, Vellianitis, G, Mavrou, G, Apostolopoulos, G, Travlos, A, Wiemer, C, Fanciulli, M, Rittersma, *ZM APPLIED PHYSICS LETTERS* 85, p3205 (2004)
17. Si overgrowth on Y<sub>2</sub>O<sub>3</sub> (110)/Si (001) by molecular beam epitaxy, Mavrou, G, Vellianitis, G, Apostolopoulos, G, Argyropoulos, K, Dimoulas, A, Scholz, R *MATERIALS SCIENCE AND ENGINEERING B* 109, p39 (2004)

18. EELS study of oxygen superstructure in epitaxial Y<sub>2</sub>O<sub>3</sub> layers, Travlos, A, Boukos, N, Apostolopoulos, G, Dimoulas, A, Giannakopoulos, C MATERIALS SCIENCE AND ENGINEERING B 109, p52 (2004)
19. MBE lanthanum-based high-k gate dielectrics as candidates for SiO<sub>2</sub> gate oxide replacement, Vellianitis, G, Apostolopoulos, G, Mavrou, G, Argyropoulos, K, Dimoulas, A MATERIALS SCIENCE AND ENGINEERING B 109, p85 (2004)
20. Electrical properties of metal-oxide-silicon structures with LaAlO<sub>3</sub> as gate oxide, Mereu, B, Sarau, G, Dimoulas, A, Apostolopoulos, G, Pintilie, I, Botila, T, Pintilie, L, Alexe, A MATERIALS SCIENCE AND ENGINEERING B 109, p94 (2004)
21. Complex admittance analysis for La<sub>2</sub>Hf<sub>2</sub>O<sub>7</sub>/SiO<sub>2</sub> high-kappa dielectric stacks, Apostolopoulos, G, Vellianitis, G, Dimoulas, A, Hooker, JC, Conard, T APPLIED PHYSICS LETTERS 84, p260 (2004)

## **2005**

1. “Void Induced Reactivity in a Mixed MTR Core” M. Varvayanni, E. Stakakis, N. Catsaros, M. Antonopoulos-Domis, Nuclear Engineering & Design, 235, 855-865, 2005
2. “Eulerian modelling of lung deposition with sectional representation of aerosol dynamics”, Mitsakou, C., Helmis, C., Housiadas, C., J. Aerosol Sci., 36, 75-94, 2005.

## **Papers accepted for publication in Refereed Scientific Journals**

1. “Derived Release Limits For the Greek Research Reactor Site Based on diagnostic Atmospheric Modelling System for Irregular Terrain”, M. Varvayanni, N. Catsaros, M. Antonopoulos-Domis, HEALTH PHYSICS, in press, 2005.
2. “Induced magnetic moment of V atoms in ultra-thin epitaxial V/Gd bilayers”, P. Pankowski, L. T. Baczewski, T. Story A., Wawro, K. Mergia, S. Messoloras, and F. Ott Phys. Rev. B (submitted)
3. Lontos C.A., Postidi M.S., Stakakis E. Carbon-related complexes in neutron-irradiated silicon, Physica B,

## **2. PEER-REVIEWED CONFERENCE PROCEEDINGS**

1. K. Eleftheriadis, S. Vratolis, C. Mitsakou, I. Colbeck, C. Housiadas, M. Lazaridis, “Impact of indoor household activities on the size distribution of fine aerosol number concentration and case specific calculated inhaled dose”, **European Aerosol Conference**, Budabest, Hungary, 6 – 10 September 5, 2004.
2. D. Mitrakos, C. Mitsakou, C. Housiadas, “Simulation of laminar flow reactor with an 1-D sectional aerosol model”, European Aerosol Conference, Budabest, Hungary, 6 – 10 September 5, 2004
3. C. Mitsakou, C. Helmis, C. Housiadas, “Extrathoracic and thoracic deposition of inhaled hygroscopic particles”, European Aerosol Conference, Budabest, Hungary, 6 – 10 September 5, 2004.
4. V. Aleksandropoulou, C. Mitsakou, C. Housiadas, M. Lazaridis, “Dose assessment based on realistic exposure scenarios in Oslo”, European Aerosol Conference, Budabest, Hungary, 6 – 10 September 5, 2004.
5. Tzika F., Stamatelatos I.E., Kalef-Ezra J. Large sample neutron activation analysis: Influence of sample inhomogeneities. Proceedings 11th International Conference on Modern Trends in Activation Analysis, University of Surrey, Guildford, UK, 20-25 June 2004

