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THE AGENCY'S TECHNICAL CO-OPERATION ACTIVITIES IN 1991

REPORT BY THE DIRECTOR GENERAL

INTERNATIONAL ATOMIC ENERGY AGENCY

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INTERNATIONAL ATOMIC ENERGY AGENCY

PREFACE

Following its usual practice, the Board of Governors has requested the communication to the General Conference of the material it used in reviewing the Agency's technical co-operation activities in 1991: this material is accordingly reproduced in the present document. The review was carried out pursuant to paragraph 19 of the Revised Guiding Principles and General Operating Rules Governing the Provision of Technical Assistance by the Agency.[1]

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[1] See document INFCIRC/267.

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LIST OF ABBREVIATIONS

AAPC	Agency's Area of Activity/Project Codes
AAS	Atomic absorption spectrometry
ADBF	Division of Budget and Finance, IAEA
AEA	Atomic Energy Authority (Sri Lanka)
AECB	Atomic Energy Control Bureau (Indonesia)
AFRA	African Regional Co-operative Agreement for Research, Development and Training
Agency	International Atomic Energy Agency
ARCAL	Regional Co-operative Arrangements for the Promotion of Nuclear Science and Technology in Latin America
ASSET	Assessment of Significant Safety Events Team
CANDU	Canada deuterium-uranium (reactor)
CC	Convertible currency
CCSQ(OPS)	Consultative Committee on Substantive Questions dealing with Operational activities
CD-ROM	Compact disk - read only memory
CEC	Commission of the European Communities
CPI-Sn	Carbomethoxy isopropyl isonitrile
DEC	Digital Equipment Corporation
DDG-TC	Deputy Director General, Department of Technical Co-operation
DNA	Deoxyribonucleic acid
DOE	Department of Energy (USA)
DRPS	Division of Radiation Protection Services, Medical Services Dept., Ministry of Public Health (Thailand)
DTPA-Sn	Diethylenetriaminepentaacetic acid
ECOSOC	United Nations Economic Social Council
ELISA	Enzyme-linked immunosorbent assay
ENPEP	Energy and power evaluation package
EWERMS	Early Warning Environmental Radiation Monitoring System
FAO	Food and Agriculture Organization of the United Nations
FICS	Financial Information Control System
GE	General Electric
GIK	Gift in kind
HpGe	High purity germanium
HPLC	High pressure liquid chromatograph
HV	High voltage

IAEA	**International Atomic Energy Agency**
ICRU	**International Commission on Radiation Units and Measurements**
ILO	**International Labour Organization**
INIS	**International Nuclear Information System**
INSARR	**Integrated Safety Assessment of Research Reactors**
JAERI	**Japan Atomic Energy Research Institute (Japan)**
KANUPP	**Karachi Nuclear Power Plant (Pakistan)**
KFK	**Kernforschungszentrum Karlsruhe (Germany)**
LAN	**Local area network**
LDAC	**Least-developed Arab country**
LEU	**Low-enriched uranium**
LINAC	**Linear accelerator**
LPG	**Liquefied propane gas**
MAED	**Model for analysis of energy demand**
MCA	**Multi-channel analyser**
MDP-Sn	**Monododecylphosphoric acid**
M/M	**Man-months**
NAA	**Neutron activation analysis**
NCC	**Non-convertible currency**
NDT	**Non-destructive testing**
NE	**Department of Nuclear Energy and Safety, IAEA**
NENF	**Division of Nuclear Fuel Cycle, IAEA**
NENP	**Division of Nuclear Power, IAEA**
NENS	**Division of Nuclear Safety, IAEA**
NESI	**Division of Scientific and Technical Information, IAEA**
NOH	**National Orthopaedic Hospital (Philippines)**
NPP	**Nuclear power plant**
OAEP	**Office of Atomic Energy for Peace (Thailand)**
OECD/NEA	**Organization for Economic Co-operation and Development - Nuclear Energy Agency**
OSART	**Operational Safety Review Team**
PAHO	**Pan-American Health Organization**
PC	**Personal computer**
PDP	**Process development pile reactor**
PNRI	**Philippine Nuclear Research Institute (Philippines)**
PUSPATI	**Tun Ismail Atomic Research Centre (Malaysia)**
PWR	**Pressurized water reactor**

R & D	Research and development
RAPAT	Radiation Protection Advisory Team
RCA	Regional Co-operative Agreement for Research, Development and Training Related to Nuclear Science and Technology
RIA	Radioimmunoassay
RIAL	Agency's Laboratories
RIC	Radioisotope Centre at the University of Colombo (Sri Lanka)
RIFA	Joint FAO/IAEA Division of Isotope and Radiation Applications of Atomic Energy for Food and Agricultural Development, IAEA
RILS	Division of Life Sciences, IAEA
RIPC	Division of Physics and Chemistry, IAEA
RPFI	Regional Project on Food Irradiation
SIT	Sterile insect technique
SPECT	Single-photon-emission computerized tomography
TACC	Technical Assistance and Co-operation Committee
TACF	Technical Assistance and Co-operation Fund
TC	Department of Technical Co-operation, IAEA
TCDC	Technical Co-operation among Developing Countries
TCIM	Division of Technical Co-operation Implementation, IAEA
TCMS	Technical Co-operation Management System
TCPM	Division of Technical Co-operation Programmes, IAEA
TCSPC	Programme Co-ordination Section, IAEA
TLD	Thermoluminescence dosimetry
TSH	Thyroid-stimulating hormone
UN	United Nations
UNAM	Autonomous National University of Mexico (Mexico)
UNDP	United Nations Development Programme
UNFPA	United Nations Population Fund
UNICEF	United Nations Children's Fund
UNTCD	Department of Techincal Co-operation for Development, United Nations
UP-PGH	College of Medicine of the University of the Philippines - Philippine General Hospital
UV	Ultra-violet
UV-VIS	Ultra-violet to visible
WAMAP	Waste Management Advisory Programme
WHO	World Health Organization
WL	Working level
WWER	Pressurized water-cooled and water-moderated power reactor

WWR-M	A type of water-water Russian reactor
XRF	X-ray fluorescence
XYZ	Three dimensional (radiation field analyser)

COUNTRY ABBREVIATIONS

BSSR	Byelorussian SSR (now Belarus)
Czech and Slovak F.R.	Czech and Slovak Federal Republic
Dem. Kampuchea	Democratic Kampuchea
Dem. P.R. Korea	Democratic People's Republic of Korea
Iran, I.R.	Islamic Republic of Iran
Korea, R.	Republic of Korea
Lao, P.D.R.	People's Democratic Republic of Lao
Libyan A.J.	Libyan Arab Jamahiriya
RSFSR	Russian Soviet Federal Socialist Republic
St. Christopher	St. Christopher-Nevis (St. Kitts-Nevis)
Syrian A.R.	Syrian Arab Republib
USSR	Union of Soviet Socialist Republics
U.A. Emirates	United Arab Emirates
UK	United Kingdom of Great Britain and Northern Ireland
U.R. Tanzania	United Republic of Tanzania
USA	United States of America

AAPC PROGRAMME-LEVEL CODES

A	=	Nuclear Power
B	=	Nuclear Fuel Cycle
C	=	Radioactive Waste Management
D	=	Food and Agriculture
E	=	Human Health
F	=	Industry and Earth Sciences
G	=	Physical and Chemical Sciences
H	=	Radiation Protection
I	=	Safety of Nuclear Installations
J	=	Safeguards
S	=	Direction and Support
X	=	Comparative Assessment

INTRODUCTION AND GLOSSARY

INTRODUCTION

This report follows the format used last year to provide, on the one hand, detailed data on the utilization of the various funds made available for technical co-operation activities in a particular year and, on the other, an impression of the results achieved.

In addition to a description of overall developments, Section II provides quantitative data, expressed both in financial and in non-financial terms, which are presented here as well as in the Tables, Figures and Annexes in a manner which facilitates comparison with prior years. Separate data on the Middle East subregion are provided in Figures 4 through 9.

Sections III and IV focus on results achieved. In Section III, a profile is provided of activities carried out with funds allocated to the interregional part of the technical co-operation programme. Section IV provides a summary of the accomplishments of each project completed during 1991. In-depth assessments of the qualitative aspects and achievements of Agency technical co-operation continue to be provided through evaluation reports.

All sums of money in the report are expressed in US dollars and have in most instances been rounded to the nearest hundred or thousand dollars. Percentages have also been rounded in statistical tables and figures.

The glossary which follows provides definition of terms and concepts used in the report as applied in respect of technical co-operation activities of the Agency.

GLOSSARY

Adjusted programme - the total value of all technical co-operation activities approved for a given calendar year plus all approved assistance brought forward from previous years but not yet implemented. It is against this figure - which is not identical with resources actually available -that the implementation rate is measured.

Disbursements - actual cash outlays for goods provided and services rendered including cash outlays against obligations raised in prior years.

Earmarkings - amounts allotted for funding approved assistance awaiting implementation.

Extrabudgetary funds - funds provided by Member States for financing specific projects or activities. These funds are separate from voluntary contributions to the Technical Assistance and Co-operation Fund.

Footnote-a/ projects - projects approved by the Board for which no immediate funds are available.

Funds in trust - funds received from Member States to finance assistance for themselves.

Implementation - the volume of funds obligated (new obligations) in a given period.

Implementation rate - a ratio obtained by dividing implementation by the adjusted programme (expressed as a percentage).

New obligations - the sum of disbursements during the year and year-end unliquidated obligations minus unliquidated obligations carried over from the previous year.

Programme year - the year for which an activity is planned.

Rephasing - a temporary release of funds approved for inputs which were planned for a given programme year and which cannot be implemented as scheduled. Rephasing does not change total inputs approved for a project; rather, it serves to keep project planning realistic.

Reserve Fund - an amount set aside by the Board each year for financing assistance of an urgent nature requested after the Board has approved the Regular Programme for the year in question.

Technical Assistance and Co-operation Fund - at present, the main fund for the financing of the Agency's technical co-operation activities; it is supported by voluntary contributions from Member States.

UNDP Programme - projects executed by the Agency on behalf of UNDP and its associated funds.

Unliquidated obligations - obligations incurred for which no cash outlays have yet been made.

Unobligated balance - total funds available less disbursements and less unliquidated obligations against the current year.

I. EXECUTIVE SUMMARY

- As an overwhelmingly positive response to the merits of the two year programme cycle for technical co-operation was received, the Board of Governors decided in December 1991 to approve the continuation of this system beyond 1992, the end of the initial four-year trial period.

- The overall implementation rate in 1991 (63.6%), the first year of the second two year cycle, is well above that of the comparable first year of the first cycle (1989: 56.5%) but below that of 1990 (67.8%). Completion of at least two biennial cycles will have to be awaited to conclude whether these fluctuations are inherent to a biennial programme. Fluctuations in the implementation rate of the Technical Assistance and Co-operation Fund (TACF) run parallel to the rate for all funds.

- Recovering from the drop which occurred in 1990, new resources for technical co-operation available in 1991 amounted to $ 49.1 million. The TACF accounted for 79.2% of all resources, extrabudgetary funds increased to 14.3% of resources, assistance in kind contributed 3.4% of resources and UNDP's share declined to 3.1%. Although total new resources increased compared to 1990, they were below the 1989 level due to the decline in UNDP funds.

- Notwithstanding increased resources, the development in respect of pledging towards the TACF target in 1991 gives cause for concern. The percentage of the target met through pledges declined from 85.3% in 1990 to 78.4% in the year under review.

- The 1991 programme was kept within the overall financial parameters upon which it was originally based. The overprogramming which occurred in the CC portion due to unforeseeable exchange losses, will be eliminated through rephasings and the introduction of the next two year programme.

- A total of 1301 projects were operational during 1991 of which 270 projects were completed; 109 regional and interregional training courses and 40 national training events were held. A total of 2351 persons received 4112 months of training abroad including scientific visits and 2306 experts/lecturers assignments were undertaken delivering 1160 months of expertise.

- **With cost-free expertise and through redeployment of staff an Information Systems Unit was set up in the Department of TC. Notwithstanding budgetary constraints further enhancements were made to a number of computer applications used in TC. Equipment donations facilitated fuller computerization and office automation in the department.**

- **The Agency's capacity to provide advisory service in respect of planning and preparing technical co-operation in Member States, carried out through pre-project assistance and advisory missions, was strengthened by sectoral support funds from UNDP.**

- **The Agency remains closely involved in the UN System machinery dealing with co-ordination of technical co-operation activities. Part of UNDP overhead costs allocated to the TC Department enables it to participate in field level co-ordination workshops organized under the aegis of the UN System, where intensive programmatic discussions with Resident Co-ordinator's teams are held.**

- **Excluding the major funding organizations of the UN System (UNDP, UNFPA, UNICEF), the Agency is the second largest provider of technical co-operation from its own resources in the UN System. If all sources of funds are considered, the IAEA TC programme is the eighth largest amongst the 33 entities of the UN System engaged in technical co-operation (1990 figures).**

II. REVIEW OF THE AGENCY'S TECHNICAL CO-OPERATION ACTIVITIES

A. Overview

1. General Issues

(a) In-house developments

1. In 1991, the Agency's technical co-operation activities entered their second biennial programme cycle. Preliminary observations made at the conclusion of the first cycle concerning the effects the two-year cycle has on the programming and implementation of these activities seem to be confirmed by developments during the year under review, although final conclusion in this respect can only be drawn after completion of at least two full cycles.

2. As described in more detail under 3 below, an evaluation of the first biennial programme carried out during 1991 evinced overwhelming support amongst recipient governments, counterparts and Agency staff alike to continue this system.

3. The Division of Technical Co-operation Programmes was heavily engaged in arranging preparatory assistance missions which were fielded to 20 countries in 1991. In addition, three country programme reviews were carried out. The fact that nuclear techniques can be applied in such a wide variety of sectors make it inevitable that in many countries a number of different institutes all have specific needs for Agency assistance. The missions nevertheless attempt to assist governments to draw up programmes in the nuclear field which will at least establish concentration areas for future assistance in sectors which have priority in national development plans. In their advice to governments, pre-project and country review missions place, where appropriate, due emphasis on the necessity to establish and maintain adequate radiation protection infrastructures.

4. The Agency's capacity to provide advisory services to Member States on overall programming matters as well as on sectoral or ad hoc issues is enhanced by special funds for sectoral support received from UNDP for this purpose. More details of the utilization of these funds which amounted to $34.200 in 1991 are provided under E.3 (para 139) in this report.

5. The UNDP Sectoral Support funds are quite distinct from - and should not be confused with - the amount of $33,000, made available to the Department of Technical Co-operation out of overhead costs earned in 1990 for the execution of UNDP financed projects by the Agency. The moneys allocated to the Department out of these overheads are intended to stimulate the Agency's contact and co-ordination with the field offices of UNDP in order to sensitize the resident co-ordinators as well as the national planning authorities to the contributions nuclear techniques can make to national development. The decision to make a small part of the overhead earned available to the

Department has enabled active participation in a UN workshop on TC co-ordination in the field held in Thailand with selected country teams from the region. Intensive discussions of the Agency's programmes in the context of the overall UN efforts in the countries concerned were held with the UNDP Resident Co-ordinators involved. The remaining funds will be utilized for similar purposes in 1992.

6. Past experience with national and regional courses on TC project design, management and evaluation techniques has demonstrated their value in ensuring that national liaison staff fully understand the policies and procedures underlying the Agency's TC programme and that national project counterparts are fully aware of the mechanism and methodology of TC project design, management and evaluation. The training programme was therefore continued in 1991 with two courses - a regional course in Ghana and a national one in the People's Republic of China. Both were considered by the participants to have been very useful.

7. The Implementation Division in the Department produced an Operations Manual which, based on a detailed analysis of the tasks and workflow in the Division, spells out the existing operational procedures for all Sections in this Division. Meanwhile, consultations with the Department of Administration on matters such as authority to contract, transfer of title of equipment purchased under TC projects continued, aimed at ensuring that, within rules and regulations, TC implementation can proceed with the flexibility essential for this type of world-wide programme.

8. Follow-up steps were taken to address the major findings of the evaluation of Information Systems within the TC Department (see para 11 last year's report[1]). Through redeployment of staff within the Department and from NESI and through the arrival of a cost free expert from the USA, it was possible to establish a separate Information Systems Unit, reporting to the DDG-TC. This new unit is responsible within TC for planning, development and supporting efficient computer based information and automation systems specific to TC's needs and for training and supporting TC users in the utilization of these systems.

9. Within existing budgetary constraints, a number of developments in the Department's computer applications were successfully introduced during the year. The training course module of the Technical Co-operation Management System (TCMS) was restructured and new on-line input programs developed so that the section concerned is now inputting a large amount of their own data. Obligations are now automatically created with correct FICS coding for processing in ADBF. Following divisional policy, all four sections in TCIM are now inputting and controlling their own data - the Experts Section using an advanced LAN-based system and the other three sections using on-line mainframe based modules of the TCMS.

10. Several major reports were developed using the TCMS. The UNDP Project Delivery Report, now provides computerized data on project budgets and revisions. The UNDP Standard Questionnaire of External Assistance is produced for each TC project and is sent to the UNDP Resident Co-ordinators in all

[1] GC(XXXV)/INF/294, page 4.

countries where IAEA assistance is provided. This in turn is used to produce the detailed Development Co-operation Reports issued by UNDP for each country, giving an overview of all technical co-operation in the country, listing projects by sector. A Fellowship Pyramid Report and a Regional Manpower Development Summary Report were introduced to better monitor the fellowship cycle from receipt of the nomination to end of training.

11. The addresses of all TC project counterparts were entered into the Agency's computerized mailing list and linked to the TCMS which facilitates communication and ensures that they now automatically receive certain Agency publications.

12. As allotment control for TC projects is maintained by TCSPC in the TCMS, a number of enhancements were made to this system. In the last quarter of 1991, on-line programs were developed to process and more promptly reflect all project budget changes. A major effort was also made to restructure and streamline all basic programs used in processing month-end and year-end financial data. A number of these have been turned over to TCSPC increasing that sections' ability to manage the TC financial accounting.

13. The current level of funding will not be fully sufficient to provide a work station for every staff member and to upgrade all existing workstations to comply with Agency-wide standards, nor is adequate backstopping fully ensured. Nevertheless, much progress in this respect has been made largely thanks to donations during 1991 of computer equipment by Member States (Japan, Iran and USA).

14. In spite of its own tight staffing situation, the TC Department co-operated with the United Nations Office at Vienna (UNOV) seconding three of its staff members to the Secretariat for Chernobyl upon request of UNOV's Director-General in her capacity as United Nations' Co-ordinator of International Co-operation for Chernobyl.

(b) External developments

15. During 1991, three additional African Member States acceded the African Regional Co-operative Agreement for Research, Development and Training related to Nuclear Science and Technology (AFRA). Thirteen countries are now participating in AFRA. Four AFRA projects were launched in 1991 one of which was made operational with extrabudgetary contributions from France.

16. The repercussions of the developments in Eastern Europe on the delivery of certain segments of the programme, already felt in 1990, continued in the year under review. Nevertheless further progress was made in utilizing non-convertible currencies based on existing contracts. As the traditional supplier firms will undoubtedly strive for new contracts in more convertible currencies in future, the question of programming NCC resources will have to be subjected to thorough analysis and review prior to drafting the 1993-94 programme. As discussed elsewhere (II E.3), the developments in Albania had a severe impact on the UNDP portion of the Agency's TC programme.

17. Close contact on technical co-operation matters was maintained with UNDP and all other agencies of the United Nations through participation in the semi annual meetings of the Consultative Committee on Substantive Questions

dealing with Operational activities (CCSQ(OPS)) and through the annual Inter-Agency Consultative Meeting under the aegis of UNDP.

18. CCSQ (OPS) has in recent years developed into an action oriented body which has been instrumental, inter alia, in elaborating guidelines for strengthening the resident co-ordinators' system at the country level. It has also taken the initiative to develop, with the International Training Centre of the ILO in Turin, a series of workshops on the management of field co-ordination for senior UN system representatives. As mentioned earlier, the Agency was able to benefit from participation in the second workshop of this type held in Thailand. During the past year deliberations in CCSQ (OPS) continued to focus on the successor arrangements of the system of UNDP support costs and on the implementation of General Assembly resolution 44/211, adopted on 22 December 1990, which deals with issues such as national project execution, decentralization, programming approaches and the resident coordinator system. The new arrangements for UNDP support costs have now come into force but all smaller specialized agencies, including the IAEA, have so far opted to remain under the old regime.

19. In its meetings in July the Economic and Social Council, ECOSOC, noted with appreciation CCSQ (OPS) work. In respect of national execution it was felt that this modality was an important contributing factor in advancing self-reliant capacity, but the desirability of continued involvement of UN agencies in a technical support role was stressed.

20. In discussing UN resolution 44/211 on Operational Activities for Development in the Second Committee of the United Nations General Assembly in November, donor countries cautioned against a rush into national execution of projects and a case by case approval was advocated, respecting the tripartite nature of the system (Governments, Agencies and UNDP). Recipient countries endorsed this gradual and progressive process and stressed the need for further simplification and harmonization of procedures for project planning, implementation, monitoring and evaluation. In respect of integrated operational response to national programme frameworks, the need for continuous dialogue between government and its partners was emphasized so that both concepts could evolve in relation to the country's needs. A national programme should not be conceived with, but by a recipient country.

2. Resources and Delivery

New resources	**$49.1 million**
Adjusted programme	**$67.8 million**
New obligations	**$43.1 million**
Implementation Rate	**63.6%**
Disbursements	**$46.1 million**

21. The total new resources available for Agency technical co-operation show an increase of 10.2%: from $44.6 million in 1990 they rose to $49.1 million in 1991. However, it must be stressed that the figure for 1990 was artificially low due to a substantial loss on exchange because of the devaluation of the rouble in that year, as explained in paragraph 18 of last year's report[1]. The

[1] See GC(XXXV)INF/294, page 5.

amounts shown in Table 1 and Figure 1 illustrate that notwithstanding increases over 1990 in the income to the TACF and in extrabudgetary funds, total resources in 1991 were somewhat below the 1989 figures.

22. The relative weight of the various sources of funds for the Agency's technical co-operation activities showed some fluctuation to the extent that, recovering from exchange losses in 1990, extrabudgetary resources grew from 10.8% to 14.3%, whereas UNDP declined from 6.4% to 3.1% of resources. The TACF retained its position as the main funding source for technical co-operation, its share increasing to 79.2%. Assistance in kind accounted for 3.4% of new resources.

23. The total of all technical co-operation activities approved for a given calendar year, plus the value of all approved but as yet unimplemented assistance from previous years (and adjusted during the year owing to cancellations, rephasings and additions) constitutes the "adjusted programme". During 1991, the value of the current-year adjusted programme rose by over $5 million to $67.8 million. It is against this figure that implementation is measured.

24. In addition to the current year adjusted programme, a further $56 million had been approved for future activities. This very high figure in future year approvals is logical in the first year of a biennial programme since it includes approvals for the second year of the biennium. A similar situation existed in 1989.

25. As has been stated, a pattern seems to emerge so far which indicates that in a biennial programme implementation is higher in the second year of a cycle. While this can only be confirmed after two or more cycles, the 63.6% implementation rate for 1991, the first year of a cycle, is indeed somewhat below that of 1990 (67.8%), but considerably above that prevailing in the comparable year 1989 (56.5%).

26. In addition to the $43.1 million worth of technical assistance set in motion during 1991, a further $3.8 million in new obligations were raised against future year components of multi-year projects.

27. The performance of each of the funds is analyzed separately in Part E of this section. A detailed and comprehensive overview of the status of the total programme at end 1991 is given in Implementation Summaries I and II. The following table summarizes financial performance during the past five years.

Rate of implementation by fund as a percentage of the adjusted programme

Year	TACF	Funds in trust	Extrabudgetary funds	UNDP	Total
	(%)	(%)	(%)	(%)	(%)
1987	67.0	55.0	37.5	77.7	61.3
1988	65.0	25.6	56.5	82.8	64.1
1989	58.0	44.1	46.7	70.2	56.5
1990	71.3	35.6	50.4	88.6	67.8
1991	67.6	45.0	52.2	47.1	63.6

28. A total of 894 projects were operational at the beginning of 1991. Through new approvals by the Board, upgrading of footnote-a/ projects and establishment of training courses and reserve fund projects an additional 407 new projects were added to the 1991 programme, bringing the total number of projects to 1301 (1990: 1058).

29. During 1991, a major effort has been made in TCPM to complete projects some of which had been on-going well beyond the originally intended duration. In many instances the objectives of such projects had been reached, but as some funds remained, they had been kept open in case further requirements e.g., for spare parts, would arise. In the interest of tighter management and to avoid the tying up of resources in this manner, the Department of Technical Co-operation will continue, in close dialogue with the Member States concerned, to ensure that projects are completed when objectives have been met. Sufficient modalities exist in the programme to cope with urgent and unforeseen needs which might emerge after a particular project has been completed. The effort made during 1991 resulted in a considerable increase in the completion of projects: 270 against 159 in the previous year. Of these 270 projects 41 were training courses. The achievements of the 229 non-training course projects are described in Section IV of this report.

30. At the end of the year, 1025 projects were still operational. They ranged in size from one month of expert services valued at $8850 to multi-year projects with a 1991 budget of around $1.3 million. The recommendation of experts who carried out assignments during 1991 were contained in a total of 500 reports for submission to national authorities in Member States. Of these 16 were published as listed in Annex III.

31. Within the UN System, the Agency is usually ranked as one of the smaller technical agencies. It is therefore of interest to note that in 1990 - figures for 1991 are not yet available - amongst the 33 United Nations entities through which technical co-operation is provided, the Agency ranked eighth in respect of the value of the technical co-operation it delivered. If TC financing obtained from the major funding bodies of the system is excluded (UNDP, UNICEF, UNFPA) and only technical co-operation financed from an agency's own resources is considered, the IAEA's technical co-operation programme is the second biggest after that of WHO.

3. Evaluation

32. Continued growth of the technical co-operation programme in both volume and complexity - accompanied by financial and manpower constraints - lends increasing importance to evaluations and reviews that contribute to increasing the effectiveness of the Agency's co-operation with its Member States. In 1991, as in the past, the selection of countries, projects or processes to be examined was made by the Secretariat on the basis of proposals and requests from Member States and the Board of Governors, as well as of the practical needs of the Department of Technical Co-operation.

33. At the recommendation of the 1986 Technical Assistance and Co-operation Committee (TACC) the introduction of a system of two-year technical co-operation programming was approved by the Board of Governors in February 1987 for a four-year trial period, beginning with the projects to be implemented during the period 1989-1990. The Secretariat was requested to carry out and submit to the 1991 TACC session an evaluation of the first such

cycle, prior to the Board making a decision as to whether to continue with two-year programming beyond the initially agreed four-year period, i.e. 1989-1992.

34. In conducting the evaluation, a total of 445 questionnaires were distributed - 265 to national liaison officers and project counterparts, and 180 to staff at Agency Headquarters - and 195 completed questionnaires were returned, representing an overall return rate of 44 per cent, which is acceptable for a mailed questionnaire. In addition, interviews were held with national authorities and local staff involved in the TC programme during TC evaluation travel and the national/regional workshops on project design, management and evaluation techniques conducted in 1990-91.

35. A very high percentage (92%) of the respondents considered biennial programming an improvement over the one-year system, and an even higher percentage (93%) thought that two-year programming should continue. Over 750 individual comments or suggestions for improvement were made. Despite some shortcomings that still exist, the expectations when two-year programming was proposed have been largely realized. In particular, there has been more time for project preparation, review and appraisal, with a consequent increase in the quality of approved projects.

36. Taking all of the above into account, the Board of Governors at its December 1991 meeting decided (a) to approve the continuation of two-year technical co-operation programming beyond the initial four-year trial period (i.e. beyond the 1991-92 cycle) as a regular practice; and (b) to approve the holding of a policy review seminar shortly before or after the 1993 session of the General Conference to review the two-year technical co-operation programming system to see what improvements could be made. In accordance with the Board's decision the Secretariat has examined the comments and suggestions for improvements of two-year programming and implementation. For some of the suggested improvements consultations with Member States may be required, following which the Secretariat will prepare a working paper for the policy review seminar.

37. The Agency's system of Interim Project Implementation Reports (IPIRs) which, over the years of its operation, has proved to be a valuable mechanism of TC monitoring, last year advanced one step further by providing a non-financial assessment of project execution. After IPIRs have been returned by counterparts they are assessed by Area Sections and Technical Officers against five specially designed criteria reflecting the actual status of the projects in question, which are then rated as to whether implementation is "excellent", "good or reasonable" or "poor". The first such rating exercise was performed with the IPIRs returned between January and mid-October 1991, with the following results: the implementation of 42% of the projects was rated "excellent:, that of 53% was rated "good or reasonable", and that of only 5% had to be rated "poor".

38. It is believed that such information will be a useful adjunct to the traditional means of measuring implementation based solely on expenditure of funds and will thus strengthen the Agency's ability to identify weaker projects and take corrective action in a timely fashion.

39. Important findings and recommendations have resulted from two sectoral evaluations completed in 1991 - a review of the Agency's assistance to developing Member States in research reactor related activities (162 projects in 36 countries in the period 1980-1990) and a survey of the Agency's TC activities in Africa in nuclear physics (47 projects in 17 countries between 1980

and 1990). The evaluations showed that in most cases the Agency had contributed considerably to the establishment of national scientific infrastructures required for research and development in peaceful nuclear applications. At the same time the reviews identified areas where further Agency support is needed, as well as some common problems affecting the efficiency of national efforts in research reactor utilization and nuclear physics.

40. As a follow-up to the previous year's in-house evaluation of WAMAP, which indicated that actual experience with this programme had been less satisfactory than expected, an in-depth review of RAPAT and WAMAP was initiated last year with the aim to examine on the spot the actual contribution of these programmes to meeting the specific needs of recipient countries. The results of this follow-up evaluation in Latin America show that certain improvements in the implementation of both RAPAT and WAMAP are still needed. At the same time, they indicate that most of the evaluation recommendations have meanwhile been implemented by the Secretariat. In particular, procedures for the Implementation of WAMAP have been elaborated by TCPM and the Department of Nuclear Energy and Safety, which it is hoped will help resolve the remaining shortcomings.

41. Another follow-up evaluation of 1991 relates to the spare parts service set up in Latin America as a result of a recommendation made in the 1985 evaluation of the provision of equipment as part of the Agency's TC programme. Having examined the present situation, the evaluation concluded that despite some shortcomings that still exist, the approach to this problem in Latin America had proved to be effective and could be recommended for other regions. A similar spare parts service is, in fact, has been established for Africa.

42. As in the past, the Secretariat conducted follow-up evaluations of all Agency interregional training courses of the previous year, the major objective being to enable the Secretariat and course organizers to systematically review the quality and impact of training in the light of the trainees' post-course assessment. An overwhelming majority of participants rated the technical content and quality of course lectures as excellent or good. High ratings were also given in respect of the organization and duration of the courses. Among recommendations for the future, the suggestion most frequently made was that more emphasis should be placed on practical training.

43. Two "in-depth ten-year country programme evaluations" were carried out in 1991 (Morocco and Chile), whereby the report on the Chile evaluation will be finalized in early 1992. In addition, "Headquarters-based country reviews" were carried out on a total of 17 countries in Africa, Asia and Latin America which attempted to provide a comprehensive picture of the Agency's co-operation with these Member States over a period of ten years.

44. In conformity with the TACC request of 1989, the TC Department presented a projection of the major evaluation activities in 1992, the benefits expected and the priorities to be assigned. Special emphasis will be placed on the review of all Agency activities relating to co-operation with developing Member States in TC and in other Departments. The plan also includes on-going project monitoring activities, in-depth evaluations of manpower development in Africa, ARCAL activities and RAPAT and WAMAP impact in Asia. Ten headquarters-based country programme reviews will be carried out.

B. Review by Field of Activity and Division

1. Field of activity

45. Based on disbursements from all funds in 1991 the emphasis clearly remained on activity D, Food and Agriculture (20.4%) and activity G, Physical and Chemical Sciences (18.6%). These two activities have alternated in accounting for the largest and second largest share in disbursements for several years now. Activities in Radiation Protection and Safety of Nuclear Installations, H and I, retained third place with a combined share of 16.9% of all disbursements (15.9% in 1990). If waste management is included, safety related activities amounted to 19.7% of all disbursements.

46. As is to be expected, the emphasis varied from region to region. One third of all disbursements in the field of agriculture were made in Africa in which region it counted for 32% of total disbursements. The largest share of total disbursements in the Middle East was represented by activity F, Industry and Earth Sciences, 45.3%, followed by Radiation Protection, 21.6%. Figure 2 gives an overview of the distribution of disbursements by activity and Figure 8 provide full details on their distribution by region.

47. These annual comparisons based on actual disbursements would in themselves not be sufficient to draw conclusions on trends. However, the distribution of disbursements amongst areas of activity and the ranking of these activities within each geographical area is very much in line with the resource allocations made in the 1991-92 TACF programme. This programme in turn showed that the relative shares of each area of activity had remained fairly constant when compared to the preceding biennial programme 1989-90.

2. Division

48. As the provision of Technical Assistance is an integral part of the Agency's activities, the proper functioning of the Agency's technical co-operation programme continues to be based on intense and active participation of the Department of Research and Isotopes and the Department of Nuclear Energy and Safety. These Departments provide the technical expertise essential for the appraisal of project requests, the evaluation of fellowship applications and expert candidatures and for technical advice and backstopping throughout the lifetime of a project.

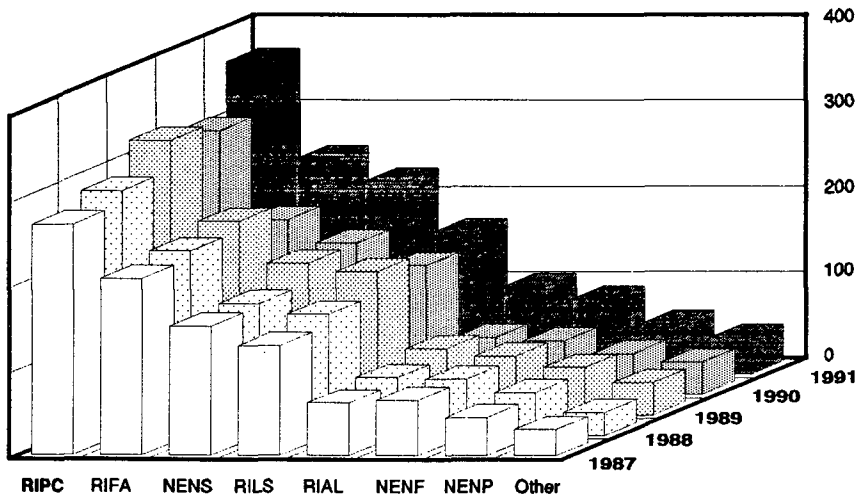
49. During 1991, a total of 174 technical officers supported 1301 projects. The average number of projects handled by each technical officer increased from 6.6 in 1990 to 7.5 in 1991. The workload is obviously not evenly distributed. The majority of TC projects remain in the Department of Research and Isotopes (885). Within this Department the Division of Physical and Chemical sciences handled, as in previous years, the largest number of projects (364). In the Department of Nuclear Energy and Safety (dealing with 386 projects) by far the largest number of projects (226) was handled in the Division of Nuclear Safety.

50. The tables and charts at the end of this section as well as Implementation Summary IIIA and IIIB illustrate in detail the technical co-operation involvement of the various Divisions in different departments.

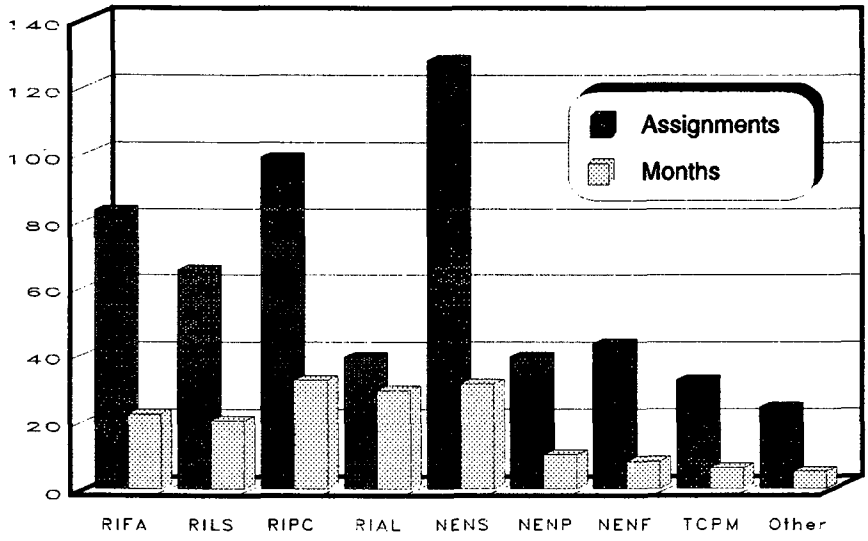
51. The importance of Agency staff from the technical Departments as a source of expertise for the delivery of technical co-operation in the field for planning, review or troubleshooting purposes, remains noteworthy: 552 assignments or nearly 24% of all assignments were carried out by the Agency's technical staff. Together they provided 14% of all the man-months delivered in 1991, reflecting the nature of these assignments which are of short duration, and often of urgent nature. Many of the assignments involved are also as lecturers for national, regional and interregional training courses. In cases where there is a continuous and frequent need for expert services in the same specialization in a number of countries, experts are based in Vienna and function as technical officers in their respective divisions in between assignments. Although part of the Agency's technical staff, they are financed from technical co-operation funds. A total of 9 such staff were charged to TC funds during 1991.

Department/ Division	Number of technical officers	Number of projects supported	Number of fellowship applications evaluated	Number of expert/lecturer assignments	Number of months
Research and Isotopes					
RIFA	24	252	219	83	22/04
RILS	13	167	135	65	20/09
RIPC	23	364	262	79	23/24
RIAL	16	102	60	59	38/08
Sub-total	76	885	676	286	104/15
Nuclear Energy					
NENS	47	226	206	130	32/17
NENP	13	59	84	39	10/10
NENF	18	88	79	43	8/25
NESI	4	13	9	8	2/05
Sub-total	82	386	378	220	53/27
Other	16	30	19	46	9/12
Total	174	1,301	1,073	552	167/24

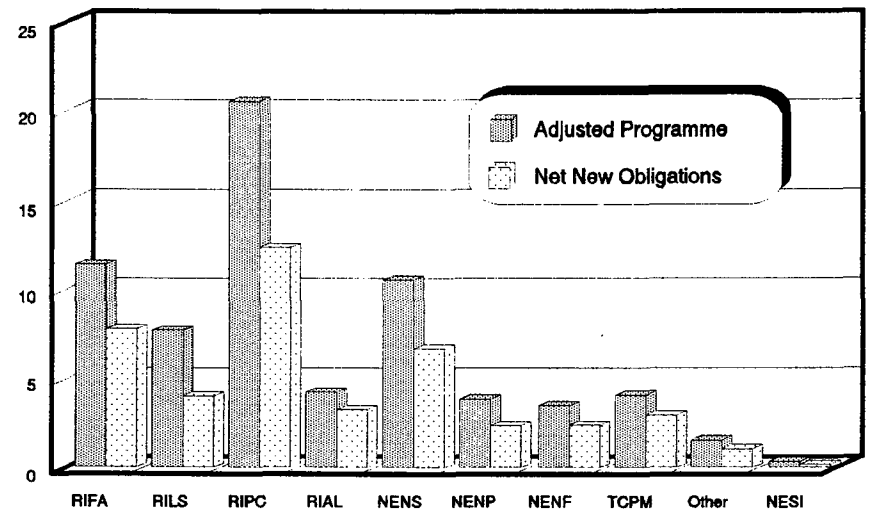
PROJECT WORKLOAD BY DIVISION: 1987 - 1991
(NUMBER OF PROJECTS)



TECHNICAL SUPPORT FOR PROJECTS: 1991
EXPERT AND LECTURER ASSIGNMENTS



IMPLEMENTATION BY DIVISION: 1991
(IN MILLIONS OF DOLLARS)



C. Review by Area

1. Africa

52. Only three years ago, Africa had the smallest programme of the four geographical regions. Its share in the total adjusted programme has grown from 16.4% in 1988 to 23.9% in 1991, so that its programme is now the second largest. In respect of the TACF funded activities, the Africa programme is the largest (26.1%). The increase in Africa's share in the total programme is a natural outcome of the increased attention and resources being devoted to the least developed Member States, most of which are in the African region.

53. Project assistance comprised numerous fields, but as in previous years agriculture, radiation protection and medicine were predominant. In 1991, a project providing assistance in association with other organizations achieved an outstanding success in eradicating the screwworm in Libya.

54. Emphasis continued to be placed on establishing or strengthening the radiation protection infrastructure as a pre-requisite for nuclear energy programmes. RAPAT missions were undertaken to Niger and Sierra Leone. Follow-up radiation protection missions were fielded to Uganda and Zambia. The mission to Uganda was financed from Sectoral Support funds made available by UNDP. Arrangements were made in 1991 for a similar mission on radiation protection financed by UNDP to visit Côte d'Ivoire in 1992. In parallel, assistance was provided to individual country radiation protection projects through the provision of equipment, experts and training. Regional co-ordination of radiation protection activities was assured through a regional project which also provided expert guidance and training to radiation protection officers and technicians. Two workshops on quality control and maintenance of equipment used for personnel monitoring were organized and attended by technicians from thirteen countries.

55. Manpower development through individual fellowships, scientific visits, training courses and workshops retained high priority, although the amount of funds that could be allocated fell far short of the training needs of growing programmes in several Member States. Regional training courses were organized in Algeria in non-destructive testing, in Ghana in project management and evaluation and in nuclear analytical techniques, in Kenya in nuclear law and safety regulations and in spent sealed sources, in Nigeria in agriculture, and in Egypt in dosimetry in radiotherapy. Of particular interest was the regional training course on project design, management and evaluation which was attended by the liaison officers from all countries in the Region. The training provided was intended to lead to improved formulation of project requests and improved national management of the assisted projects.

56. The year under review was characterized by the start of the implementation of the First AFRA Programme and by the expansion of assistance to the least developed countries.

57. Under the AFRA Programme two regional training courses were hosted by Egypt in food preservation and in irradiation processing. Each course was attended by scientists drawn from 8 AFRA Member States. The implementation of the AFRA project "Radioimmunoassay", financed by extra-budgetary

contributions by the Government of France got underway by organizing a meeting of the project co-ordinators in Kenya, visits by the experts to the participating countries and the supply of bulk reagents to the beneficiary laboratories. The project on waste management also got underway by organizing a meeting of the project co-ordinators in Cairo. The Second technical working group meeting of AFRA national co-ordinators took place in Algiers in July 1991 and the First AFRA annual report prepared by the Agency was submitted to the Meeting of AFRA representatives in September.

58. A programming mission to Namibia was fielded to take stock of the state of nuclear technology in the country and to advise the Government on those areas where Agency assistance could be applied most usefully in future. Based on the recommendations of the mission, the first requests for technical co-operation from Namibia were received by end 1991 in time for appraisal and consideration in the 1993-94 programming exercise.