6. Kasviki K., Stamatelatos I.E., Kalef-Ezra J. Prompt gamma neutron activation analysis for small animal in vivo body composition studies. Effects of animal body size and inhomogeneities. Proceedings 11th International Conference on Modern Trends in Activation Analysis, University of Surrey, Guildford, UK, 20-25 June 2004
7. “Void induced reactivity in a mixed MTR core” M.Varvayanni, E.Stakakis, N.Catsaros, M.Antonopoulos-Domis, 29th IMORN - International Meeting on Reactor Noise, 17-19 May, Budapest (2004)
8. “Gamma heating estimation in a mixed MTR core” M.Varvayanni, E.Stakakis, J.Anoussis, N.Catsaros, M.Antonopoulos-Domis, 29th IMORN - International Meeting on Reactor Noise, 17-19 May, Budapest 2004
9. “Mechanical and Structural Changes in n-irradiated SiCf/SiC composites”, G. Vekinis, K. Mergia and G. Xanthopoulou, XX International Conference on advanced ceramics, Korea, 2004
10. “Large sample neutron activation analysis: Influence of sample inhomogeneities” F. Tzika, I.E. Stamatelatos, J. Kalef-Ezra Proceedings 11th International Conference on Modern Trends in Activation Analysis, MTAA-11, University of Surrey, Guildford, UK, 20-25 June 2004
11. “Prompt gamma neutron activation analysis for small animal in vivo body composition studies. Effects of animal body size and inhomogeneities”. K. Kasviki, I.E. Stamatelatos, J. Kalef-Ezra Proceedings 11th International Conference on Modern Trends in Activation Analysis, MTAA-11, University of Surrey, Guildford, UK, 20-25 June 2004
12. “The development of a TOF reflectometer at the Greek Research Reactor”, K. Mergia, Proceedings of the Technical Meeting on Neutron Reflectometry, IAEA, Vienna 2004
13. “The Greek Research Reactor: Physical Protection Beyond INFCIRC/225” Th. Matikas and N. Catsaros, INMM 45th Annual Meeting, Orlando, Florida, U.S.A., 18-22 July 2004

### **3. TECHNICAL REPORTS- DEMO & P-INTR-P Reports**

1. Varvagianni M., *Individual Effective Doses and Derived Release limits for the Greek Research Reactor Site*, P-INT-RP/04/1
2. Varvagianni M., *The Fuel Burnup Determination Methodology and Indicative Depletion Calculations in the Greek Research Reactor*, P-INT-RP/04/2
3. Tzika F., Chanousis A., Kovatsos C. and Stamatelatos I.E., *GRR1- tunnel monitor operational tests*. INT-RP/2004/2.
4. Stamatelatos I.E. and Tzika F., *Research reactor radiation protection regulations*. INT-RP/2004/3 (in Greek).
5. “Individual Effective Doses & Derived Release limits for the Greek Research Reactor Site”, M. Varvayanni, P-INT-RP/04/1 (2004)
6. “The Fuel Burn-up Determination Methodology and Indicative Depletion Calculations in the Greek Research Reactor” M. Varvayanni, P-INT-RP/04/2 (2004)
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### **4. EDUCATIONAL ACTIVITIES**

1. Stamatelatos I.E., IAEA Regional Post-Graduate Educational Course on Radiation Protection and Safety of Radiation Sources, Greek Atomic Energy Commission, Athens, Greece.
2. Stamatelatos I.E., Inter-University Post-graduate course on Medical Radiation Physics.