59. With respect to other least developed countries programming missions were also undertaken to Ethiopia and Tanzania. Programming missions to least developed countries aim at assessing the possibilities and advantages of using nuclear techniques in line with the national development plans of these countries. Emphasis is placed on strengthening the national infrastructure so that these countries can acquire the potential to make use of nuclear techniques. Manpower development through training programmes, the establishment of an appropriate radiation protection infrastructure and the creation of capabilities for repair and maintenance of equipment receive most attention. To be effective, assistance to least developed countries has to be broadly based, especially in its initial phases. A rigid limitation to strictly nuclear components in assistance aimed at creating a basis for nuclear technology development would make such assistance of doubtful value, and would prolong a vicious circle where lack of infrastructure prevents the absorption of assistance and thereby impairs the development of the infrastructure upon which increased utilization of nuclear technologies has to be based.

2. Asia and the Pacific

60. Although the share of Asia and Pacific in the total adjusted programme shrunk to 24.8%, this still represents the largest segment of the total programme. The implementation rate of 63.4% is very close to the overall implementation rate of 63.6% prevailing in 1991.

61. Applications of radiation and radioisotopes in industry and hydrology was, as for several years now, the most important field of activity in the country programmes of the Asia and Pacific region. Each country participated in at least one of the sub-fields, the most important being general industrial application especially non-destructive testing, for which country projects were operational in nine of the fifteen recipient Member States. Projects related to radiation processing - including Radiation Vulcanization of Natural Rubber Latex (RVNRL) - were operational in half of the Member States. Use of radioactive tracer techniques in industrial processes, as well as in the studies of sediment transport to address the problem of siltation in harbors in many countries of the region was also an important feature of the programme. These national activities, prompted by the RCA programme, were appropriately interfaced with the regional programme.

62. Three large scale multi-disciplinary projects funded by UNDP in China, Indonesia and Thailand and one agency project in Malaysia were the highlights of the programme in the field of application of isotopes and radiation in agriculture. Under specific sub-fields, the projects focussed on mutation breeding, animal production and health and soil-plant studies. In the Health Sector, 11 countries in the region have at least one operational project related to the radioisotope diagnostic investigations in medicine to improve the health care available to the population.

63. In the field of Safety in Nuclear Energy, assistance covered a wide spectrum of projects. For countries with weak radiation protection infrastructures, these focussed on establishing and strengthening such infrastructure, including the provision of regulatory assistance. For intermediate and advanced level countries in this respect, radioactive waste management and environmental monitoring projects were executed. Increased concern about radioactivity in the environment was reflected in the fact that nine of the recipient Member States in the region have now operational projects on environmental radiation monitoring under normal and emergency situations. In four countries with strong nuclear power programmes, namely the Republic of Korea, China, Pakistan and Indonesia, safety related assistance included safe operation, site safety, and emergency planning and preparedness. These countries were also recipients of technical assistance relating to various aspects of the Nuclear Power Programme, including uranium exploration, site selection studies, control instrumentation, as well as safety and manpower training.

64. A follow-up RAPAT mission to China was conducted in 1991. Pre-OSART follow-up review missions to Qinshan and Guangdong Nuclear Power Plants were also carried out at the request of the Chinese Government. In following up the recommendations of RAPAT missions, special emphasis has been placed on creating a core of trained manpower in various important areas through conducting a series of National Workshops on the introduction of a radiation safety regime. Such Workshops were organized in the Democratic People's Republic of Korea, Mongolia, Sri Lanka and Viet Nam. Transfer of technology in repair, maintenance and design of personal computer based instruments figured prominently in the TC programme of several Member States. Nuclear analytical techniques including neutron activation analysis and x-ray fluorescence techniques have been promoted continuously for multi-elemental analysis of geological and environmental samples, water and biological materials.

65. Several initiatives were taken to improve the effectiveness of the TC programme and in particular to interface the Agency programme with that of UNDP and other Agencies of the UN system. Special efforts were made in the case of Malaysia, Myanmar, Philippines and Viet Nam to solicit UNDP support for Agency activities and/or to co-ordinate the Agency's programme with that of other UN agencies.

66. Following the success of the pioneer "National Workshop on TC Project Management and Evaluation" in Pakistan in 1990, a similar workshop was conducted in Beijing at the request of the Government of the Peoples' Republic of China. The workshop aroused considerable interest among the participants, who were mostly project counterparts. Improved understanding between the Agency and its local counterparts is paying dividends in improved implementation of TC programmes in China.

67. In order to increase awareness of similar activities in other countries of the region, three TC workshops were organized, bringing together all counterparts of projects in a particular field to exchange experiences, and to discuss problems encountered and how these were resolved. The excellent feedback received from the participants encourages the Agency to incorporate provisions for this type of workshop in the programme for 1993-94. This should not only promote TCDC, but also act as a stimulus for further RCA programmes.

3. Latin America

68. Continuing economic difficulties in the region are having a serious impact on the availability of trained manpower for technical co-operation projects in Latin America countries. Because of low salaries in the public sector an appreciable number of trained counterparts have left organizations and institutes which are recipients of Agency technical co-operation. Notwithstanding the delays and difficulties this is causing in many projects, the implementation rate in Latin America was, as in previous years, the highest of all regions: 71.3%. The region's share in the total adjusted programme stood at 22.5% and one quarter of the total assistance set in motion in 1991 went to Latin America.

69. Support to activities related to the use of radiation and isotopes in medicine continued in many countries. To improve the treatment of cervical cancer, which in this region has the highest incidence among the gynecological cancers, arrangements were made to provide remote control after-loading intracavitary irradiators to Ecuador, Guatemala and Venezuela. The provision of a rotatory gamma camera to the Clinical Hospital of the University of Chile was made possible through joint funding from the IAEA and the University. The facility will be used for dynamic studies, mainly for diagnosis of coronary cardiopathy, as well as for training and research. To complement a gamma camera previously supplied by the Agency, a SPECT system was provided to Panama, enabling the Santo Domingo Hospital to expand diagnosis to patients that at present do not receive appropriate services. A nuclear medicine project at the national level has been started in Bolivia, with the participation of five hospitals. In this context, a new RIA laboratory in Tarija was set up to complement the already existing network of five RIA laboratories. The laboratory of radiopharmacy in La Paz was upgraded to step-up the production of radiopharmaceuticals for distribution to other nuclear medicine centres and a refurbished gamma camera was ordered for the San Juan de Dios Hospital in Santa Cruz. The Centre in La Paz is acting as a focal point for training and expertise and is providing equipment maintenance services.

70. In the field of nuclear power a new regional project was started to foster the exchange of information and experience in the operation and construction of nuclear power plants, with the participation of four Latin American countries. The technical co-operation with Mexico relating to safety aspects of the Laguna Verde NPP has been continued. An ASSET mission took place to Laguna Verde in September 1991. The plant concluded its first cycle of operation with an outstanding record of 250 days of continuous commercial operation. To transfer the technology for continuous inspection of pressure vessels in order to ensure safety, a new project was started with Argentina. In support of the Cuban nuclear power programme a 3 year project was started to develop the capability to undertake safety assessments of the NPP being built at Juragua. In order to assist Brazil in achieving a safe operation of the

ANGRA NPP a project was set up with reserve funds to finance OSART and ASSET missions.

71. A number of projects supported radiation protection and waste management activities in several countries. A major effort has been made to assist Member States in the establishment of radiation protection regulations and infrastructure. Two multi-year projects have started in Cuba in order to strengthen the already existing radiation protection infrastructures. The equipment, expertise and training will be provided to install a secondary standard dosimetry laboratory as well as to upgrade existing laboratories for the monitoring of personnel, environment and foodstuffs. A RAPAT mission to Paraguay was carried out as was a WAMAP mission to Venezuela.

72. In the field of industrial applications of nuclear techniques, the regional non-destructive testing (NDT) project ended in 1991. Through this project and with the active participation of 18 Latin American and Caribbean countries, an autonomous capacity in NDT was established. More than 22,000 persons have been trained in different levels of the most common NDT techniques. Industry in the region is now aware of the need to use NDT and there is a widespread application of these techniques, following international standards. As a follow-up a new project on NDT in quality control and assurance programmes was initiated. An extrabudgetary funded project on industrial applications was concluded in Ecuador, which provided gammagraphy equipment and accessories together with expert services and training to the Aychapicho Nuclear Centre. The Centre is now giving quality control services in industrial radiography to government institutions and private industries.

73. The support of the Agency to environmental studies has continued in 1991. A regional project on the use of nuclear techniques for environmental studies has started with the participation of six countries. Air pollution in Mexico City and Santiago de Chile is being studied, as well as water pollution in the Lago de Valencia in Venezuela and the Rio de La Plata in Argentina and in other locations where contamination has been detected. A project was started in Sao Paulo, Brazil, to identify the residues arising from pesticide use in soil, plants, foods and animals. Also in Brazil an extrabudgetary funded project has started to obtain data on the behaviour of radionuclides in the tropical agricultural environment.

74. A project in Guatemala on the control of the Mediterranean fruit fly that started in 1988 came to an end in 1991. The project was financed by extrabudgetary funds and contributed significantly to strengthen a multilateral programme to control the fly, which has caused great damage to the agricultural sector in Guatemala. Additionally, the Agency financed 36 months of fellowship training for the counterpart staff.

75. In Cuba, two projects that made substantial contributions to the field of food preservation were concluded. An important irradiation facility was established by making available a Cobalt-60 industrial type irradiator, ancillary equipment, expert advice and training. The facility is being used routinely for food irradiation.

76. Under the ARCAL programme, the project on improvement of cereals through mutation breeding concluded after seven years of activities. This project together with several national TC projects and Co-ordinated Research Programme on the same subject helped to establish specialized laboratories that in some countries are the only ones of their kind. New technologies such as the double-haploid were transferred to improve mutation breeding

programmes. Some countries like Brazil, Costa Rica and Guatemala have been successful in developing new cereal varieties better suited to local conditions.

77. In the framework of an ARCAL project, new nuclear information centres were inaugurated in Costa Rica, Cuba, Ecuador and Peru to assist local researchers and to interact with other centres already established in the region. Since the ARCAL programme depends to a large extent on the co-operation between the participating countries, the adverse effects of the economic situation during 1991 described above was particularly felt in this programme.

78. Preparation of the programming of technical co-operation for 1993-94 received an early start through pre-project missions to several countries during 1991. In addition, a four expert mission visited seven countries in order to define the parameters of a new ARCAL project on industrial applications of nuclear techniques.

4. The Middle East and Europe

79. The Middle East and Europe's share of the total adjusted programme increased from 17.6% in 1990 to 22.2% in 1991. Implementation rose significantly, from 51.5% in 1990 to 57.5% in 1991.

80. As the programmes with the Member States of this region are handled through one administration unit, the above figures refer to the region as a whole. Wherever possible, data on the Europe and Middle East sub-regions are provided separately in this report (see Figures 4-9). As the two groups of countries, the Middle Eastern and the European, often have dissimilar group priorities and interests as regards the peaceful applications of atomic energy, the sub-regional programmes are specifically tailored to meet the needs of the countries of each sub-region. There is, however, a unique opportunity to utilize expertise available in the region to ensure the rapid transfer of technology between the sub-regions.

81. Many institutions in the region are effectively applying nuclear techniques in such diverse fields as medicine, hydrology, agriculture and industry. Radioisotopes and radiation techniques are being used to improve crops, to determine groundwater resources, to sterilize medical supplies, to analyze hormones, to check for weak spots in pipelines, to control the quality of industrial products, and to study environmental pollution.

82. Several countries in the Middle East and Europe region have food irradiation programmes at various stages of development; others are contemplating the introduction of this technology. In 1991, there were two major activities on food irradiation: firstly, a Co-ordination Meeting in Ankara, Turkey, where the various programmes of the participating Member States were reviewed and redefined. This was followed by a workshop on the use of electron accelerators for food irradiation, in Warsaw, Poland, where this novel technology was demonstrated and information on the technique was disseminated to the participants. The regional project on food irradiation, which provides assistance in programme planning and aims at promoting the harmonization of regulations governing food irradiation to facilitate trade and also includes technical and economic feasibility studies, was nearing completion by year's end.

83. The Soil Fertility, Irrigation and Crop Production Section of the Joint FAO/IAEA Division and the Soil Unit of the Agency's Seibersdorf Laboratory have been instrumental in developing recognized methods of measuring nitrogen fixation by pasture and grain legumes based on the use of the stable isotope nitrogen-15 as tracer. Through a regional project on nitrogen fixation approved for 1991, which complements national projects, the Agency is assisting countries in the Region to co-ordinate experiments and to exchange information about national efforts. A co-ordination meeting and group training workshop were held in Vienna and Damascus respectively, during which programmes and experimental setups were defined and new techniques imparted to participants.

84. Through a TC project on Radiopharmaceuticals in the Middle East, which began in 1988, a workshop on generator and cyclotron-produced radiopharmaceuticals was organized in Riyadh, where participants received training geared to improving the quality control of radiopharmaceutical preparations. In the six workshops thus far organized, participants have been trained in techniques including radioimmunoassay, production of radioisotopes and radiation protection. Emphasis in this regional project has been placed on the development of local capabilities towards radiopharmaceutical production, an undertaking which is also subject of several national projects in the region.

85. The Agency has been promoting environmental isotope studies to estimate the recharge rates of aquifers from rain and surface waters, and to ascertain the age of groundwater as well as the interconnections between surface and groundwaters. Such studies have made significant contributions to the knowledge of the hydrology of the region. The Agency's project on Isotope Hydrology in the Middle East, also supported through national projects, continues to address the special needs of countries in the sub-region, as the mapping of water resources is most essential in these arid and semi-arid areas. A co-ordination meeting and group training workshop were held in Vienna and Ankara respectively, during which hydrogeological principles and sampling techniques were taught to participants. The emphasis in the project thus far has been on improving the capabilities of the counterparts to undertake isotopic analysis of water and interpret the experimental data. Four regional workshops have so far been organized, during which results of on-going well-water sampling programmes in the participating countries were discussed; these results were linked to the general hydrogeological problems in the region.

86. Under a multi-year project on Environmental Monitoring in the Middle East, which began in 1987, efforts were made to co-ordinate environmental monitoring in the participating Member States. The project focused on determination of radiation levels in the local environment; this became particularly relevant after the Chernobyl accident. Automatic Early Warning Environmental Radiation Monitoring System (EWERMS) have been established in most countries in the region, to alert the populations when higher than normal levels of radiation occur, especially in the event of a nuclear accident. The computerized networks that were established operate via telephone and other lines, assuring continuous remote sensing. Installation and training missions on the EWERMS networks were carried out in five of the Member States in 1991. Furthermore, the Agency has assisted in establishing or improving the measurement of radiation doses in research institutes, in hospitals, in industry and in the environment. Monitoring of foodstuffs, including imports, was also a major objective; a workshop on advanced radiochemical techniques for the monitoring of food and environmental samples was organized in Damascus,

during which participants were taught up-to-date techniques on radiochemical analysis of various samples. Seven other workshops had previously been organized, and the topics of discussion included derived intervention levels, intercomparison studies of milk powder samples, and EWERMS.

87. During 1991, a growing interest was shown by the countries in the region in the use of radioisotope and radiation in industrial applications. Assistance was provided to some countries towards the construction and/or preparation for the construction of cyclotrons, and also towards the development of industrial sterilization facilities. These activities were supported under the regional project for industrial application of radiation technology. Workshops on technology transfer and good radiation practice were organized under this project, which benefitted most Member States in the region.

88. A set-back occurred in Albania where, due to the economic and political circumstances which developed in the second half of the year, UNDP requested that the start of the already approved UNDP/IAEA project for the establishment of a research reactor, be put on hold.

89. There is a wide range of regional activities related to nuclear power plant planning, construction, operation and safety. Agency assistance has focused in particular on improving nuclear safety, in-service inspection, and maintenance of reactors in the region, as well as on radioactive waste management. The safety of nuclear power plants is a matter of particular concern; technical assistance is being given to the Member States in the European sub-region which are operating the WWER-type reactors in the following important fields:

- up-grading nuclear safety, in particular assisting in a WWER-440/213 safety assessment study and severe accident simulation development (PSA level I study),
- nuclear power plant maintenance and
- radioactive waste management.

90. In-service inspection of nuclear power plants in the region is one of the most important tasks being undertaken. Technical assistance is being given to support efforts by Member States operating WWER-type reactors to develop adequate national infrastructures and systems for In-service inspections, particularly through on-the-job training, workshops and expert services. Also, through an extrabudgetary contribution from Spain, the technical specifications and basic design of appropriate in-service inspection equipment is being provided to the countries participating in this programme.

91. In 1991, a radioactive waste management project was initiated and activities were concentrated on the exchange of information and the formulation of common problems to be solved, i.e. improving safety and reliability of waste management systems. Radioactive waste management policy, regulatory structure, legislation, current status of technology in the countries were among the main subjects discussed at workshops.

92. Through numerous workshops and systematic exchanges of information, and through linkages between national projects and programmes on the one hand and regional projects on the other, transfer of knowledge and

techniques from countries with advanced nuclear technology to others in the region is thus being achieved in a wide variety of fields.

5. Global and Interregional

93. In Section III of this report, a detailed overview is provided of the Agency's technical co-operation in respect of interregional activities. Naturally, most of the Agency's technical co-operation resources are devoted to meet the requests of individual Member States. Therefore the interregional component continues to represent a relatively modest share of the TC programme; 5.6% of the total adjusted programme and 7% of the TACF financed part of the programme in 1991. It is nevertheless of utmost importance for the Agency's training course programme as well as for the provision of preparatory assistance, programme reviews and a number of activities which are most efficiently undertaken on an intercountry basis.

D. Review by Component

1. Experts

94. Over a quarter (25.4%) of the adjusted programme for 1991 was earmarked for experts services. The value of the expert services delivered during 1991 constituted 22.7% of the value of the total programme delivery.

95. The following tables, which provide a five year perspective on the delivery of expert services, show that the high number of persons recruited and assignments arranged in 1990 has again increased.

Year	Adjusted programme	New obligations	Implementation rate	Earmarkings
	$ millions	$ millions	%	$ millions
1987	14.4	8.0	55.6	6.4
1988	14.3	7.7	54.1	6.6
1989	16.1	7.8	48.2	8.3
1990	17.6	10.0	57.0	7.6
1991	17.2	9.7	56.2	7.5

Year	Number of persons	Number of assignments	Number of months	Months per assignment
1987	1100	1808	1356	0.75
1988	1263	2023	1239	0.61
1989	1337	2144	1246	0.58
1990	1414	2221	1217	0.55
1991	1463	2306	1160	0.50
Increase over five years(%)	33.0	27.5	(14.5)	

96. Notwithstanding numerous cancellations and postponements during early 1991 due to the situation in the Gulf area, the implementation rate in this component was close to 1990 levels. That this result could be achieved in a zero growth environment is certainly in no small part due to the positive effects of the reorganization of the Section in the previous year and to the full use of the computerization of the Expert Post Control System (EPCS) as an effective office automation tool. The average duration of an expert mission is now 15 days as compared to 24 days five years ago. The trend towards shorter assignments has been noted throughout multilateral technical co-operation programmes and the Agency is no exception. A positive factor contributing to this development is the improved technical capability of counterpart organizations who request, more specialized missions of shorter duration instead of long-term expertise for basic guidance. Nevertheless, the trend is strengthened by two factors, which are more specific to the Agency. Firstly, in highly specialized fields, assignment have often to be tailored to meet the limited availability-periods of the specialists involved, so that two or more assignments over one or two years are scheduled rather than one continuous one. In most cases this is also for the recipient the optimum arrangement since it allows work to be set up, to be checked mid way and assessed at the end. This enhances self reliance and sustainability of the project in the recipient institute by ensuring that expert advice is available at key stages of an activity, but that the project is first and foremost implemented by the counterparts.

97. The second factor is of statistical nature: a growing number of national and regional workshops and training courses are being organized outside and in addition to the major interregional training courses. As in such cases the arrangements for recruitment of lecturers or for the travel of e.g. national counterparts going to a regional workshop devolve upon the Expert Section, the resulting recruitment numbers become part of the computer-generated expert assignment and man-months statistics. Missions performed by staff members from Technical Divisions, which usually are of very short duration, are also part of the statistics. Efforts have been initiated to capture the various categories of persons covered by assignment actions of the Expert Section to allow a more precise analysis of trends in the delivery of expertise in future.

98. Meanwhile new features were initiated in the Expert Post Control System. These include a country information system which will contain all the information required for recruiting an expert from a particular country or sending an expert on mission to a particular country, with a regular update on the security situation, special visa requirements etc. In addition, evaluation requests with respect to an expert's mission are now computerized as are various detailed reports and statistics on the expert component.

99. With the assistance of a cost-free expert from Germany, a project was started to improve and expand the expert roster by developing a list of detailed keywords for classifying experts' specializations, thereby enabling more accurate roster searches. At the same time a thorough review of the experts currently on the roster was initiated.

100. Additional information on the expert component appears in Table 3A and Figure 4 which show, inter alia, where the experts provided in 1991 came from and to which region they went. In Table 3A all experts, including Agency staff on expert assignments and national experts, are shown by nationality. Table 6A provides a further breakdown by recipient country.

2. Equipment

101. Equipment continues to be by far the largest component of the Agency technical co-operation programme. Over 43% of the adjusted overall programme for 1991 was earmarked for equipment provisions.

102. A considerable increase in the value of equipment assistance set in motion as reflected by the volume of new obligations was registered, from $15.6 million in 1990 to $19.1 million during 1991. Although the 1990 figure was low because of NCC devaluations which occurred in that year, the 1991 increase remains nevertheless significant as can be seen when compared with a "normal" year 1989 when $17.6 million was obligated.

103. The rapidly changing political and economical situation in countries which are major suppliers of equipment financed from non-convertible currencies puts significant additional burdens on the Agency's Field Procurement Section. Although considerable amounts of non-convertible currencies were obligated, the difficulties signalled in this respect in paragraph 104 of last year's report[1] continue unabated.

104. The following table provides a five year perspective on the work of the Field Procurement Section. Further information on equipment delivery is given in Figure 5 which shows where the equipment was bought and to which regions it was shipped.

Year	Adjusted programme	New obligations	Implementation rate	Earmarkings	Disbursements	Number of purchase orders [a]
	$ millions	$ millions	%	$ millions	$ millions	
1987	28.2	16.2	57.5	12.0	23.0	3,701
1988	29.8	19.9	66.9	9.9	16.1	3,386
1989	30.5	17.6	57.7	12.9	18.7	3,894
1990	23.5	15.6	66.4	7.9	23.7	3,763
1991	29.6	19.1	64.6	10.5	19.2	3,772

[a] including training course equipment and research contract orders

105. A number of new programs were introduced in the computerized field procurement system. Particularly significant improvements were made in respect to the follow-up of equipment delivery. Although the Agency is able to maintain very detailed records of all equipment it has shipped, it totally depends on the feedback of the end users to obtain confirmation of arrival or information concerning non-arrival, damages or non-functioning of the equipment supplied.

106. During 1991, this systematic feedback improved considerably which in turn allowed the Agency to take quicker and more effective action to solve problems which were encountered. Such prompt feedback from all recipient countries and institutions, particularly in problem cases, remains indispensable to ensure maximum benefit of the equipment to the recipient concerned.

[1] See GC(XXXV)/INF/294, page 20.

107. Continuous efforts are being made throughout the UN System to increase procurement from developing countries. In some agencies a preferential margin was allowed to suppliers from developing countries when they participated in competitive bidding. However, the UNDP Governing Council concluded that this system had no merit and that it should be discontinued. In view of the Agency's limited resources for technical co-operation, and also in view of the fact that much of the equipment it is requested to provide is based on very precise specifications from the requesting country, the Agency had at any rate not considered to propose to change its rules on competitive bidding in this regard. It is therefore worth noting that, even so, procurement from developing countries for the Agency's technical co-operation activities increased.

3. Fellowships

108. The share of fellowship provisions in the total adjusted programme increased further, reaching 16.1% in 1991, against 15.5 in 1990. In that part of the programme financed from the TACF, fellowship provisions accounted for 19%.

109. The fellowship programme appears particularly sensitive to the fluctuations which begin to be discernible in a two-year cycle programme whereby implementation in the second year is well above that in the first year of the cycle. Conclusions on trends are still speculative and can only be drawn after completion of at least two cycles. However, it is likely that in the fellowship's programme the second year of a cycle sees a larger number of fellows placed since most of the procedure of nominating and placing a fellow - which can at times be lengthy - would take place during the first year.

110. During 1991, the first year of the new two-year cycle, the figures indeed show a decline when compared to 1990 (a second year of the two-year cycle), but they are in virtually all categories above those registered for the comparable year 1989. The average duration of training per fellow remained at four months, as in 1990. Likewise the cost of fellowship training remained fairly stable at $2556 a month, against $2436 in 1990.

111. The following table shows these developments. Additional information on fellowship training is provided in Figure 6 and in Tables 3B and 6B, showing the place of study and the country of origin of the fellowship holders.

Year	Adjusted programme	New obligations	Implementation rate	Ear-markings	Number of fellows	Number of fellowship months	Number of visiting scientists	Number of visiting scientist months
	$ millions	$ millions	%	$ millions				
1987	7.8	6.5	83.1	1.3	870	4437	160	101
1988	7.7	5.3	68.3	2.4	682	3056	156	88
1989	9.6	6.0	62.4	3.6	732	2713	192	129
1990	9.7	6.8	69.9	2.9	814	3260	243	148
1991	10.9	6.6	60.6	4.3	747	2926	203	120
Increase over five years (%)					(14)	(34)	27	19

112. As indicated above, the number of fellows, the number of months of training provided and the number of visiting scientists, while not reaching 1990 levels, were all above those of 1989. This must be seen against the added perspective of political developments in Eastern Europe during 1991. In earlier years the former German Democratic Republic, the former USSR and Yugoslavia were important host countries, accepting large numbers of fellows. Many of the traditional host institutes involved were during 1991 no longer or not yet in the position to continue to play this role.

113. Development of appropriate office automation for the management of the growing fellowship programme - which now handles well over one thousand new applications each year -was initiated during 1991. While resource constraints impede a more rapid development, internal staff resources were mobilized to help in the design of a management information system. Modalities, such as the group-fellowship training programme, of which eight were organized during 1991, also help to facilitate the implementation of the programme. Closest co-operation is being maintained with area officers within the Department of Technical Co-operation and with the technical officers in other Departments during all phases of a fellowship, from nomination to final report, to ensure that training objectives are achieved.

4. Training Courses

114. As is shown in the table below, activities in the training course programme continued in 1991 at the high level reached in prior years. In addition to the interregional and regional courses reflected in the table, 40 national group training events took place.

Year	Adjusted programme	New obligations	Implementation rate	Earmarkings	Number of courses	Number of participants	Number of months
	$ millions	$ millions	%	$ millions			
1987	4.5	2.9	65.4	1.5	64	945	915
1988	6.9	4.5	65.0	2.4	88	1109	958
1989	8.3	5.0	60.2	3.3	106	1265	1090
1990	9.6	8.3	86.6	1.3	108	1358	1188
1991	7.5	6.1	81.6	1.4	109	1401	1066

115. More courses than ever before were hosted by developing Member States. As is shown in Annex II - which provides details on subject and location of the courses -93 events or 85% of the total took place in these countries.

116. The various regional agreements continue to provide an ideal framework for training courses. Within the RCA (Asia and Pacific) 41 courses were implemented, 27 of which were part of the activities of the UNDP/RCA project. Although some courses planned for Latin America had to be postponed due to economic difficulties in several countries in the region, a large number of training events of different types nevertheless took place under ARCAL projects.

117. In Africa, where manpower training remains the most important road towards the creation of local capabilities in the nuclear field, three training courses were implemented under the AFRA programme. A further 17 regional courses were held as part of the regional programmes for Africa.

118. Major training courses have to be planned well in advance. Once dates for the event have been established, all the work involved in host institute arrangements, nomination and selection of participants, travel arrangements, recruitment of lecturers etc. must be done by fixed deadlines. This puts a certain ceiling on the number of courses that can be handled with existing staff resources. Since implementation of a course cannot deviate from the strict time schedule established for it, a high implementation rate prevails in this part of the programme. In 1991 it stood at 81.6%, considerably above the rate for the programme as a whole.

119. During 1991, a forecast of interregional and regional training courses to be given during the period 1992-1996 was elaborated, based on past training course experience and on an assessment of present and future needs of Member States. In respect of nuclear power, nuclear safety, radiation protection and nuclear fuel cycle courses this assessment was based on a review carried out in May 1991 by the Advisory Committee on Training in Nuclear Power and Nuclear Safety in which 15 Member States were represented.

120. As in the past, many training events benefitted from extrabudgetary contributions from Member States. Without these contributions from nine donor countries, the scope of the 1991 Training Course programme would have been much reduced.

5. Sub-contracts and Miscellaneous

121. The share of the programme that is delivered through the sub-contracting modality shows no significant fluctuation over the years. It hovers around a modest 2 - 2.5%. As the following table illustrates, an increase in actual amounts of technical assistance provided through sub-contracts did take place since 1986, reaching around $1.3 million in 1990.

Year	Adjusted programme	New obligations	Implementation rate	Earmarkings	Disbursements
	$ millions	$ millions	%	$ millions	$ millions
1987	0.9	0.5	60.8	0.4	0.5
1988	0.9	0.7	81.1	0.2	0.8
1989	1.7	0.8	48.8	0.0	0.7
1990	1.5	1.1	72.6	0.4	0.7
1991	1.8	1.0	54.9	0.8	1.3

122. As the component breakdown in the Implementation Summary I shows, 1% of the adjusted programme was allocated to the miscellaneous component. About 48% of the amounts obligated under this item are payments for Agency radiation protection services. The remainder covers charges such as insurance premiums, charges associated with handling of

Agency activities by UNDP field offices, mission cancellation costs and printing and shipping of certain TC documents.

E. Review by Fund

1. Technical Assistance and Co-operation Fund

New resources	**$38.9 million (79.2% of total)**
Adjusted programme	**$52.0 million (76.7% of total)**
New obligations	**$35.1 million (81.4% of total)**
Implementation Rate	**67.6%**
Disbursements	**$35.8 million (77.7% of total)**

123. Resources for the Technical Assistance and Co-operation Fund increased by 12% from $34.7 million in 1990 to $38.9 million in 1991. The importance of this source of funding for IAEA TC activities has further increased. In 1981, the TACF provided 53% of TC resources. It now accounts for nearly four-fifths. However, the increase in TACF resources should not conceal the fact that the percentage of the target met through pledges is in alarming decline. In 1990 pledges of $38.8 million were received against a target of $45,5 million, yielding an overall percentage of 85.3%, in 1991, $38.4 million against a target of $49 million was pledged which amounted to only 78.4% of the target. Even more alarming are estimates for 1992 when pledges are estimated to reach approximately 72%.

124. As can be seen in Table 1, total additional income to the TACF, other than pledges, amounted to $438,000 in 1991 (a loss of $88,000 in CC and a gain of $526,000 in NCC). This figure is composed of several positive and negative amounts. In the CC portion, interest and miscellaneous income amounted to $863,000, assessed programme cost to $1,048,000, and partial UNDP support costs to $33,000. This total of $1,944,000 in extra income was, however, more than offset by a very significant loss on exchange of $2,032,000. In NCC, assessed programme costs brought $453,000 in addition to which $673,000 in NCC was transferred from the Administrative Fund as approved by the Board of Governors[a].

125. Against this extra income of $1,126,000 in NCC exchange losses of $600.000 in NCC were incurred. The table below summarizes the various elements constituting the miscellaneous income:

[a] see GOV/2491/Rev.1/Mod.1.

Miscellaneous Income

Type	Convertible	Selected Non-convertible	Total
	$thousands	$thousands	$thousands
Interest and other income	863	0	863
Assessed programme costs	1,048	453	1,501
UNDP support costs (partial)	33	0	33
Transfer from Administrative Fund to TACF	0	673	673
Exchange loss (realized)	(342)	(31)	(373)
Exchange loss (unrealized)	(1,690)	(569)	(2,259)
Total	(88)	526	438

126. As the following table shows, the overall programme was fully funded at the end of 1991. The overprogramming in CC, $1,144,000, was more than offset by the surplus funds in NCC totalling $2,470,000. However, it is the intention of the Agency to keep as far as possible both components of the programme balanced. This would have been achieved were it not for the "unrealized losses" on exchange (see above table) in the CC portion which are impossible to anticipate during the year with any degree of accuracy. The existing overprogramming in the convertible currency portion of the programme will largely disappear as a result of rephasings into the next biennium, which will be carried out mid 1992. Any amount of overprogramming that would still be expected to remain by the end of 1992 will be deducted from the anticipated 1993-94 resources, so that the programme for the next biennium will be within expected resources.

Resources available and programme commitments by year-end
(in thousands of dollars)

Year	Available financial resources			Programme			Balance		
	CC	NCC	Total	CC	NCC	Total	CC	NCC	Total
1982	14,186	3,670	17,856	13,788	4,071	17,859	398	(401)	(3)
1983	17,044	3,351	20,395	17,407	3,442	20,849	(363)	(91)	(454)
1984	19,240	3,274	22,514	19,583	3,782	23,365	(343)	(508)	(851)
1985	18,975	5,663	24,638	21,392	5,536	26,928	(2,417)	127	(2,290)
1986	14,002	8,813	22,815	18,146	7,706	25,852	(4,144)	1,107	(3,037)
1987	10,164	7,345	17,509	16,758	8,753	25,511	(6,594)	(1,408)	(8,002)
1988	13,833	11,376	25,209	18,590	11,456	30,046	(4,757)	(80)	(4,837)
1989	19,274	13,982	33,256	21,435	15,146	36,581	(2,161)	(1,164)	(3,325)
1990	23,879	7,332	31,211	22,688	6,511	29,199	1,191	821	2,012
1991	24,208	10,084	34,292	25,352	7,614	32,966	(1,144)	2,470	1,326

127. The implementation rate of the TACF-based programme was 67.6% in 1991 against 71.3% in 1990 and 58% in 1989. This follows closely the fluctuations observed in the overall implementation rate. There was however a significant difference in the implementation rate for the CC programme which reached 70.4%, and that in NCC where only 43.9% could be utilized. As can be seen in the following table, $35,1 million, the highest amount for any year so far, was obligated in 1991 against the current year programme. In addition, $3,8 million was obligated in connection with future years programmes so that the total value of technical co-operation set in motion in 1991 reached $38,9 million, an increase of $4,3 million, or 12.4%, over 1990.

Year	Adjusted programme	New obligations	Implementation rate	Earmarkings
	$	$	%	$
1987	40,436,825	27,078,352	67.0	13,358,473
1988	43,652,306	28,383,470	65.0	15,268,836
1989	48,867,916	28,320,331	58.0	20,547,585
1990	46,880,397	33,422,585	71.3	13,457,812
1991	51,965,550	35,124,387	67.6	16,841,163

128. Approvals for 23 projects with a total value of $525.000 were made against the Reserve Fund in 1991, utilizing 75% of the $700.000 allotted by the Board for this purpose. The 1991 utilization rate of 75%, which is below that prevailing in 1990, confirms that utilization of the Reserve Fund tends to be higher in the second year of a two-year cycle. Of the approvals under the Reserve Fund 11 were for new projects and 12 pertained to additions to on-going projects. Eleven of the approvals were for activities dealing with Safety issues. The largest amount for supplemental assistance was added to a Regional African activity "Water Desalination using Nuclear Heat Reactors". Details of all approvals are provided in Annex VIII.

2. Extrabudgetary Resources (including Funds in Trust)

New resources.....$7.0 million (14.3% of total)
Adjusted programme.....$12.6 million (18.6% of total)
New obligations.....$6.5 million (15.1% of total)
Implementation Rate.....51.4%
Disbursements.....$6.7 million (14.5% of total)

129. After the slump registered in 1990 - caused by an exchange loss against roubles -extrabudgetary resources surged back to $7 million, comparable to the level prevailing in 1989. With this 45.6% increase over 1990, extrabudgetary resources in 1991 accounted for 14.3% of total resources as against 10.8% in the previous year. Included in these figures is the funds in trust category which increased substantially due to contributions from Syria and Ghana towards the purchase of two miniature neutron source reactors, for a total of $0.5 million.

130. The largest part of the extrabudgetary resources received were for footnote-a/ projects for which financing was still being sought in 1991. With these funds 32 footnote-a/ projects could be made operational as well as five footnote-a/ components of TACF financed projects. The total value of projects and project components made operational in 1991 was higher than in the previous year, and higher than in any preceding year with the exception of 1989. However, due to the fact that the value of the total approved footnote-a/ projects in the 1991 programme was over two and half times as large as that in 1990, the percentage of footnote-a/ projects made operational fell back sharply, as illustrated in the following table.

Year	Approved footnote-a/ projects	Footnote -a/ projects & components made operational	Share of footnote-a/ projects made operational
	$	$	%
1987	6,352,200	3,005,300	47.0
1988	8,182,800	3,782,102	46.2
1989	9,933,900	5,332,606	53.7
1990	6,013,000	4,359,800	72.5
1991	16,205,200	4,491,519	27.7

131. Although the implementation of the extrabudgetary part of the programme is subject to a number of constraints, it has nevertheless been possible to improve the overall implementation rate further, it rose from 46.5% in 1989 to 49.5% in 1990 and reached 51.4% in 1991.

132. The USA was in 1991 the largest extrabudgetary donor, followed by Germany and the United Kingdom. In addition, three major donors, namely the USA, Germany and France made offers for priority financing of fellowships under type II arrangements for fellows connected to footnote-a/ projects which were upgraded with their extrabudgetary contributions. The total value of this offer, not reflected in the above resource figures, amounted to $517,800.

3. UNDP

New resources.....$1.5 million (3.1% of total)
Adjusted programme.....$3.2 million (4.7% of total)
New obligations.....$1.5 million (3.5% of total)
Implementation Rate.....47.1%
Disbursements.....$1.9 million (4.1% of total)

133. It should be noted that "resources" in the UNDP context represent the total delivery achieved, whereas the "adjusted programme" reflects the totality of approved UNDP projects at year-end.

134. As can be observed from the above table, UNDP's share of the adjusted programme has now declined to under 5% of the total. It is indeed at the lowest level since 1985, also in absolute monetary terms. In addition, each of the indicators: resources, new obligations and disbursements show a significant

decrease of $1.4 million compared to 1990. Moreover, the implementation rate dropped from 88.6% in 1990 to 47.1%.

135. The main reason for this decline is due to factors beyond Agency control. Project ALB/87/001 -"Strengthening of nuclear technical applications using a research reactor" - which had an approved 1991 budget of $1.3 million (accounting for almost 40% of the total 1991 UNDP provisions), could not be implemented as planned in view of political and economic uncertainties which emerged in the country towards the end of 1991. On request of UNDP, commencement of implementation of the project on site was postponed. There is at present little chance that this project will be implemented in the near future, since UNDP anticipates that Albania may request a reordering of its priorities to be funded from UNDP resources.

Year	Adjusted programme	New obligations	Implementation rate	Earmarkings
	$	$	%	$
1987	3,307,300	2,568,677	77.7	738,623
1988	3,682,121	3,050,530	82.8	631,591
1989	4,427,249	3,105,808	70.2	1,321,440
1990	3,223,083	2,855,764	88.6	367,319
1991	3,210,360	1,513,194	47.1	1,697,166

136. There are few prospects that the decline illustrated in the above table can be halted or reversed in the near future, judging by the small number of projects in the pipeline by the end of 1991. The Agency continues to make every effort to strengthen its contacts with UNDP field offices within the extremely limited resources it has for this purpose, but, as repeatedly stated, the volume of UNDP financed activities in the Agency's field of competence in final analysis solely depends on the priority that national planning authorities are prepared to give to such activities.

137. During 1991, three UNDP-financed projects were completed and one new project approved, so that 18 were under implementation at the year end. These projects are listed in Annex VI. The IAEA also acted as an associated agency for one UNDP-financed project executed by UNTCD and one project executed by the Government of China.

138. In addition to the above discussed funds, which UNDP made available for projects for which IAEA is executing agency, UNDP also gives non-project related financial support to technical agencies to enable them to provide advice in their sphere of competence to governments. From these "Sectoral Support" funds some technical agencies have financed regional advisors in the field. IAEA has for some years now been successful in utilizing this facility to obtain funds for additional programming and advisory missions which otherwise could not have been fielded. During the past five years, nearly $120,000 was obtained for this purpose.

139. With the $34,200 available for 1991, it was possible to field the programming mission to Namibia, referred to under II.C.1. above. Myanmar received advisory missions concerning the contribution nuclear techniques could make in NDT methods in industry, in solving siltation problems at Inle lake, and in animal and crop production. The recommendations made are

intended to lead to the formulation of projects in these fields. A similar preparatory mission financed from UNDP Sectoral Support was carried out to the Philippines to assist in project formulation in the animal health field. In addition, these funds covered a mission to Uganda to advise on radiation safety measures to be adopted for radiation sources in medicine, industry, hydrology and research.

4. Assistance in kind

Resources	**$1.7 million (3.5% of total)**
Disbursements	**$1.7 million (3.7%.of.total)**

140. The volume of assistance in kind made available in 1991 is 0.5 million less than that of the previous year ($1.7 million against $2.2 million) and amounted to 3.5% of total resources. Ten years earlier, in 1981, assistance in kind was $2.8 million and represented 11.4% of the programme. As in this resource category the resources made available equal disbursements, as recorded at year-end, the concepts of "adjusted programme", "new obligations" and "implementation rate" do not apply.

141. Assistance given in kind is recorded at year end according to strict criteria: such assistance is only reported in respect of equipment if such equipment has actually been shipped from one country to another. In respect of experts, credit is given to donor countries when persons are made available for services outside their own country, or when a country pays for the services of an expert from another country. Similar criteria exist in respect of training course participants.

142. A variety of activities are made possible through assistance in kind, but this resource category remains particularly important for the Agency's training programmes. About 12% of all fellowships, covering 409 months of training, were provided by 15 different countries amongst which were 3 developing Member States. In addition, 236 experts and lecturers were provided by either cost-free or part-free by 36 countries and 4 international organizations.

143. Three countries and one international organization provided stipends and travel costs for 66 participants in regional training courses. The three developing countries involved financed 48 of these.

144. As shown in Annex I, the USA remained the largest donor, followed by Germany, UK, India, Argentina, France, China and the Rep. of Korea. The percentage of assistance in kind donated by Member States who are themselves recipients of technical co-operation was 22.4%

III. A PROFILE OF INTERREGIONAL TECHNICAL CO-OPERATION ACTIVITIES

Introduction

145. A profile of technical co-operation activities in one particular region has been presented each year since 1987 in Section III of the report on the Agency's Technical Co-operation Activities. These profiles covered, for each country in the region reviewed, the different stages of development in the utilization of nuclear technology and the Agency's technical co-operation involvement in the countries concerned. The first region reviewed was Latin America (1987), followed by Africa (1988), Asia and the Pacific (1989) and the Middle East and Europe (1990). Although most of the Agency's Technical Co-operation resources are devoted to country projects, interregional activities are nevertheless of great importance to the programme as a whole. It is therefore appropriate to also describe these activities in some detail.