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## **7. Plasma Physics**

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## 8. SCIENTIFIC AND OTHER PROJECTS

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2. EVK4-CT-2000-00018: Characterization of urban air quality indoor/outdoor particulate matter chemical characteristics and source-to-inhaled dose relationships (URBAN-AEROSOL).
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11. Integrated Project EXTREMAT "New Materials for Extreme Environments", 1/12/2004 -30/11/2009

### *Environmental Radioactivity Laboratory*

#### Services

1. Control of radioactivity in consumer products, materials and other samples.

#### ***SELF-FINANCED***

Incomes:

2004 120 000 EURO

2. Oriented and applied studies for third party under contracts (e.g. Contract with the National Technical University of Athens, on the radiological control of new buildings of the Ethniki Asphalistiki etc)

#### ***SELF-FINANCED***

Incomes:

2004 30 000 EURO

3. Contract with the AGET cement industry (in collaboration with the Reactor Laboratory of INT-RP) on the subject: "Evaluation of the environmental impact on the atmosphere due to the operation of the AGET installations in Volos".

Duration: 2002-2004

Total funding: 53000 €

For 2004 –Funding for ERL 10500

### **E.U. - 5<sup>th</sup> Framework**

#### 3. Contract EVK4-CT-2000-00018:

Project: Indoor/Outdoor Particulate Matter Chemical Characteristics and Source-to-Inhaled Dose Relationships

(in collaboration with the Reactor Laboratory of INT-RP)

Duration: 2001-2004

Total funding: 98973 €

**2004 funding for ERL 7500**

#### 4. Contract EVK4-CT-2002-00090.

Project: "Integrated Exposure Management Tool Characterizing Air Pollution-relevant Human Exposure in Urban Environment" (URBAN-EXPOSURE)

(in collaboration with the Research Reactor Laboratory of INT-RP)

Duration: 2002-2005

Total funding: ERL - 53300 €

**2004 for ERL 12500**

### **GSRT project**

#### **COMMUNITY SUPPORT FRAMEWORK III**

#### **OPERATIONAL PROGRAMME COMPETITIVENESS**

#### **AXIS 4 – MEASURE 4.5 Natural Environment and Sustainable Development**

Technology development for optimising air quality in industrial buildings: Characterisation of Air Quality in Industrial Buildings – Mechanisms Controlling the Indoor/Outdoor Particulate Matter Chemical Characteristics And their Effects to Human Exposure and Inhaled Dose (INDOOR-HEALTH)

Duration: 2003 – 2006

Total funding: 17000EURO

(in collaboration with the Research Reactor Laboratory of INT-RP)

2004 ERL funding 35000 €

### **CIESM Projects**

Mediterranean Mussel Watch. Designing a regional program for detecting radionuclides and trace contaminants

CIESM

Incomes

2004 4000 EURO

### **Contract with the Greek Ministry of Environment**

Subject: Study of the contribution of various natural and artificial radionuclides to the exposure of the population of the Eastern Aegean islands. Dispersion of long-lived radionuclides in the marine water of the region. (Project Leader – Prof. Antonopoulos - Domis)

Incomes  
2004 5800 EURO

### *Studies*

“Radiological control of molluscs produced in regions of the Thermaikos Gulf”.

Contract with the Prefecture of Thessaloniki.

2004 2500 EURO

## **Health Physics & Environmental Hygiene Laboratory**

### **Projects**

Projects funded by the European Union (EU), General Secretariat for Research and Technology (GSRT), Hellenic Institute of Hygiene and Work Safety, and Specialized Services offered by the Laboratory.

1. Contract E675

Project: Biodosimetry of ionizing radiation and cytogenetic studies in preleukemic diseases.