146. The bulk of the resources allocated to the Agency's interregional programme (71% in 1991) is devoted to the financing of the Agency's interregional training courses. Over the past decade, each year around 20 such training events on a wide range of subjects have been held. This component of the Agency's interregional programme is not elaborated on here as details are provided annually to the Technical Assistance and Co-operation Committee and are, as every year, included elsewhere in this report (see., for example, Section II D.4 and Annex II).

147. Part of the Agency's interregional technical co-operation activities concerns the provision of advisory services to Member States in the planning, designing and programming of technical co-operation projects. These services are provided in the form of pre-project assistance. In 1991 alone, 17 missions went to 20 countries to assist in the planning and formulation of programmes and projects. Since 1987 well over half of the Agency's developing Member States have benefitted from pre-project assistance.

148. Closely related to these activities are country programme reviews, started in 1991, as such reviews result in recommendations which find their reflection in the formulation of technical assistance requests. Three such reviews, in Ethiopia, Guatemala and the United Republic of Tanzania, were undertaken in 1991.

149. In addition to financing training courses and pre-project assistance, interregional funds are used to provide advisory services of a technical nature in response to collective requirements of Member States. The assistance provided in this manner is often a direct complement to assistance provided at the country or regional level but, as the subject matter is of importance to numerous Member States, there are advantages in meeting their needs through interregional projects.

150. The following narratives describe activities carried out through eight interregional projects covering a wide range of subjects and provide an overview of the results achieved so far.

Basic Safety Standards

151. In 1982, the Agency, together with ILO, OECD/NEA and WHO, issued revised Basic Safety Standards for Radiation Protection incorporating new recommendations of the International Commission on Radiological Protection (ICRP). These standards are intended to improve radiation safety for both workers and the general public and are mandatory for the Agency's own operations and for Agency-assisted operations. An advisory group reviewed the Agency's nuclear and radiological safety programme in 1982 and gave highest priority to the implementation of the new standards. The Agency subsequently initiated various activities aimed at assisting Member States in the practical implementation of the Basic Safety Standards.

152. A key activity in this connection is the provision of assistance to counterpart organizations by Radiation Protection Advisory Teams (RAPATs), which assess radiation protection practices and procedures in developing Member States, determine immediate and future radiation protection needs and priorities, and recommend measures to strengthen radiation protection capabilities and accelerate adoption of the Agency's Basic Safety Standards. Future long-term technical co-operation activities connected with radiation protection are based on such assessments.

153. A RAPAT mission normally involves 3-4 highly qualified and experienced persons - both Agency staff members and external experts. Representatives of WHO, ICRP and ILO also participate. By the end of 1991, 56 RAPAT missions had been performed, 18 to Africa, 17 to Latin America, 12 to Asia and the Pacific, and 9 to the Middle East and Europe. Experts from 21 countries participated; in addition, WHO was represented on seven missions, ICRP on three and ILO on one. A mission normally lasts 4 - 5 days and involves extensive discussions with - and analyses of the activities of - the national authority for radiation protection. Visits to users of ionizing radiation (for example, hospitals and clinics, universities and research institutes) are included in the programme.

154. In general, RAPAT missions have found that radiation protection activities in developing countries are at various stages of development, ranging from an absence of the most basic elements to reasonable sophistication. Some countries lack any programme, strategy or infrastructure for radiation protection and urgently need to place their applications of ionizing radiation under a radiation protection regime. In a large group of countries, these elements exist but are inadequate. A shortage of trained manpower is an acute problem in the majority of countries visited. In many cases, sophisticated instrumentation may be available, but the necessary expertise is not.

155. On the basis of RAPAT experience, the general conclusion is that technical co-operation efforts should focus on the development of longer-term strategies in the shape of national radiation protection programmes, on the creation of necessary infrastructures (legislation, standards and competent

national licensing and enforcement authorities), and on manpower development.

Radioactive Waste Management

156. Management of radioactive waste is an essential element in the safe use of nuclear energy. All countries which use nuclear energy in any form will produce radioactive waste which must be disposed of safely, and adequate technology must be available to them for this purpose. To arrive at practical solutions for the integrated development of waste management schemes, and to solve problems of low and intermediate level waste management and disposal, an interdisciplinary approach is needed that takes into account radiation protection, nuclear safety, siting and environmental factors, waste processing, basic engineering, operational safety and decontamination techniques. Many developing countries lack the infrastructure, regulatory framework and expertise needed to develop a comprehensive waste management strategy.

157. The Agency's Radioactive Waste Management Advisory Programme (WAMAP) was initiated in 1987 to support developing Member States in planning integrated waste management and disposal systems and to foster technical co-operation in this area. Funding is provided from the Technical Assistance and Co-operation Fund and technical support by the Waste Management Section of the Division of Nuclear Fuel Cycle and Waste Management. The programme involves one-week missions conducted by international experts and Agency staff for the purpose of assessing the waste management needs of developing Member States and giving advice on waste management problems. During the period from 1987 to 1991, 35 missions were carried out under the programme - 7 to Africa, 9 to Asia and the Pacific, 8 to Latin America and 11 to the Middle East and Europe. Eleven of the countries visited had nuclear power plants in operation or under construction, together with nuclear fuel cycle facilities, nine had uranium or monazite processing programmes, nineteen had research reactor centres or programmes and eleven were essentially limited to isotope applications. Thirtysix experts from 13 countries participated in the missions.

158. The planning of a mission includes a preliminary assessment of the needs of the country, on the basis of information available at Headquarters and of the country's responses to a questionnaire. In the light of this preliminary assessment, the terms of reference of the mission are drawn up and appropriate expertise is engaged, taking into account the sources and nature of waste arisings and the status of waste management in the country. During the mission, waste management requirements are assessed with special reference to operational and planned programmes, and recommendations are made on safe waste management options, including waste segregation, treatment, conditioning, storage and disposal. Technical advice on specific waste management problems is also offered.

159. The general conclusions of WAMAP missions point to the need to create an awareness of the importance of safe radioactive waste management and to establish national waste management programmes for ensuring nuclear safety and performing operations in an environmentally acceptable manner. Major findings applicable in varying degrees to a majority of countries often

indicate a lack of awareness of the need for safe radioactive waste management and failure to accord due priority to waste management - and consequent inadequacy of the resources allocated. As effective policies and integrated programmes are absent, there are no adequate infrastructures in terms of legislation, regulations and national authorities. Where programmes suffer from insufficient expertise and inadequate information, unsystematic disposal and deficiencies in the control of spent radioactive sources often occur. New, improved equipment and technologies are frequently needed, together with a stronger safety culture for waste management. As in industrialized countries, public acceptance may pose problems.

160. WAMAP recommendations missions provide the background for technical co-operation and waste management projects in developing countries. Currently, waste management projects are operational in twelve countries; regional projects are under way in Africa and in the Middle East and Europe.

Equipment Maintenance Training

161. During 1982 and 1983, several Member States submitted requests for technical assistance projects involving the delivery and installation of liquid nitrogen production facilities. Installation, start-up and operation of such facilities require considerable expertise and training, which - as experience has shown - cannot be readily obtained from the equipment suppliers. To ensure that appropriately trained technical staff would be available, a project was created in 1984 to provide hands-on training to technicians from developing countries in the operation and maintenance of the type of liquid nitrogen production facility to be provided under country projects. It was also intended to provide assistance by Agency specialists in the installation and start-up of the facilities at recipient institutions. The project provided for the installation of a liquid nitrogen production plant at the Agency's laboratory at Seibersdorf; upon completion of training activities, the equipment would be available for installation in a developing country.

162. Following a review of the project in May 1986, it was decided that the cost of installing the plant at Seibersdorf, including site preparation and the erection of a new building, could not be justified by the value of the training to be provided, which could be given by the experts responsible for installing such plants in the individual developing countries; this particular plant, which was simple to operate and to maintain, could be offered to a developing country that had a need for it and was prepared to make a firm commitment to provide the necessary building and related facilities. The Syrian Arab Republic was selected, and installation of the plant was completed in September 1989.

Nuclear Power Programme Implementation

163. Under this interregional activity, initiated in 1985, the Agency has provided technical assistance in many areas related to nuclear power feasibility studies and nuclear power programme planning and implementation: preparation of feasibility reports, bid evaluation, co-ordination of planning activities, project management, safety and regulatory

aspects, quality assurance, commissioning of nuclear power plants and introduction of advanced nuclear power technologies.

164. During 1991, a consultant designed country-specific training courses on nuclear power project management and programme implementation. Such courses were conducted in Egypt, the Republic of Korea and Yugoslavia.

165. A country-specific training course on quality assurance was conducted in Poland. Expert missions to the Islamic Republic of Iran assisted in reviewing damage to the civil structures of the Bushehr Nuclear Power Plant and in assessing the status of the construction. Assistance was provided to the People's Republic of China in studying the feasibility of introducing high-temperature gas-cooled reactor technology. The Republic of Korea was assisted in the development of evaluation methodology for selecting an advanced reactor system suitable for the country. Assistance was provided to Indonesia in drawing up terms of reference for a feasibility study on what will be the country's first nuclear power plant. Also experts advised on industrial infrastructure development, electricity generation expansion planning and aspects of financing and bid evaluation.

Siting of Nuclear Installations

166. Siting is one of the first concerns of a country embarking on a nuclear power programme or establishing a research reactor facility, but siting expertise is available only in countries that have experience of the entire siting process for a number of nuclear installations. In 1984, a multi-year interregional project was initiated to provide support to developing Member States through expert missions and training at the Agency's headquarters and at other organizations involved in siting studies and research, to create a better understanding of safety criteria related to siting and, in the long term, to strengthen the capability of developing Member States for performing independent safety studies.

167. The major activities performed under the project were the preparation of guidelines and technical documents, the conducting of training and the provision of expertise. Checklists in the areas of meteorology, geology, hydrogeology and seismology were prepared for use by experts during review missions related to site safety problems and as a basis for the development of related technical documents. Guidelines were prepared for a review of seismic safety of a research reactor in Morocco; they were later used as the basis for technical documents on the siting of research reactors and on the earthquake-resistant design of facilities with limited radioactive inventories. Guidelines on quality assurance in nuclear power plant siting were developed as a technical document and eventually as a safety guide.

168. A software package on seismic safety was acquired for training specialists from developing Member States - initially in Vienna and later at the national and the interregional level. A two-week training course was conducted in Vienna in 1985 for twenty participants from countries which were then in the process of nuclear power plant siting. In Beijing, China, a series of one-week lectures was given on several topics related to nuclear power plant site selection, including demography, meteorology, hydrology and seismic safety.

169. Expert missions were conducted to Albania, Hungary, Iraq, Morocco, Pakistan, Portugal and Turkey for the purposes of identifying needs, planning activities or troubleshooting. Follow-up, when necessary, was carried out through national technical co-operation projects.

170. Such activities will be expanded under a new project, Siting and Seismic Review of Research and Power Reactors, approved in 1991.

Nuclear Measurement Techniques

171. In 1987, a project was initiated for improving the capability of nuclear scientists in developing Member States to carry out accurate, reliable and reproducible nuclear measurements and for strengthening collaboration between nuclear laboratories in developing countries. The project is intended to contribute over the long term to the development of self-supporting nuclear infrastructures in developing countries. A total of 41 laboratories agreed to participate.

172. The first phase of the project, which involved nuclear measurements of increasing complexity, consisted of intercomparison exercises with emphasis on the utilization of equipment. The first intercomparison exercise covered nuclear analytical techniques and consisted in determining major, minor and trace elements in samples by a variety of techniques and low-level activity in milk powder samples by low-level counting techniques. The second exercise, carried out at laboratories equipped with neutron generators, consisted in taking measurements to determine the angular distributions of neutron fluxes.

173. The first exercise revealed serious inconsistencies in the quality of the measurements reported by all except one or two laboratories, indicating a need for further efforts to improve the capability of nuclear laboratories in developing countries to carry out accurate nuclear measurements. However, the approach should be narrower, concentrating on training in all steps: sample preparation, the use of reference materials, equipment operation, and data collection, processing and analysis. It was concluded that such training could best be conducted in small, homogeneous groups on a regional basis and that the initial prospects for regional activities were most promising in Africa. A regional project, X-Ray Fluorescence Laboratory Network in Africa, was therefore approved for implementation in 1992.

Electron Beam Technology for Flue Gas Purification

174. The emission of toxic gases from coal- and oil-fired boilers in electric power plants and other industrial plants has long been recognized as a major cause of environmental pollution. One technology being developed for the removal of toxic components from flue gases is based on the irradiation of flue gases with electron beams in the presence of ammonia. The result is the conversion of toxic gases into a solid product, which can be precipitated using standard techniques and transformed into agricultural fertilizer.

175. In view of the considerable interest in many Member States, the Agency organized consultants' meetings in 1986 and 1987 to review the status of this

technology. On the basis of conclusions and recommendations from these meetings, an interregional project was initiated in 1988. The main objectives of the project were to promote the exchange and transfer of technology in connection with the use of electron beams for flue gas purification and to facilitate the co-ordination of research and development work in this area.

176. A variety of training workshops and seminars were held during the 1988-91 period: in 1988, at a workshop in Madrid attended by 20 participants from seven countries, the status of technological development was reviewed with particular attention to the final report on four years of operation of the Ebara/DOE demonstration unit in the United States; in 1989, at a workshop in Poland attended by 13 participants from seven countries and by 30 Polish observers, the agenda included a discussion and analysis of plans for the construction of a large-scale demonstration facility in Poland (in addition, two one-day seminars were held in Warsaw and Krakow for participants from Polish industry and utilities from the Polish Government); also in 1989, two-day seminars were organized in India (Bombay), Thailand (Bangkok) and the Republic of Korea (Daejong), with 50 to 80 persons attending and lecturers from the United States, Japan and the Agency; in 1991, a workshop in Warsaw was attended by about 60 participants and observers from ten countries, the main emphasis being the technical and economic feasibility of the process. Concurrently, a research co-ordination meeting was held on the same subject, marking the official inauguration of a large demonstration facility in Poland.

177. Various other activities stemmed in large measure from the project. A co-ordinated research programme was initiated in 1989 with the participation of research groups from China, Denmark, Germany, Israel, Italy, Japan, Poland and the Soviet Union. Feasibility studies were initiated in China, Poland, Mexico, Czechoslovakia, India and the Republic of Korea, the Mexico study being assisted under a technical co-operation project (MEX/8/016). Thanks partly to assistance provided through a technical co-operation project (POL/8/007), a demonstration facility (the largest of its kind in the world) was installed at a thermal power plant in Warsaw and put into operation in 1991. The Agency provided some analytical equipment and two electron beam accelerators, other equipment was received from the USA, Japan and Germany.

Nitrogen Fixation Studies

178. In view of low crop yields and poor soil, enhancing biological nitrogen fixation by crop plants and improving fertilizer use efficiency are of great importance to many developing countries. In this connection, nuclear techniques (particularly techniques involving the use of nitrogen-15) are widely employed in assessing fertilizer uptake and nitrogen-fixing ability and determining optimum times for fertilizer application.

179. A project was initiated in 1985 to help scientists from developing Member States who had participated in interregional soil science training courses to conduct follow-up research on nitrogen fixation and related fertilizer studies. The project was extended in 1988 to include the provision of assistance to participants in subsequent soil science training courses held at Seibersdorf every year since 1978. The assistance involves the supply of nitrogen-15 labelled fertilizer for experimental purposes and the provision of related

analytical services. The project provides a unique opportunity for training course participants to apply the concepts and techniques learned during the courses.

180. The project has helped to increase agricultural productivity in Member States and strengthened the scientific capabilities of local staff. During the period 1985-91, grants were awarded to 25 scientists from 20 Member States; also 18.4 kg of nitrogen-15 labelled fertilizer were made available and 4083 samples were analysed at the Agency's laboratories at Seibersdorf. Research work performed within the framework of this project has been of excellent quality and highly relevant both for increasing agricultural productivity and for reducing imports of expensive nitrogen fertilizers.

IV. PROJECTS CONCLUDED DURING 1991: ACHIEVEMENTS

In the following pages, brief accomplishment summaries are given for projects - excluding training courses - which were "operationally" completed during 1991. For the project cancelled during this period, the reasons leading to its cancellation are given.

A project is "operationally completed" when all experts have returned from their assignments, all equipment has been delivered and all fellows have returned home. As bills may still be outstanding, "financial completion" may in some cases still follow.

The achievement summaries show only what was accomplished during the lifetime of the project and indicate the degree to which the objectives had been met at the time of the project's completion. Whether the momentum leading to these accomplishments can be sustained and whether the project will have a continuing development impact over the longer term can only be ascertained through post-project evaluation. When specific expert recommendations are translated into practice, trained counterpart staff are retained for the activities involved and equipment is fully used and kept functioning, the benefits arising out of the project will obviously go well beyond the achievement of the immediate objectives.

The achievements are sorted by country alphabetically. In each case the description is preceded by the objectives of the project printed in capitals.

ALBANIA

ALB/2/006 RADIOANALYTICAL LABORATORY

COMPLETED: **91-12-31** TOTAL COST: **$165,818**

TO STRENGTHEN THE LOCAL CAPABILITY FOR THE APPLICATION OF RADIOTRACER METHODS, PARTICULARLY FOR INORGANIC TRACE ELEMENT ANALYSIS AND MICROELEMENT DETERMINATION WITH A VIEW TO PROMOTING THE WIDER APPLICATION OF NUCLEAR TECHNIQUES.

The project has resulted in the technology transfer (to the Institute of Nuclear Physics, Tirana) of trace element analytical techniques including tracer and isotope dilution analysis and, to a limited extent, radioimmunoassay (RIA). This is a significant contribution to the country's programme of applying nuclear techniques in science and industry. The IAEA established a laboratory for trace element determination through the provision of equipment, such as a UV-spectrophotometer, a low level alpha-beta counter, an RIA system and an isotachophoretic analyser. Expert services in isotope dilution analysis were also provided. A number of studies, such as ash content determination in coals, a new separation pre-concentration technique using foamed polyurethane sorbents, determination of progesterone in milk samples, were initiated.

ALB/8/004 TRACERS IN INDUSTRY

COMPLETED: **91-08-31** TOTAL COST: **$78,346**

TO APPLY RADIOACTIVE TRACERS IN SEVERAL INDUSTRIAL ENDEAVOURS.

The project has resulted in strengthening the capability of the Institute of Nuclear Physics, Tirana, to use radioisotopes in industrial applications. In particular, a high level in tracer testing and modelling of mineral processes has been achieved. Development of control of processes and production in the local industry has been initiated. The Agency provided a logging counter and expertise which resulted in a co-operation with an experienced foreign institute.

ALGERIA

ALG/1/009 ION IMPLANTATION TECHNIQUES

COMPLETED: **91-07-26** TOTAL COST: **$40,918**

TO INTRODUCE AND DEVELOP CHARGED PARTICLE ACTIVATION ANALYSIS AND RUTHERFORD BACKSCATTERING TECHNIQUES FOR ANALYSIS OF IMPLANTED MATERIALS USING A VAN DE GRAAFF ACCELERATOR.

After training of local staff and provision of expert services by the Agency, the Centre for Nuclear and Solar Studies, Algiers, is capable of fully utilizing the Van de Graaff accelerator and the ion implanter. Charged particle activation analysis and Rutherford backscattering techniques are now routinely used for characterizing various implanted materials. The local staff member who received training abroad is now capable of training others based on his own experience in this field.

ALG/4/002 INSTALLATION OF A CYCLOTRON

COMPLETED: **91-07-26** TOTAL COST: **$20,555**

TO ADVISE ON THE DESIGN, INSTALLATION AND USE OF A CYCLOTRON FACILITY FOR PRODUCTION OF MEDICALLY IMPORTANT RADIONUCLIDES.

The Centre for the Development of Nuclear Techniques, Algiers, sought Agency assistance for the design, installation and use of an appropriate cyclotron facility for production of radioisotopes for medical purposes. Under this project, the Agency provided expert advice and training which led to the definition of types and quantities of radionuclides required by medical institutions in Algeria and to the establishment of general and detailed drawings, including cost estimates, for installation of the cyclotron. These drawings were accepted by the cyclotron supplier in Belgium. Two staff members were awarded scientific visits in Hungary.

ALG/4/003 MAINTENANCE OF NUCLEAR INSTRUMENTS

COMPLETED: **91-08-05** TOTAL COST: **$42,180**

TO PROVIDE SPARE PARTS AND EQUIPMENT IN ORDER TO STRENGTHEN EXISTING INFRASTRUCTURES.

The project has provided spare parts and expert services for the repair of important equipment: an atomic absorption spectrometer, pilot food irradiator, DEC 350 computer, and several detectors. It has also permitted the Centre for the Development of Nuclear Techniques, Algiers, to upgrade several existing facilities, including the data acquisition system for nuclear activation analysis and the water demineralization system of the pilot food irradiator.

BANGLADESH

BGD/2/008 DEVELOPMENT OF NUCLEAR ANALYTICAL FACILITIES

COMPLETED: **91-12-10** TOTAL COST: **$74,511**

TO DEVELOP A NUCLEAR ANALYTICAL CAPABILITY FOR PROVIDING SUPPORT SERVICES TO AGRICULTURE, MEDICINE AND INDUSTRY.

The 3 MW TRIGA Mark II research reactor has been in operation at the Atomic Energy Research Establishment at Savar since September 1986. In support of the reactor, the Institute of Nuclear Science and Technology established a nuclear analytical laboratory equipped with ultraviolet/visible infrared and atomic absorption spectrophotometers. In 1988 the Atomic Energy Commission sought the Agency's assistance to upgrade the laboratory's capability to provide analytical support services to agriculture, medicine and industry. A hyper pure germanium detector with PC gamma spectrometry system, contamination monitor, reference materials, calibration sources and essential items of laboratory equipment were provided by the Agency. A six-months fellowship was awarded in the field of radiochemical activation analysis. The staff at Savar has acquired the basic knowledge and capability to provide reliable analytical services with environmental, geological, agricultural and forensic samples. Research work in these areas has also been undertaken.

BGD/4/006 REACTOR UTILIZATION (ISOTOPE PRODUCTION)

COMPLETED: **91-12-10** TOTAL COST: **$918,055**

TO PLAN AND DESIGN A LABORATORY FOR SHORT AND MEDIUM HALF-LIFE RADIOISOTOPE PRODUCTION USING A RESEARCH REACTOR (TRIGA MARK II) FOR MEDICINE, AGRICULTURE, INDUSTRY AND RESEARCH.

The Institute of Nuclear Science and Technology of the Bangladesh Atomic Energy Commission (BAEC) requested Agency assistance to establish a laboratory for radioisotope production using a Triga Mark II research reactor which became operational in 1986. The intention was to meet Bangladesh's requirements for short and medium half-life radioisotopes used in nuclear medicine, mainly iodine-131 and technetium-99m and iodine-131 labelled Hippuran. Under this project, initiated in 1982, the Agency has been

supporting the BAEC by providing iodine-131 and technetium-99m production facilities and a hot cell installation for low level iodine labelling. Auxiliary equipment was also provided, including a freeze drying unit, beta-gamma contamination monitors, chromatographic equipment and desktop computers. Ten Agency experts carried out ten missions and gave advice on designing the radioisotope production laboratory, a ventilation and filtration system for the laboratory, and hot cell facilities. The experts gave practical training to counterpart staff on production of instant technetium-99m by the methyl ethyl ketone extraction method, on processing irradiated materials for production of iodine-131, and on preparation and quality control of radiopharmaceuticals. Ten project-related fellowships and a project-related scientific visit were awarded to counterpart staff. As a result of this project, a functional, well equipped laboratory with trained personnel, capable of producing radioisotopes and labelled compounds, has been established. A complementary project, BGD/4/014, was approved for 1991-92 to establish a technetium generator production line.

BGD/6/007 NUCLEAR MEDICINE

COMPLETED: **91-12-31** TOTAL COST: **$328,914**

(1) TO UPGRADE THE CAPABILITY OF THE INSTITUTE OF NUCLEAR MEDICINE AT DHAKA AND THE NUCLEAR MEDICINE CENTRES AT CHITTAGONG, DINAJPUR, RAJSHAHJ AND SYLHET FOR IN-VIVO CLINICAL DIAGNOSIS AND RESEARCH. (2) TO IMPROVE QUALITY CONTROL PROCEDURES IN RADIOIMMUNOASSAY AND IN REAGENT PRODUCTION.

The Bangladesh Atomic Energy Commission (BAEC), in co-operation with the Health Directorate, has been assisting in the establishment of nuclear medicine centres at major hospitals throughout the country. The BAEC sought Agency assistance to upgrade these centres and to include a wider range of diagnostic services. Under this project, approved in 1983, three experts as well as technical staff of the Agency undertook three missions to provide training on quality control of nuclear medicine instruments and on the use of the gamma camera. They also reviewed the planning and progress of the project. Basic equipment, including a gamma camera and computer, a rectilinear scanner and standard equipment for a radioimmunoassay laboratory, were provided, which helped to improve the quality, quantity and range of nuclear medical investigations performed at four nuclear medicine centres. Under the project, two fellowships were awarded for training abroad, one of which was funded by India. Four project-related fellowships were granted for practical training abroad, one of which was funded by the USA. These inputs helped create an ongoing one-year National Training Course in nuclear medicine for physicians, leading to a university diploma in nuclear medicine. This will help substantially in producing the well trained manpower required to run the nuclear medicine centres in Bangladesh. The activities initiated under this project are being continued under Project BGD/6/009, with the immediate objectives of upgrading and modernizing three further medical centres.

BGD/8/006 DEVELOPMENT OF NON-DESTRUCTIVE TESTING

COMPLETED: **91-12-31** TOTAL COST: **$160,475**

TO DEVELOP NON-DESTRUCTIVE TESTING FACILITIES AND IMPART TRAINING IN ORDER TO PROVIDE EFFICIENT SERVICES TO LOCAL INDUSTRIES.

This project was approved in 1986 to develop non-destructive testing (NDT) facilities at the Atomic Energy Centre of the Bangladesh Atomic Energy Commission (BAEC) and to train NDT personnel. The Agency was requested to provide equipment, expert services and training. Two experts undertook three missions to assist in setting up an NDT laboratory, to train personnel in various NDT techniques, and to assist the counterpart in preparing standard training programmes. A national training course on Radiographic Testing, Level 2, was also organized by the Agency. Equipment provided included an eddy current defectoscope and digital ultrasonic thickness gauge, an ultrasonic flow detector with accessories, a gamma radiographic camera with gamma ray projectors, magnetic particle testing equipment and a film processor. The counterpart was awarded a scientific visit to NDT institutions in the USA and the UK. Training of personnel was carried out mainly through the UNDP/IAEA/RCA projects RAS/79/061 and RAS/86/073, implemented by the Agency. As a result of the project, the counterpart institute now provides the local industrial sector with efficient, qualitative and low cost NDT services as well as quality control of the industrial products. To meet the growing needs for NDT services, BAEC asked the Agency for additional support, which has been approved as a footnote-a project, BGD/8/010.

BRAZIL

BRA/4/038 SILICON DOPING BY NEUTRON TRANSMUTATION

COMPLETED: **91-09-12** TOTAL COST: **$69,990**

TO ESTABLISH A WORKING LABORATORY FOR ROUTINE PRODUCTION, STORAGE, QUALITY CONTROL AND DELIVERY OF N-TYPE DOPED SILICON CRYSTALS FOR THE ELECTRONIC INDUSTRY.

Under this project, a facility was established at the Institute for Nuclear Energy and Research (IPEN), São Paulo, to provide an irradiation service utilizing the IEA-R1 reactor for neutron transmutation doping of silicon crystals, with an initial capacity of 500-600 kg/year. The foundation was laid for IPEN to establish regular production at the industrial level with improved capacity and efficiency, obtaining a regular supply of F-Z silicon from local sources. The Agency provided expert services to design and set up the facility as well as several items of equipment including a self-powered neutron detector. Experts advised on quality assurance and quality control, flux equalization, strategies, and monitoring and control of residual radioactivity. One staff member was awarded a fellowship to study methods of producing silicon by neutron transmutation doping.

BRA/8/020 RADIATION IMMOBILIZATION OF BIOLOGICALLY ACTIVE MATERIALS

COMPLETED: **91-12-02** TOTAL COST: **$54,224**

TO IMPROVE THE DEVELOPMENT OF IMMOBILIZATION OF BIOMATERIALS BY RADIATION- INDUCED PROCESSES; TO CARRY OUT FURTHER APPLICATIONS OF RADIATION AND TO INITIATE RADIOSENSITIVITY.

The project strengthened the capability of the Institute for Nuclear Energy and Research, University of São Paulo, to utilize radiation-induced processes for immobilizing biomaterials. The Agency supplied an expert who, in addition to giving advice to the counterpart, delivered a series of lectures to 40 participants including professors. An infrared spectrophotometer and a viscometer were also supplied. Basic trials were started for refining the fundamental techniques and determining the preferable conditions, particularly in enzyme immobilization. The basis was established to extend the immobilization of enzymes by the physical entrapping method, using polymerization, to some other medical enzymes such as glucose oxidase and cholesterol oxidase.

BRA/9/017 SAFETY ANALYSIS: ANGRA UNITS 2 AND 3

COMPLETED: **91-02-13** TOTAL COST: **$131,241**

TO IMPROVE EXPERIENCE AND CAPABILITY OF CNEN STAFF IN SAFETY ANALYSIS REVIEW AND INSPECTION.

In 1982, the National Nuclear Energy Commission (CNEN), requested Agency assistance to improve safety aspects in connection with the Angra nuclear power plants. The project provided experts to advise and train the counterpart staff in various aspects of systems analysis and the related safety and risk analyses, and in undertaking reviews and inspections. In particular, experts gave advice on cooling water, auxiliary ventilation and protection systems, on fuel management, on effluent treatment, and on norms and licensing. In addition, advanced training on thermohydraulics was provided on site, while three fellowships and seven scientific visits to specialized institutions in the United States of America, the Federal Republic of Germany and Spain were financed for members of the counterpart staff. A special mission was funded to develop a reliability database for nuclear power plants. The CNEN staff are now better able to carry out their responsibilities in safety analysis assessment and licensing in respect of nuclear power plants and fuel cycle facilities.

BRA/9/028 RADIOACTIVE EFFLUENT MONITORING

COMPLETED: **91-06-25** TOTAL COST: **$94,582**

TO EVALUATE RADIOLOGICAL IMPACT ON THE ENVIRONMENT DUE TO LIQUID AND GASEOUS RELEASE FROM NUCLEAR INSTALLATIONS.

The Institute for Nuclear Energy and Research (IPEN), Sao Paulo, Brazil's largest nuclear research institute and part of the Nuclear Energy Commission, operates several nuclear facilities including a research reactor, laboratories for the production of labelled compounds, a decontamination unit, and uranium fuel

cycle facilities. The project provided IPEN with the training and equipment required to evaluate radiological consequences in the environment as a result of its activities. Improved analytical techniques were established, particularly for determination of uranium, thorium and iodine-131 in environmental samples and liquid effluents. Widely diverse types of samples were collected and a number of possible contaminants determined using alpha, beta and gamma ray measurements after chemical processing and separation. Statistical evaluation of the results obtained has been performed and the basis established for collecting additional samples and determining other contaminants affecting the environment.

BRA/9/032 OCCUPATIONAL RADIATION PROTECTION

COMPLETED: **91-11-28** TOTAL COST: **$101,320**

TO UPGRADE DOSIMETRY FACILITIES FOR ASSESSING THE EFFECTIVE DOSE EQUIVALENT OF WORKERS OCCUPATIONALLY EXPOSED TO RADIATION.

The project contributed to upgrading the dosimetry facilities at the Institute of Radiation Protection and Dosimetry, Rio de Janeiro, for assessing the effective dose equivalent of workers exposed to radiation. A computer programme was designed for quality control of the dosimetric systems, which led to better services and to the development of statistical studies on occupational exposure. Experts gave advice on the establishment of the quality control programme, on personnel dosimetry in general, and on how to improve the utilization of the facilities and upgrade some of the systems available, including automation of the film dosimetry service. The ground was prepared for eventual introduction of ICRU quantities. Equipment supplied under the project included a thermoluminescence system, a film processing machine, a densitometer and a computer system. Three counterparts were awarded fellowships on film dosimetry, external radiation monitoring and instrumentation.

BRA/9/033 LICENSING AND SURVEILLANCE OF NUCLEAR FACILITIES

COMPLETED: **91-12-31** TOTAL COST: **$34,841**

TO PROVIDE TECHNICAL SUPPORT FOR TRAINING AND DEVELOPMENT OF PROFESSIONAL CAPABILITY AT THE BRAZILIAN REGULATORY AGENCY AS RELATED TO CONTROL, SURVEILLANCE, ACCIDENT PREVENTION AND LICENSING PROCEDURES FOR NUCLEAR INSTALLATIONS.

The project was approved in 1988 and resulted in improvement of the capability of the National Nuclear Energy Commission (CNEN) to control, carry out surveillance, and prevent accidents at scientific, medical and industrial facilities using radionuclides. All aspects of existing regulations were improved for all the facilities concerned. Experts advised on upgrading and application of the overall legislation currently available and on specific problems of medical and industrial facilities. A scientific visit was awarded to the main counterpart to visit regulatory institutions in Canada and the Federal Republic of Germany in order to study their regulations and procedures.

BULGARIA

BUL/4/002 RESEARCH REACTOR MODERNIZATION

COMPLETED: **91-01-08** TOTAL COST: **$1,298,773**

TO ASSIST IN MODERNIZING THE ONLY BULGARIAN RESEARCH REACTOR IN ORDER TO UPGRADE ITS USE IN THE PHYSICAL SCIENCES AND IN THE PRODUCTION OF RADIOISOTOPES; TO IMPROVE SAFETY.

This project, started in 1982, despite some initial delays owing to extended negotiations with the supplier, has been instrumental in modernizing the Bulgarian research reactor at the Institute for Nuclear Research and Nuclear Energy, Sofia. The major items supplied included a reactor auxiliary system and the fuel for a complete new reactor core. Safety related systems were also provided. Agency experts reviewed the Safety Analysis Report and advised the Government on the requirements for a new operating licence. Two fellowships were also awarded. The upgrading has been completed and reactor operation could be resumed on the issuance of the new operating licence.

BUL/8/008 STERILIZATION OF MEDICAL SUPPLIES

COMPLETED: **91-07-26** TOTAL COST: **$582,405**

TO SET UP AN IRRADIATION FACILITY FOR STERILIZING MEDICAL AND COSMETIC SUPPLIES.

In 1984, Pharmachim, a Bulgarian commercial industrial association that produces medical supplies and cosmetic products, sought Agency assistance for the supply and installation of a cobalt-60 irradiation facility, since restrictions on the use of ethylene oxide as sterilizing agent had made it necessary to change existing practices. A complete semi-industrial gamma irradiator fabricated in Canada was ordered, installed and successfully commissioned in 1990. Despite a delay of over a year in the transport of the cobalt-60, the facility was put into operation in good time. Several Agency experts advised Pharmachim on radiation engineering and radiation sterilization as applied in the pharmaceutical industry, and a seminar on operation of the facility was held. Three project-funded or project-related fellowships and four scientific visits were awarded to counterpart personnel, and these have contributed significantly to the good standard of irradiation practice. The Pharmachim sterilization facility is now fully operational and has improved the quality of its products.

BUL/8/011 IRRADIATION FACILITY

COMPLETED: **91-01-17** TOTAL COST: **$151,592**

TO UPGRADE THE EXISTING IRRADIATION FACILITY WITH A VIEW TO DEVELOPING PRACTICAL APPLICATIONS IN INDUSTRY, MEDICINE AND AGRICULTURE.

During the early 1980s, Bulgaria embarked on a programme to increase its use

of radiation technology in industry and medicine. This was one of the projects initiated by the Government at the Institute for Nuclear Research and Nuclear Energy, Sofia. The Institute had been operating a cobalt-60 irradiation facility since 1975 and the Agency supplied a new cobalt-60 source, funded through an extrabudgetary contribution by the USSR. Bulgaria has thus been able to modernize one of its irradiation facilities, making possible a variety of practical applications in industry, medicine and agriculture, such as sterilization of medical products and drugs, as well as irradiation of food and other experimental materials. The Institute expects to receive a complementary second cobalt-60 source through bilateral agreements with the USSR and in connection with this project. This will enable Bulgaria to strengthen its capabilities for research and development on new radiation technologies, and to embark on a national programme for design and commissioning of industrial gamma-irradiators.

BUL/9/010 PRE-OSART AND OSART MISSIONS

COMPLETED: **91-01-09** TOTAL COST: **$21,843**

TO UNDERTAKE A PRE-OSART MISSION TO BELENE AND AN OSART MISSION TO KOZLODUY NUCLEAR POWER PLANTS.

This Reserve Fund project was approved in 1990 to review the operational safety of Kozloduy nuclear power plant unit 5 (1000 MW(e) WWER type), and the construction standards of Belene nuclear power plant (under construction). The first mission under this project, comprising three Agency experts, was a preliminary visit to Kozloduy to assist in the preparations for the Operational Safety Review Team (OSART) mission scheduled for late 1990. It was decided that, as a first step to a full-scope OSART mission, six Agency experts would visit the Kozloduy nuclear power plant in October 1990 to carry out a limited-scope OSART mission. It reviewed the conduct of operations, maintenance and technical support at unit 5. The recommendations will be submitted shortly for consideration by the Bulgarian authorities. The full-scope OSART to Kozloduy is scheduled for July 1991 under a separate project. A pre-OSART review of the Belene construction site was also performed by seven Agency experts in July 1990. They reviewed mainly project management, quality assurance, civil engineering, mechanical equipment, preparations for startup and operation, and training and qualification of personnel. The results of the experts' review and their recommendations have been presented in a report to the Bulgarian authorities.

BYELORUSSIAN SOVIET SOCIALIST REPUBLIC

BYE/9/002 RADIATION PROTECTION

COMPLETED: **91-07-29** TOTAL COST: **$51,799**

TO ADVISE ON LONG TERM MEASURES IN RADIATION MONITORING AND PROTECTION FOR MITIGATION OF RADIOLOGICAL EFFECTS OF THE CHERNOBYL ACCIDENT.

This Reserve Fund project was initiated at the request of the Byelorussian SSR Government in 1990. The assistance mainly consisted of radiation monitoring equipment. One advisory mission and a fellowship training at Seibersdorf were

also arranged. This emergency technical assistance provided the BSSR with modern equipment for radiation protection and monitoring, and paved the way for the initiation of a long term programme in the country for mitigating the effects of the Chernobyl accident.

CHILE

CHI/1/014 NEUTRON ACTIVATION ANALYSIS

COMPLETED: **91-12-10** TOTAL COST: **$89,655**

TO PROMOTE MORE EFFICIENT UTILIZATION OF AN EXISTING RESEARCH REACTOR BY UPGRADING FACILITIES FOR NUCLEAR ACTIVATION ANALYSIS, THUS PERMITTING MULTI-ELEMENT DETERMINATION OF TRACE LEVELS.

This project was approved in 1987 to assist the La Reina Research Centre to meet the steady increase in demand for analytical services. The Agency was requested to provide expertise and equipment to automate the analytical system. Through the interconnection of microcomputers with automatic sample changers and multichannel analysers, the laboratory has optimized resources and the personnel has gained valuable experience. The Research Centre is now able to satisfy the demand for analytical services at a national level in many disciplines. As a result of this project, the laboratory is now capable of dealing efficiently with the determination of rare earth and with multi-elemental analysis in geological samples, both of which activities are of great value to the economy of the country.

CHI/4/010 IRRADIATION AND TESTING OF REACTOR MATERIALS

COMPLETED: **91-12-10** TOTAL COST: **$58,061**

(1) TO CARRY OUT STUDIES ON RADIATION DAMAGE (2) TO INSPECT AND EVALUATE REACTOR FUEL.

This long term project was approved in 1982 with the aim of assisting the Chilean Nuclear Energy Commission (CCHEN) to carry out studies for reactor materials, in particular graphite, stainless steel and Zircaloy, including radiation effects on reactor fuels. Upon the decision of the Chilean Government in 1985 to create a plant for the production of fuel elements, the objectives of this project were extended to provide basic support for the experimental work, to fabricate miniplates and to set up qualification for the reactor fuels and other reactor materials. The fabrication line was originally designed for U3O8 material but the use of U3Si2, a more modern fuel, was later incorporated. While the infrastructure and major equipment for the fuel element plant were all provided by Chile, the IAEA's contribution in terms of training and expert assistance was essential to provide the staff with experience for the fabrication process and for the qualification of LEU fuels. This project therefore set up a step-by-step procedure for the manufacture and inspection of low enriched research reactor fuel which can be made by CCHEN staff and which can be used for both La Reina and Lo Aguirre reactors.

CHI/4/012 REACTOR MATERIALS CORROSION STUDIES

COMPLETED: **91-12-10** TOTAL COST: **$58,897**

TO ANALYSE AND STUDY CORROSION PROBLEMS AT THE LA REINA NUCLEAR REACTOR.

At the request of the Chilean Government, this project was approved in 1983 to assist the Chilean Nuclear Energy Commission (CCHEN) to analyse and study the corrosion problems which had been arising for some years in the research reactor RECH-1 at La Reina Nuclear Centre. The necessary laboratory facilities were set up under the project. The problems were identified and the analysis of maximum impurity concentrations and the electrochemical measures carried out enabled norms to be established for controlling the reactor pool water, thus preventing deterioration of metallic elements. Periodic corrosion controls are now being applied to guarantee correct operation of both the La Reina research reactor and the research reactor RECH-2 at Lo Aguirre Nuclear Centre.

CHI/4/014 NUCLEAR INSTRUMENTATION

COMPLETED: **91-12-31** TOTAL COST: **$32,032**

TO INCREASE THE CAPACITY AND EFFICIENCY OF DESIGN AND MAINTENANCE OF NUCLEAR ELECTRONICS AND MICROPROCESSOR-BASED EQUIPMENT.

This project was approved in 1989 to assist the Chilean Nuclear Energy Commission (CCHEN) in linking existing nuclear electronic systems in order to increase their capacity and efficiency as well as in setting up a methodology for preventive maintenance. The objectives were fully achieved. The most valuable applications introduced under this project are, first, the automation with computers of the neutron diffractometer system for the research reactor and, second, the data acquisition system for the mass spectrometer, Micromass 602-C. The microprocessor laboratory is now equipped to undertake minor repairs of the CCHEN nuclear instruments and to connect interfaces wherever and whenever necessary for various research reactor project developments.

CHI/5/013 REPRODUCTIVE PHYSIOLOGY OF THE VICUNA

COMPLETED: **91-12-31** TOTAL COST: **$150,159**

TO STUDY THE REPRODUCTIVE PATTERNS OF THE VICUÑA THROUGH APPLICATION OF RADIOIMMUNOASSAY TECHNIQUES FOR MEASURING REPRODUCTIVE HORMONES.

At the request of the School of Veterinary Sciences of the University of Chile, a project was approved in 1985 to assist research on the reproductive physiology and endocrinology of the vicuña by radioimmunoassay (RIA) techniques. The project was part of a large scale national programme on wildlife conservation operated by the Forest National Corporation at its National Park of Lauca in the high Andes, 2400 km north of Santiago. The Agency equipped the laboratory at the University of Chile for hormone RIAs and trained the staff to

examine the breeding behaviour of the vicuña at Lauca National Park. The enthusiasm and dedication of the project counterpart overcame the initial difficulties due to the very limited resources and to the fact that a field station was located far from the laboratory. The studies conducted under this project and one related Research Contract have already produced unique and valuable data on environment, age distribution, body condition, health and reproductive physiology of the vicuña and it is expected that the research work will continue in the future.