Duration: 1999-2005

Total funding: 990000 €

2. Contract E894

Project: Electromagnetic radiation: Measurements of physical parameters and health effects in biological systems.

Duration: 2002-2004

Total funding: 176082 €

3. Contract E1148

Project: Development of new methods for biomonitoring of workers exposed to chemical genotoxic agents.

Duration: 2003-2005

Total funding: 58694,60 €

4. Contract E1056

Project: The role of Intercellular communication and DNA double strand breaks in the induction of bystander effects.

Duration: 2003-2006

Total funding: 261100 €

5. Contract E674

Project: Specialized Radiation Protection Services.

Duration: 2001-2004

Total funding: €

## **Environmental Research Laboratory**

1. AEOLOS Assessment of Impact of SF6 And PFCs Reservoir Tracers On Global Warming (EC ENK6-CT-2001-00501) (1/11/2001-31/10/2004) (Total NCSR “D” Budget: 354,722 EURO, EC Funding: 177,361 EURO)
2. QNET - CFD A thematic network for quality and trust in the industrial application of computational fluid dynamics (EC G1RT-CT-2000-5003) (1/5/2000-30/4/2004) (Total NCSR “D” Budget: 68,133 EURO, EC Funding: 68,133 EURO)
3. DSSNET - Improvement, extension and integration of operational decision support systems

- for nuclear emergency management (EC FIR1-CT-2000-40076) (Total NCSR “D” Budget: 6,500 EURO, EC Funding : 6,075 EURO)
4. EIHP2 European Integrated Hydrogen Project - Phase II (EC ENK6-CT-2000-00442) (1/2/2001-31/1/2004) (Total NCSR “D” Budget: 150,000 EURO, EC Funding: 74,998 EURO)
  5. ROSE Remote optical sensing evaluation (EC GRD1-2000-25009) (1/7/2001-30/6/2004) (Total NCSR “D” Budget: 203,596 EURO, EC Funding: 101,798 EURO)
  6. BOND Biogenic Aerosols and Air Quality in the Mediterranean Area (EC EVK2-CT-2001-00107) (1/11/2001-31/10/2004) (Total NCSR “D” Budget: 453,004 EURO, EC Funding: 226,502 EURO)
  7. PICADA-Photocatalytic innovative coverings applications for depollution assessment (GIRD-CT-2001-00669) (1/1/2002-31/12/2005) (Total NCSR “D” Budget: 381,651 EURO, EC Funding: 50% EURO)
  8. OSCAR-Optimised Expert System for Conducting Environmental Assessment of Urban Road Traffic (EVK4-CT2002-00083) (1/9/02-31/08/05) (Total NCSR “D” Budget: 209,851 EURO, EC Funding: 50% EURO)
  9. MOREOIL-Evaluation of the miscible gas injection in Oil Reservoirs by Monitoring the Asphaltenes Concentration (NNE5-2001-250) (1/3/2002-31/8/2005) (Total NCSR “D” Budget: 435,000 EURO, EC Funding: 35% EURO)
  10. METROPOLIS- Metrology in Support to Precautionary Sciences and Sustainable Development Policies (No: G6RT-CT-2002-05095) (1/7/02-30/6/04) (Total NCSR “D” Budget: 5,400 EURO, EC Funding: 100% 5,400 EURO)
  11. SRN Innovative and sustainable sub-surface exploitation of natural resources (ENK6-CT2002-20694) (1/12/02-30/11/05) (Total NCSR “D” Budget: 11,400 EURO, EC Funding: 100% EURO)
  12. ENVITRACER - Development of Environmentally Friendly Tracer Technology for Improved Reservoir Description (ENK6-CT-2002-00602) (starting date 1-11/02, duration 42 months); (Total NCSR “D” Budget: 498,574 EURO, EC Funding: 50% EURO)
  13. HYSTORY - Hydrogen Storage in Hydrides for Safe Energy Systems, (ENK6-CT-2002-00600), (starting date 1-11/02, duration 36 months); (Total NCSR “D” Budget: 262,688 EURO, EC Funding: 50% EURO)
  14. 01 PRAXE 37 Tracer technology for the advanced characterization of hydrocarbon reservoirs (17/9/02-16/3/04) (Funding from GSRT 44,000 EURO)
  15. 02 PRAXE 42 Commercialization of the 3-D environmental fluid mechanics software package ADREA-HF, DELTA-B (16/9/03-15/3/05) (Funding from GSRT 44,000EURO)
  16. HYSAFE - Safety of Hydrogen as an Energy Carrier, (SES6-CT-2004-502630), (1/3/04-29/2/09); (Total NCSR “D” Budget: 314,394 EURO, EC Funding: 173,279 EURO)
  17. STORHY - Hydrogen Storage Systems for Automotive Application, (SES6-CT-2004-502667), (1/3/04-31/8/08); (Total NCSR “D” Budget: 252,300 EURO, EC Funding: 50% EURO)
  18. EURANOS – European Approach to nuclear and radiological emergency management and rehabilitation strategies (FI6R-CT-2004-508843) (1/4/04-31/3/09); (Total NCSR “D” Budget: 98905 EURO, EC Funding: 50% EURO)