CHI/8/015 POLLUTION DISPERSION

COMPLETED: **91-01-08** TOTAL COST: **$16,705**

TO USE RADIOACTIVE TRACERS TO MONITOR DISPERSION OF POLLUTANTS IN CANALS, RIVERS, LAKES AND THE SEA.

In 1984, at the request of the Chilean Nuclear Energy Commission, this project was approved to assist in extending the studies of dispersion of pollutants in canals and rivers, that had been under way for some two years, to include isotope tracer methodology and to broaden their scope to cover lakes and sea. Expert advice was provided, together with on-the-job training. Two project-related fellowships were awarded, one funded by Italy, one by Spain. An adequate programme for the use of artificial radioactive tracers was established and its application has proven to be particularly important for investigating pollution in the sea. Guidance was given on the course of future activities. The development of dispersion models will lead to the establishment of pollution control regulations.

CHI/8/016 SEEPAGE IN LAKES AND RESERVOIRS

COMPLETED: **91-12-31** TOTAL COST: **$140,081**

TO IDENTIFY, BY TRACER TECHNIQUES, SITES OF GREATEST SEEPAGE IN THE RESERVOIR; TO DETERMINE THE MAIN COURSES OF SEEPAGE FLOW AND SEEPAGE PATTERNS AND TO ESTABLISH A METHODOLOGY WHICH COULD BE APPLIED TO OTHER HYDROLOGICAL PROBLEMS.

This project was approved in 1987 to assist Chile in studying seepage flow and patterns by means of tracer techniques in order to improve water utilization and conservation. The lake Laja, 450 km south of Santiago, was chosen by the National Electricity Holding Company (ENDESA) as the main site for the research since it is the only water resource in central Chile that can be used for both irrigation and electricity generation. Natural and artificial tracers were used. The results of the experiments demonstrated that a preferential seepage pathway exists which most probably coincides with the earlier river bed. More precise identification of the pathway showed that repair work to reduce seepage would be technically and economically feasible. The technology transfer was fully assimilated by the project staff and the methodology is now being applied to the study of two potential hydroelectrical dams. Further applications of isotopic techniques to study hydrogeological problems related to other dams in Chile are also under consideration.

CHI/9/010 WASTE MANAGEMENT

COMPLETED: **91-01-08** TOTAL COST: **$66,527**

TO SET UP A PROGRAMME FOR STORAGE AND DISPOSAL OF RADIOACTIVE WASTE.

As a result of the increase in applications of radioisotopes, the Chilean Nuclear Energy Commission decided to formulate and establish a programme to handle the resulting low and intermediate level wastes. Expert advice and training were provided to initiate a waste management programme and to treat and condition such wastes, with emphasis on solidification processes. Equipment including a Ge(Li) detector system and a waste treatment unit was provided. In addition to two fellowships (one funded by the USA), an Agency Research Contract was awarded. While the assistance given at the time was adequate to meet needs and suited the existing infrastructure, a more complete approach to handling the waste has been initiated by the Commission. The experience gained under this project and recommendations made by the Waste Management Advisory Programme. (WAMAP) mission undertaken in 1989 are being taken into account in a new long term, comprehensive programme which will include setting up a new facility and drafting the necessary regulations. These activities are being implemented with Agency assistance under Project CHI/9/016, which was approved in 1989.

CHI/9/012 MARINE ENVIRONMENT PROTECTION

COMPLETED: **91-01-08** TOTAL COST: **$4,706**

TO PREPARE REGULATIONS SPECIFYING THE CONDITIONS UNDER WHICH NUCLEAR VESSELS MAY ENTER CHILEAN PORTS AND WATERS; TO FORMULATE A RADIOLOGICAL MONITORING PROGRAMME SO AS TO ENSURE COMPLIANCE WITH THESE REGULATIONS.

Agency support was sought by the Chilean Nuclear Energy Commission and the Directorate General of the Chilean Maritime Territory to assist in drafting regulations to govern passage through Chilean waters and visits to Chilean ports of nuclear-powered vessels. An expert advised on various aspects of such regulations, including control of discharges and related monitoring activities. Draft regulations conforming to international agreements have been proposed for approval, and the establishment of a laboratory for radiological control is under consideration.

COLOMBIA

COL/1/006 NEUTRON ACTIVATION ANALYSIS (PHASE II)

COMPLETED: **91-12-31** TOTAL COST: **$51,252**

TO INCREASE THE OUTPUT CAPABILITY OF NEUTRON ACTIVATION ANALYSIS SERVICES, INCORPORATING AN AUTOMATIC SAMPLE CHANGER INTO THE EXISTING INFRASTRUCTURE.

This project was approved for 1990 as a follow-up to Project COL/3/008, for assistance to the Institute of Nuclear Affairs (IAN), Bogota. The Agency supplied

the requested equipment, including an automatic sample changer and a computer system. Two fellowships were awarded for training in neutron activation analysis, and expert services were provided for prospection of minerals and data analysis. Equipment, expert services and training contributed significantly to strengthening IAN's analytical capability in neutron activation analysis. Various samples of ores containing gold, silver and rare earth, as well as pasture and foodstuffs, are being routinely analysed. Further progress can be expected through the Agency-assisted modernization of IAN's research reactor.

COL/3/008 NEUTRON ACTIVATION ANALYSIS

COMPLETED: **91-12-10** TOTAL COST: **$22,649**

TO SUPPORT NON-DESTRUCTIVE METHODS IN MINERAL ANALYSIS.

This project was approved in 1986 to support non-destructive methods in mineral analysis at the Chemistry Section of the Institute for Nuclear Affairs (IAN), Bogota. Equipment provided included a gamma spectrometry system consisting of a hyperpure germanium detector and multichannel analyser. The Agency's Technical Officer undertook an initial planning visit to IAN, while additional expert assistance was provided under a follow-up project, COL/1/006, approved in 1989, to which fellowship training of the counterpart was eventually transferred. The project has contributed towards improving mineral prospection programmes (radioactive minerals, gold and silver) and was also instrumental in allowing staff to carry out analyses of mercury and zinc in human hair and fingernails.

COL/4/007 NUCLEAR INSTRUMENTATION

COMPLETED: **91-09-12** TOTAL COST: **$112,656**

TO ESTABLISH A CENTRAL ELECTRONICS LABORATORY AT THE INSTITUTE FOR NUCLEAR AFFAIRS FOR THE MAINTENANCE, REPAIR AND DEVELOPMENT OF NUCLEAR INSTRUMENTS.

This project was initiated in 1986. An Agency expert visited the project twice to assist in establishing the electronic laboratory, in planning activities and in training project staff. The expert also gave advice to University Hospitals in various parts of the country, thus providing the basis for maintenance and repair of nuclear medical instrumentation, including gamma cameras. A multichannel analyser, an Si(Li) detector, a logic analyser, a computer system and other electrical and electronic items were supplied. The project also received regional assistance under the ARCAL programme. In addition to training provided by the Agency expert, two fellowships and two scientific visits were awarded. As a result of this project, Colombia now possesses a very active electronics laboratory for the maintenance and repair of nuclear instrumentation and is also developing some instrumentation prototypes. The laboratory is now servicing all other departments of the Institute of Nuclear Affairs as well as a number of medical centres, in particular for the repair and maintenance of gamma cameras. Six regional training courses under the ARCAL programme were organized by the staff of the laboratory, and the chief counterpart has provided expertise to several outside training courses. Facilities set up through this project are being complemented by the

establishment of an electronics calibration and testing laboratory (Project COL/4/010).

COL/5/008 RADIATION-INDUCED MUTATION BREEDING

COMPLETED: **91-12-10** TOTAL COST: **$126,650**

(1) TO OBTAIN RICE VARIETIES RESISTANT TO ALUMINIUM AND MANGANESE TOXICITY AND TOLERANT OF SALINITY. (2) TO DEVELOP WHEAT AND BARLEY VARIETIES RESISTANT TO AND TOLERANT OF DISEASES, PESTS, DROUGHT AND ADVERSE SOIL CONDITIONS.

This project was approved for 1986 and received additional funding in 1987 and 1988. Its purpose was to assist the Plant Breeding Sections of the Institute of Nuclear Affairs (IAN), Bogota, and of the Colombian Agricultural and Livestock Breeding Institute (ICA), Villavicencio, in upgrading the level of mutation breeding in Colombia and in obtaining desirable mutants of rice, wheat and barley resistant to adverse environment. A Mutation Techniques Laboratory, including an in-vitro culture facility, was established at IAN. An intensive fellowship programme, including long term fellowships, was established at IAN on the use of radiation-induced mutations. Mutation breeding techniques were also introduced at ICA, Villavicencio. In view of the importance of rice to Colombia's economy, this crop was the first to be chosen for the mutation programme. Resistance to adverse environmental stresses such as aluminium or manganese soil toxicity and to diseases, as well as semidwarfness and earliness, were the characters desired for the rice breeding programme. With the help of five Agency experts, mutation breeding experiments were established and numerous desired mutants are already under agronomic evaluation. Training in mutation breeding was provided through four fellowships and one scientific visit; some items of agricultural and laboratory equipment were also supplied. The results obtained under this project are being further developed, and extended to other types of cereals such as sorghum, under the follow-up project COL/5/013. This project is emphasizing co-operation between IAN, ICA and the National University of Colombia in order to increase the movement of practical application to the specialized agricultural institutions, which in turn would make available the practical results to Colombian agriculture.

COL/5/010 NUCLEAR TECHNIQUES IN SOIL-SCIENCE STUDIES

COMPLETED: **91-12-31** TOTAL COST: **$147,018**

(1) TO DESIGN FIELD EXPERIMENTS IN CONNECTION WITH SOIL FERTILITY STUDIES USING PHOSPHORUS-32 AND NITROGEN-15 IN WHICH WATER DEMAND WILL BE TAKEN AS REFERENCE PARAMETER. (2) TO TRAIN STAFF OF THE AGRICULTURAL AND LIVESTOCK BREEDING INSTITUTE'S EXPERIMENTAL STATIONS IN SOIL FERTILITY, FERTILIZER USE AND WATER MANAGEMENT.

This project, approved in 1988, was intended to assist the Institute of Nuclear Affairs (IAN) in Bogota and the Colombian Agricultural and Livestock Breeding Institute (ICA) in Villavicencio and Bogota. During the first two years of the project, fertilizer studies were carried out on the interrelationship of nitrogen and potassium absorption in the cultivation of rice, potato and wheat. In these studies, not only was nitrogen-15 used as a tracer, but rubidium-85 was used

to study potassium uptake. While the fertilizer efficiency of potassium could be successfully ascertained with the use of rubidium-85, the use of nitrogen-15 in rice cultivation showed an increased efficiency of nitrogen fertilizers if applied two months after the initial sowing. Some of the analytical results obtained in IAN's laboratories were later corrected by comparative analyses performed at the home institutions of the Agency experts. At a later stage, experiments were carried out with phosphorus-32 on the role of phosphorus in soils and phosphate management practices. Studies were also carried out on soil-water-fertilizer relationship to determine the efficiency of nitrogen, phosphorus and potassium-based fertilizers. The Agency provided expert services in isotope techniques in fertilization studies and water use efficiency, as well as on sample preparation for nitrogen-15 determination. Equipment supplied included a nitrogen-15 analyser and labelled fertilizers. Training was provided under the project for three staff members, and additional training abroad was financed by other sources. The academic background of the project staff in the field of agronomy is also being improved and upgraded at the National University of Colombia. The project has improved IAN's analytical capability for the use of isotope techniques in plant nutrition studies. However, owing to changes in staff, co-operation with ICA was less intensive than originally anticipated and should be improved in the future.

COL/6/004 NATIONAL IMMUNOASSAY TRAINING PROGRAMME

COMPLETED: **91-12-10** TOTAL COST: **$54,734**

TO ASSIST UNIVERSITIES IN ESTABLISHING REGULAR COURSES AT THE UNDERGRADUATE AND GRADUATE LEVEL IN RADIOIMMUNOASSAY FOR CLINICAL DIAGNOSIS.

The project was established in 1989 to upgrade radioimmunoassay (RIA) techniques for clinical diagnosis. It was implemented by the Institute of Nuclear Affairs and two Universities, one in Cali and the other in Bogota. The Agency supplied essential equipment, including a mini-assay scaler, fraction collector, balance calibrator, ISOCOMP-I, freeze dryer and refrigerated centrifuge. The laboratories were also supplied with RIA reagents and were supported by two expert missions of one month each, one dealing with solid phase separation techniques and the other in support of a national pilot training course in RIA methods. Agency support has contributed to the creation of a network of RIA laboratories in Colombia and a significant number of persons trained in RIA performance. Implementation of this project significantly assisted in establishing a national RIA training programme and upgraded diagnostic procedures in several areas of public health concern, especially that of endocrinological disorders.

COL/8/014 DISPERSION COEFFICIENTS IN THE MAGDALENA RIVER

COMPLETED: **91-07-29** TOTAL COST: **$66,561**

TO DETERMINE TRANSIT TIME, DISPERSION COEFFICIENTS AND FLOW ALONG THE MAGDALENA RIVER IN ORDER TO DEFINE THE RIVER CHARACTERISTICS FOR PREDICTION OF POLLUTION LEVEL.

To address the problems of flooding and pollution of the Magdalena River, the Hydrology Department of the Institute of Nuclear Affairs, Bogota, requested

Agency assistance in obtaining basic hydraulic parameters of the river. Under this project, initiated in 1989, a 1095 km stretch of the river (71% of the total length) extending from the confluence of the River Bogota in Girardot to its mouth, was studied using artificial tracers (tritium, bromine-82 and uranine), stable isotopes of water (deuterium and oxygen-18) and chemistry of the water. Two large scale water tracing experiments, one under high and the other under low water conditions, were carried out with the assistance of two Agency experts who paid two visits each to the project. Counting and other laboratory equipment, as well as services and analyses, were provided by the Agency. A dynamic model was developed for predicting the behaviour of conservative tracers or pollutants injected into the river. Stable isotopes of water were also measured in six different sampling campaigns, from which information was obtained on the following points: (1) Origin of the water flowing along the river at different times of the year; identification of the mean elevation from which the water is coming; and the contribution of groundwater to the main flow. (2) Meteorological data on precipitation at the catchment basin; seasonal effects of cloud dynamics. (3) Water exchange between river and neighbouring swamps; investigation of water renewal at these swamps. (4) Determination of the relative contribution to the main flow of important tributaries such as the Cauca, San Jorge and Cesar rivers. The chemistry of the water provided information on the levels of pollution produced by the main polluted tributaries carrying waste water from Bogota, Tunja, Bucaramanga and Barrancabermeja. Owing to the large flow rates existing in the Magdalena River, the level of contamination is kept relatively low except in the vicinity of the discharge points. The project also contributed to increasing the Institute's capability of dealing with future hydrology projects (such as COL/8/017 and COL/8/018) through fellowships awarded to four of the Institute's collaborators.

COL/9/002 RADIATION PROTECTION

COMPLETED: **91-12-10** TOTAL COST: **$88,554**

TO ESTABLISH RADIATION PROTECTION METHODS FOR APPLICATION TO THE GENERAL PUBLIC AND THE ENVIRONMENT, INCLUDING MEASUREMENTS OF RADIOACTIVITY, SELECTION OF CRITICAL GROUPS AND ASSESSMENT OF INTERNAL AND EXTERNAL COLLECTIVE DOSES.

This project for assistance to the Radiation Protection Services of the Institute of Nuclear Affairs (IAN), Bogota, was approved for 1988-89 and was financed by extrabudgetary contributions from the United Kingdom, supplemented with some regular TC funds. Expert services were provided for environmental radioactivity measurements and quality control in spectrometry. Equipment included a semiconductor detector system, calibration sources and a computer system. Two fellowships were awarded for radiation protection in nuclear medicine centres. The project contributed successfully to setting up an in-vitro bioanalysis programme with appropriate calibration standards and a spectrometry system. The programme is being applied at various centres of nuclear medicine. The project also assisted in establishing calibration standards for air samples and a radiological control programme. IAN will continue to develop the bioanalysis programme for control of internal contamination in co-operation with the centres of nuclear medicine in Bogota, the National University and the Cancer Institute, with a view to extending it later to the rest of the country.

COSTA RICA

COS/1/006 CRYOGENIC SERVICE

COMPLETED: **91-10-15** TOTAL COST: **$107,051**

TO SUPPLEMENT ASSISTANCE PREVIOUSLY PROVIDED IN THE FIELD OF NUCLEAR TECHNIQUES.

A USSR-made nitrogen liquifier was delivered and installed with the assistance of an Agency expert. It is operating with a somewhat reduced output due to high environmental temperatures. An additional special cooling device had to be designed and installed to allow correct operation. The liquid nitrogen produced by this machine is utilized for cooling semiconductor detectors used in projects related to neutron activation analysis and X-ray fluorescence analysis.

COS/5/009 MUTATION BREEDING OF LEGUMES

COMPLETED: **91-12-10** TOTAL COST: **$56,172**

TO OBTAIN FUNGUS-RESISTANT CROP VARIETIES.

This project was approved under the TC Reserve Fund for 1986 and the regular TC programme in 1988 for assistance to the School of Agricultural Sciences at the National University, Heredia. Experts gave advice on project planning and monitoring as well as on induced mutation experiments in in-vitro cultures. Two fellowships and a scientific visit for project staff completed training of counterparts in mutation breeding. The provision of some laboratory equipment enabled staff to monitor field experiments closely and to carry out advanced research. This project introduced mutation breeding techniques for in-vivo and in-vitro studies. Disease-resistant common bean varieties, as well as a variety of cowpea, have been identified and are being further evaluated. Research with a view to practical application through agricultural extension is being continued under the follow-up project COS/5/011, approved for 1991-92, which is adding yam and banana to the crops for which genetically resistant varieties are being sought.

COS/8/002 ISOTOPES IN HYDROLOGY

COMPLETED: **91-02-11** TOTAL COST: **$153,201**

TO ASSESS THE GEOTHERMAL ENERGY POTENTIAL OF COSTA RICA.

This project was approved in 1982 in order to support isotopic and geochemical exploration of the Miravalles geothermal areas of Costa Rica, and to establish a laboratory to carry out geochemical analysis of samples from various geothermal sites at the Instituto Costarricense de Electricidad (ICE). Nine expert missions were arranged in 1990, and equipment, including a spectrophotometer and a chromatographic system, was provided by the Agency. The Miravalles exploration was completed and the origin of recharge identified. The laboratory was set up at the Miravalles camp, appropriate training was provided to several counterparts, and analyses are being

routinely carried out with good results. These achievements have persuaded ICE to continue applying isotopes in geothermal studies, and a new project, COS/8/004, on isotope tracing in geothermics, is to be initiated in 1991 to continue the work already started and to extend activities to other geothermal fields in Costa Rica. If exploitation of these fields proves feasible, geothermal resources could contribute towards meeting the country's growing energy demands.

CHINA

CPR/0/004 WORKSHOP ON THE MANAGEMENT AND EVALUATION OF TC PROJECTS

COMPLETED: **91-12-02** TOTAL COST: **$12,332**

TO DISCUSS MANAGEMENT AND EVALUATION OF TECHNICAL CO-OPERATION PROJECTS.

Under this project, financed from the Reserve Fund, five Agency staff members successfully conducted a National Workshop on the management and evaluation of TC projects in China. The workshop was held from 17 to 26 January 1991 at Taian, Sandong Province, and was attended by 30 participants from 19 Chinese institutes. The workshop discussed the Agency procedures and techniques in the management and evaluation of projects and how they are implemented in China. The lessons learnt from the workshop are expected to contribute to an improvement in the quality of project requests and their implementation in the counterpart institutes in China.

CPR/4/005 NUCLEAR FUEL AND MATERIALS STUDIES

COMPLETED: **91-12-17** TOTAL COST: **$64,266**

TO STUDY THE PROPERTIES AND PERFORMANCE OF URANIUM DIOXIDE FUEL AND THE CORRELATION BETWEEN MICROSTRUCTURE AND CORROSION BEHAVIOUR IN ZIRCALOY.

In support of the nuclear power programme in China, the Nuclear Material Institute of the Southwest Centre for Nuclear Reactor Engineering and Design, Chengdu, has been engaged in R&D on nuclear fuels and reactor materials for several years. In this connection, it was intended to carry out investigations on the performance of uranium dioxide fuel and the behaviour of Zircaloy. Under this project, initiated in 1988, five Agency experts advised the counterpart on high performance fuel and materials, Zircaloy water side corrosion and fine ceramics. Equipment supplied included a rapid surface area analyser and a double-jet electropolisher. One counterpart was also trained abroad on a long term fellowship. Under this project, considerable progress has been made on the development of high performance uranium dioxide fuel and on the behaviour of Zircaloy, resulting in the publication of four scientific papers.

CPR/5/002 FOOD IRRADIATION

COMPLETED: **91-12-02** TOTAL COST: **$171,529**

TO ESTABLISH A CO-60 GAMMA IRRADIATION FACILITY WITH ASSOCIATED LABORATORY FOR FOOD PRESERVATION ON A PILOT PLANT SCALE.