### **System Reliability and Industrial Safety Laboratory**

#### **PROJECTS**

1. **Comparative Risk Assessment of Energy Sources for Electricity Production** (4.250€)
2. **Concerted Action on Brownfield and Economic Regeneration Network: “CABERNET”**, contract No EVK4-CT-2001-20004 (17.000 €).
3. **PRISM**: development of a network of industries and research centers for dissemination of information concerning human factors and practical safety rules for the industry. GRT-CT-2001-05029 (8.000€)
4. **Reliability assessment of large technological systems**, N.C.S.R. “DEMOKRITOS”.

5. **S2S A Gateway to process safety** G1RT-CT-2002-05094 (84.000€)
6. **WORM “Occupational Risk Model”, (RIVM, Netherlands)** (€272.000)
7. **Safety Studies of SEVESO II Installations (145.000€), Ministry of Development, Greece**

**Solar and Other Energy Systems Laboratory**

**On-going Research Projects**

Τίτλος	Δράση / Χρηματοδότηση	Διάρκεια	Προϋπολογισμός Συνολικός/Εργαστηρίου
Παροχή εξειδικευμένων επιστημονικών και τεχνολογικών υπηρεσιών και προϊόντων	/ ΙΔΙΩΤΕΣ	03 - 06	250.000 / 250.000
Παροχή Διαπιστευμένων Δοκιμών & Βελτιστοποίηση Προϊόντων ΑΠΕ	4.2.2 /ΓΓΕΤ	03 - 06	452.580
Παροχή εξειδικευμένων Υπηρεσιών στον τομέα ΑΠΕ, στα πλαίσια υλοποίησης του Προγράμματος ΑΚΜΩΝ	4.2.2 /ΙΔΙΩΤΕΣ	03 - 06	452.580
Ενσωμάτωση Θερμικών Ηλιακών σε Κτίρια	ΕΠΙΑΝ / ΥΠΙΑΝ-ΙΔΙΩΤΕΣ	03-06	1.401.000 / 293.000
Ηλιακό Σύστημα TRITON	ΕΠΙΑΝ / ΥΠΙΑΝ-ΙΔΙΩΤΕΣ	03-06	1.684.525 / 50.000
PROTEAS PV System	ENERGY-FP5 / EE	03-05	1.916.685 / 110.434
CHINA-GREECE : Joint Research and Technology Programmes	ΕΠΙΑΝ / ΥΠΙΑΝ	03-05	12.327 / 12.327
ADIRA: Autonomous desalination system for sea & brackish water desalination	MEDA / EE	03-07	2.729.259 / 240.255
NEGST: New generation of solar thermal systems	FP6 / EE	03-06	1.365.531 / 30.720