The Shanghai Irradiation Centre, under the Shanghai Institute of Nuclear Research, has established a 200 kCi cobalt-60 gamma irradiation facility for preservation of food by irradiation on a semi-commercial scale. Under this project, which was initiated in 1987, a national seminar and a training course on food irradiation were organized during 1988. An Agency expert assisted in an economic feasibility study on commercial processing of food at the Shanghai Irradiation Centre, and provided research guidance on the use of irradiation as a quarantine treatment for fruits at the Laboratory of Insect Toxicology of the South China Agricultural University, Guangzhou. Equipment provided included a thermoluminescence dosimeter, a high speed refrigerated centrifuge, a spectrophotometer and a computer system. Two counterpart staff were trained abroad on long term fellowships and two were awarded scientific visits. As a result of the project, semi-commercial irradiation preservation of food has been implemented by the Shanghai Irradiation Centre, and scientists at the South China Agricultural University are now capable of conducting research on irradiation as a quarantine treatment for local fruits, especially lichee. Several research scientists have also become knowledgeable about research on various aspects of food irradiation.

CPR/5/003 MUTATION PLANT BREEDING

COMPLETED: **91-12-31** TOTAL COST: **$35,639**

TO OBTAIN SUPERIOR VARIETIES OF CROP PLANTS BY MUTATION BREEDING TECHNIQUES.

The Institute for the Application of Atomic Energy of the Chinese Academy of Agricultural Sciences, Beijing, has been applying mutation breeding techniques to such crops as wheat, sorghum, maize, barley and soybean since the early 1960s with a view to increasing yield, resistance to disease and tolerance to environmental stress, as well as to improving quality. While success had been achieved in developing superior cultivars, the Institute recognized the need for fresh ideas, improved techniques and assistance from outside experts. Under this project, approved in 1987, three Agency experts advised on mutation breeding in general, mutation genetics and mutation breeding for resistance to disease. Two counterparts were trained abroad on long term fellowships, one under the project and the other under the Agency's regional manpower development programme. The Institute now has the capability of introducing superior mutant varieties of crop plants and improved methods of mutation induction with consequent benefit to the national economy.

CPR/8/003 GAMMA RADIOGRAPHY

COMPLETED: **91-12-31** TOTAL COST: **$174,476**

TO STRENGTHEN THE CAPABILITY FOR GAMMA RADIOGRAPHIC NON-DESTRUCTIVE TESTING.

A Centre for Non-Destructive Testing (NDT) with facilities for gamma radiography has been established at the Shanghai Nuclear Engineering Research and Design Institute, which performs tests on components for China's nuclear power plants in accordance with the manufacturer's inspection requirements. With a view to strengthening its capability, the Government requested the Agency to provide some equipment and expert services. Under this project, supported by extrabudgetary funds from the Federal Republic of Germany, the Agency provided some basic equipment including gamma ray projectors with all accessories. Two experts undertook three missions to commission the equipment as well as to train counterpart staff on its use and maintenance and on industrial radiography in general. One long term fellowship was awarded for training abroad and three scientific visits were granted under the Agency's manpower development programme. The Centre is now providing the anticipated NDT services to the Qinshan Nuclear Power Plant.

CPR/8/004 TRACER STUDIES FOR MONITORING POTENTIAL ZONES IN OIL FIELDS

COMPLETED: **91-12-31** TOTAL COST: **$70,155**

(1) TO CHARACTERIZE THE LAYER IN TERMS OF PERMEABILITY OF THE TANGJIAHE RESERVOIR OF THE DAGANG OILFIELD USING A RADIOTRACER TECHNIQUE. (2) TO ADJUST DEVELOPMENT PLANS IN ORDER TO IMPROVE RECOVERY EFFICIENCY OF THE RESERVOIR AND INCREASE PRODUCTION.

To overcome the difficulties caused by flooding at the Dadang Oilfield since 1974, with consequent reduced production, the oilfield authorities, under the Ministry of Petroleum Industry, have been developing a tracer method using a plastic microsphere, with iodine-131 as tracer, for determining the "water intake profile" of the complex and heterogeneous formation of the Tangjiahe reservoir of the Dadang Oilfield. Expert services and fellowship training were requested from the Agency to develop a radiotracer method based on interwell relationships established through tracer tests in order to improve oil recovery at the oilfield. The project was approved under the Reserve Fund in 1988 and two Agency experts advised the counterpart on isotopic tracer tests for interwell monitoring and on their applications. Seven counterpart staff were awarded scientific visits abroad to study the practical applications of the technique. As a result of the project, the counterparts have established a programme on the design and implementation of a tracer technique at an international standard. Although the results still require further interpretation and comparison with other data, it is evident that interwell tracer survey technology would offer engineering and economic benefits and increase oil recovery in the region.

CPR/9/003 TRAINING CENTRE FOR RADIATION PROTECTION

COMPLETED: **91-01-08** TOTAL COST: **$91,480**

TO ADVISE AND TRAIN LOCAL RADIATION PROTECTION STAFF ON SAFE TRANSPORT OF RADIOACTIVE MATERIALS, EMERGENCY PLANNING AND PREPAREDNESS, AND PREVENTION OF OVER-EXPOSURE TO RADIATION.

With the development of nuclear power in China, which foresees several nuclear power plants in operation by the year 2000, and the rapid increase in the application of radioisotopes and radiation in various sectors of the national economy, there was an urgent need for manpower trained in radiation protection of workers and the general public. The Bureau of Radiation Protection and Safety of the Ministry of Energy Resources therefore planned to establish a national training centre. On the basis of recommendations made by a Radiation Protection Advisory Team (RAPAT) mission in 1984, the project was originally approved in 1985 under the Agency's Reserve Fund and subsequently supported under the regular TC Programme. Under this multi-year project, the Agency sent six expert missions to advise, inter alia, on regulations for the safe transport of radioactive materials, emergency planning and preparedness, medical aspects, the training programme, environmental models, systematic safety appraisal, and limiting releases of radioactive effluents from the mining and milling process. Some audio-visual equipment and a computer system were also supplied. One staff member was given a fellowship under the Regional Manpower Development Project. The Government has now established a Training Centre for Radiation Protection and Nuclear Safety at Taiyuan, completed in 1989. It has an auditorium, a conference hall, classrooms, meeting rooms, a guest house with accommodation for 100 persons, and the necessary training facilities. The Centre has already organized 12 national training courses covering different aspects of radiation protection (481 participants) and hosted two Agency-organized regional training courses under the IAEA/RCA programme (32 participants from 12 RCA member countries). Agency experts serving under the project delivered lectures in some of the above training courses. The Centre is well equipped to organize national, regional and interregional training courses.

CPR/9/005 RADIATION PROTECTION IN MEDICINE

COMPLETED: **91-12-02** TOTAL COST: **$115,709**

TO STRENGTHEN RADIATION PROTECTION SERVICES FOR MEDICAL WORKERS AND PATIENTS.

The Institute of Radiation Medicine, Tianjin, under the Chinese Academy of Medical Sciences, is responsible for radiation protection and for monitoring workers and patients involved in medical applications of radiation and radioisotopes. Among the recommendations of an Agency Radiation Protection Advisory Team mission to China were development of the necessary regulations, technical standards and codes, optimization of radiation protection, internal dose estimation, epidemiology methods in research, methods of monitoring doses received by patients and occupational workers, radiation emergency, and early diagnosis and prognosis for overexposed individuals. The Government therefore intended to update the codes and procedures related to the protection of radiation workers and patients exposed

to radiation. Under this project, initiated in 1986, the Agency provided an expert to advise on these topics. Equipment supplied by the Agency included an elutriator rotor, a thrombolastograph and a computer system for data collection and dose calculation. Three counterpart staff were trained on long term fellowships and six were awarded scientific visits. The Institute had already conducted a nationwide survey on the frequency of medical exposure, covering 15 000 hospitals in 24 provinces and a sampling measurement of patient doses covering 200 hospitals in 14 provinces. A study on exposure to radiation and its effects on health among diagnostic X-ray workers in China was also carried out and the results were published in a scientific journal. The Institute has established standard codes and practices for medical radiation workers, developed computer software for dose estimation, and file recording for modernizing and normalizing personal dose monitoring, and holds regular courses to train medical X-ray workers and supervisors to implement quality assurance procedures for X-ray diagnosis, radiotherapy and nuclear medicine in order to optimize medical exposure procedures.

CPR/9/011 PRE-OSART MISSION TO GUANGDONG NUCLEAR POWER PLANT

COMPLETED: **91-12-31** TOTAL COST: **$45,707**

TO REVIEW THE PRE-OPERATIONAL SAFETY OF THE GUANGDONG NUCLEAR POWER PLANT UNDER CONSTRUCTION.

Under this project, financed from the Reserve Fund, an Agency Pre-Operational Safety Review Team (Pre-OSART) comprising seven external experts and four Agency experts reviewed the activities and the preparations for future plant operation at the construction site of the 900 MW(e) Guangdong Nuclear Power Plant at Daya Bay. The review was carried out from 26 November to 14 December 1990, and the team gave advice on the project management, quality assurance, civil and mechanical work, mechanical and electrical equipment and instrumentation and control equipment, on preparations for startup and plant operation and on training and qualification of personnel, as related to the quality of work and improved safety practices. Their recommendations are being considered by the appropriate authorities in China.

CPR/9/012 PRE-OSART FOLLOW-UP REVIEW OF QINSHAN NUCLEAR POWER PLANT

COMPLETED: **91-12-31** TOTAL COST: **$14,219**

TO UNDERTAKE A FOLLOW-UP REVIEW OF THE PRE-OSART MISSION CARRIED OUT IN APRIL 1989.

Under this project, financed from the Reserve Fund, a team of three Agency staff members visited the Qinshan Nuclear Power Plant construction site in the province of Zhejiang from 14 to 18 January 1991 to review the response to the recommendations and suggestions made as a result of the Pre-Operational Safety Review Team (Pe-OSART) review in April 1989. The team was impressed by the amount of work done by the Qinshan Nuclear Power Company in this connection. It was observed that out of the 108 recommendations and suggestions made during the Pre-OSART review, 78 had been completed, satisfactory progress had been made on 20, and five had been withdrawn by

the team after review. For the remaining five cases, further improvements have been suggested, which include computerization of the document control system, control of rigging and lifting equipment, and development of maintenance procedure. These recommendations are being considered by the power plant authorities.

CUBA

CUB/1/005 NUCLEAR MEASUREMENTS RESEARCH LABORATORY

COMPLETED: **91-12-02** TOTAL COST: **$147,620**

TO EXPAND THE USE OF AN EXISTING NEUTRON GENERATOR TO INCLUDE NUCLEAR DATA MEASUREMENTS.

Utilization of the neutron generator at the Advanced Institute of Sciences and Nuclear Technology, Havana, was much improved by the introduction of the associated particle method for measuring the energy dependence of differential neutron cross-sections. An associated alpha particle time-of-flight system was successfully set up for 14 MeV neutron scattering experiments, and the facility is now suitable for experimental investigations of the secondary neutrons (1 MeV) emitted from the neutron-induced reactions. An infrastructure was created for nuclear data measurements and was utilized to measure double differential cross-sections in lead and carbon. Expert advice was provided on the development and experimental activities of the associated particle method and advanced aspects of fast neutron activation analysis. The project contributed to the provision of experts in other nuclear applications at the Institute. Equipment was supplied to improve the performance of the neutron generator, and three counterparts were awarded fellowships in Hungary and at the IAEA's Laboratories, Seibersdorf.

CUB/4/008 NUCLEAR ELECTRONICS

COMPLETED: **91-11-28** TOTAL COST: **$193,249**

TO STRENGTHEN THE LOCAL CAPABILITY FOR DEVELOPMENT AND MAINTENANCE OF NUCLEAR INSTRUMENTATION IN SUPPORT OF THE COUNTRY'S NUCLEAR PROGRAMME.

The Agency assisted in establishing a laboratory for the repair and maintenance of nuclear instrumentation at the national level. All necessary equipment and spare parts were supplied and experts advised on the organization of the laboratory, servicing and maintenance of the equipment, and related subjects. Three fellowships were granted, and attendance at several training events were financed under the IAEA Regional Programme. The facility is now providing services to all the institutions in Cuba that utilize nuclear instrumentation.

CUB/5/004 FOOD IRRADIATION

COMPLETED: **91-11-28** TOTAL COST: **$948,562**

TO SET UP A SCIENTIFIC AND MATERIAL BASIS FOR INTRODUCING FOOD PRESERVATION BY IRRADIATION.

Assistance had been provided to Cuba under a UNDP-funded IAEA-implemented project (CUB/77/001) to establish a facility at the laboratory level to carry out research in the field of food irradiation. The present project was approved in 1976, with footnote-a status, in response to Cuba's request for assistance to set up an industrial facility. The Agency provided the facilities and expertise required to introduce the preservation of food by irradiation on a full scale basis. The project was later upgraded and extended under Project CUB/5/006. The Agency supplied a cobalt-60 industrial type irradiator and all necessary ancillary equipment and accessories, including equipment for radiation protection. An expert advised on programme planning. Four fellowships were awarded for training in specialized institutions abroad, and the attendance of counterparts at international meetings was financed from other sources. Significant results were obtained on potatoes and onions, and encouraging work was done on garlic, spices and cocoa beans. As a result of this and Project CUB/5/006, the facility is now operating on a semi-industrial scale to preserve by irradiation some foods such as onions, cocoa beans and garlic.

CUB/5/006 RADIATION PRESERVATION OF AGRICULTURAL PRODUCTS

COMPLETED: **91-11-28** TOTAL COST: **$102,887**

TO DEVELOP METHODS FOR INCREASING THE SHELF-LIFE OF AGRICULTURAL PRODUCTS AND TO CARRY OUT MARKETING STUDIES.

Assistance had been provided to Cuba under a UNDP-funded IAEA-implemented precursor project (CUB/77/001) to establish a facility at the laboratory level to carry out food irradiation research. The present project was approved in response to Cuba's request for further assistance, as an extension of Project CUB/5/004, initiated under footnote-a in 1976, to introduce the preservation of food by irradiation on an industrial scale. Significant results were obtained to increase the shelf-life of potatoes and onions, and encouraging work was done in garlic, spices and cocoa beans. It was found that an average minimum dose of 0.08 kGy is sufficient to inhibit germination of the tuber during refrigerated storage for six months and, under room temperature conditions, for five months. Two varieties of onion were irradiated and it was found that an average total dose of 0.08 kGy applied within the dormancy period two weeks after harvesting, inhibited germination, reduced losses and extended the preservation time for both varieties. Studies were also carried out to determine the effects of storage conditions for potatoes and onions under both refrigerated and room temperature conditions. An economic analysis was conducted to determine the most efficient use of the facility and to evaluate the marketing structure for irradiated food in Cuba. Experts advised on food preservation, grain disinfestation and process control. Two fellowships were awarded for training in specialized institutions abroad, and the attendance of counterparts at international meetings was financed from other sources. As a result of this and Project CUB/5/004, the facility is now being utilized widely for the preservation of onions, cocoa beans and garlic.

CUB/5/009 CATTLE INFERTILITY IN SUB-TROPICAL AREAS

COMPLETED: **91-07-26** TOTAL COST: **$101,298**

TO STUDY, BY MEANS OF RADIOIMMUNOSASSAY, HORMONE PROFILES OF DAIRY COWS AFFECTED BY ENVIRONMENTAL STRESS AND THEIR CORRELATION WITH THE DEATH OF EMBRYOS WITH A VIEW TO IMPROVING REPRODUCTIVE MANAGEMENT AND THE GENETIC SELECTION OF DAIRY CATTLE.

In 1959, 35 000 pure Holstein cattle were imported from Canada, and the herd now produces a significant percentage of Cuba's total milk production. Although the Holsteins have adjusted well to the sub-tropical conditions in Cuba, their reproductive performance, particularly their fertility under specific climatic conditions, is in need of improvement. The Agency was requested to provide equipment, expert services and training to enable local scientists to undertake research on the effects of climate on the fertility of Holstein-based dairy cattle in Cuba. With the use of radioimmunoassay (RIA) kits supplied by the Agency to determine progesterone, in conjunction with traditional fertility measures, numerous reproduction criteria were defined. The most useful results were: Silent ovulations and anovulatory heats occurred, respectively, in 27.4% and 11.1% of dairy cows during the dry season and in 32.7% and 13.1% during the wet season. Studies on repeat breeder cows revealed that 9.2% cycled without ovulating; 7.7% were artificially inseminated in the luteal phase; 21.6% exhibited endocrine asynchrony; 7.7% had uterine infections; and 9.2% were infertile. It was concluded that the determination of hormonal levels (by RIA) in dairy cattle contributed to a clearer understanding of their reproductive behaviour and was of practical value to the researcher, the veterinarian and the dairy farmer. The Cubans have now developed their own solid phase non-extraction RIA kit for progesterone in order to continue the work begun under this project (and related Research Contract) and for the benefit of other scientists in the region. The Agency has provided equipment for the laboratory and kits for thyroid hormones. Experts were also provided on RIA methodology, the fertility of dairy cattle, and compilation of data. Fellowships and scientific visits were awarded in Canada, Costa Rica and Mexico.

DOMINICAN REPUBLIC

DOM/0/002 NUCLEAR SCIENCE LABORATORY

COMPLETED: **91-02-13** TOTAL COST: **$336,365**

TO ESTABLISH A LABORATORY FOR THE APPLICATION OF NUCLEAR ANALYTICAL TECHNIQUES.

In 1981, the Agency participated in a workshop and seminar sponsored by the Association of University Professors of Physics of Central America and the Caribbean. The Government of the Dominican Republic, on the basis of the recommendations made at that meeting, sought Agency assistance to establish a nuclear science laboratory at the Department of Physics of the Autonomous University of Santo Domingo. The project was established in 1982. Analytical techniques for which equipment was provided include alpha, beta and gamma spectrometry, X-ray fluorescence and positron annihilation. Eight fellowships were awarded for training abroad. The Laboratory is now being used not only for teaching and research by the Department of Physics but also

by the Faculty of Humanities and Education and other Departments of the Faculty of Sciences. The gamma spectroscopy equipment is being used regularly in routine analysis of imported foodstuffs, and the X-ray fluorescence facility is rendering valuable services to mining companies and government institutions in the study of environmental problems. A new project, DOM/8/004, on nuclear techniques in environmental studies, will add to the instrumentation and expertise acquired through this project.

DOM/8/002 ISOTOPES IN HYDROLOGY

COMPLETED: **91-02-13** TOTAL COST: **$144,337**

TO APPLY ISOTOPE TECHNIQUES IN THE STUDY OF AQUIFER DYNAMICS AND SEEPAGE IN RESERVOIRS.

The project, initiated in 1986 using the Agency Reserve Fund, studied the seepage from the Chacuey and Maguaca Reservoirs, used for irrigation, and from the Sabaneta Reservoir, used for irrigation and production of electricity. In all cases the origin of the seepage was identified and various appropriate solutions were put forward. The work at the Sabaneta Reservoir, in a karst region, is being continued under Project DOM/8/003 to study the best method of solving the seepage problem there. The success of these studies drew attention to the work carried out by the National Institute of Water Resources which has since received considerable Government support in the form of increased staff and budget in order to expand its activities. Three fellowships were awarded, and Agency experts provided on-the-job training in the application of isotope techniques to improve the management of water resources.

DOM/8/003 GROUNDWATER HYDROLOGY

COMPLETED: **91-08-05** TOTAL COST: **$135,063**

TO INTRODUCE ISOTOPIC TECHNIQUES IN THE STUDY OF WATER RESOURCES IN KARSTIC SYSTEMS.

About two thirds of the total surface of the Dominican Republic is covered by karstic rocks and consequently most of the country's water resources are located in this kind of geological formation. Many problems on karst hydrology which could benefit from the use of nuclear and tracer techniques were identified, but the staff of the National Institute of Water Resources (INDRHI), Santo Domingo, required assistance in carrying out extended experiments. The Agency supplied expert and consultant services in the use of tracers in karstic aquifers as well as equipment, including a spectrophotometer, a fluorimeter and some ancillary laboratory items. As a result of the project, INDRHI mastered the technologies, first, for the use of fluorescent tracers and artificial tritium (tritiated water) in karst hydrology, and, secondly, for the measurement of natural tritium. A fully equipped laboratory for chemical analysis of water was also established. A general survey of stable isotopes of water (deuterium and oxygen-18) and natural tritium was carried out at the most important karstic system of the country. More than 300 water samples were measured and experimental work using fluorescent tracers was carried out at the Los Bolos and Sabaneta dam areas. The resulting information provides a general framework for planning and interpreting

experiments on karst hydrology. The infrastructure and expertise acquired through this project (including a fellowship at the Agency's Hydrology Laboratory) is being put to good use in carrying out a new hydrology project, DOM/8/005, which studies sedimentological problems of the Nizao River.

DEMOCRATIC PEOPLE'S REPUBLIC OF KOREA

DRK/1/004 THERMOLUMINESCENCE DOSIMETRY

COMPLETED: **91-06-01** TOTAL COST: **$85,285**

TO APPLY THERMOLUMINESCENCE DOSIMETRY IN RADIATION PROTECTION, RADIATION THERAPY AND RADIATION PROCESSING FOR ABSORBED DOSE MEASUREMENT.

In view of the increasing demand for radiation protection services in the country, the Institute of Radiation Protection, Pyongyang, sought Agency assistance to strengthen its capability for personnel dose control for radiation workers. The Agency provided the Institute with equipment, including a thermoluminescence dosimeter, a high temperature furnace, an oscilloscope, a pulse generator, a pulse height analyser with sodium iodide detector, and a turbomolecular pumping assembly. In 1988, the Agency provided two months expert services to train local staff in setting up a thermoluminescence dosimetry (TLD) measurement system and its calibration and to advise the counterpart on the production of TL materials. In 1989, an expert mission assisted the counterpart in radiation detection. Fellowship training was also provided. With the Agency's assistance, a service system for control of personnel radiation dose was established at the Institute. At present, services are being provided to about 1500 radiation workers in the fields of medicine, agriculture and industry. The TLD laboratory is also capable of synthesizing the TL materials, and fabricates about 45 000 TL pellets per year. This laboratory is used as a base for radiation protection training for 40 trainees per year. The Institute of Radiation Protection intends to expand its services in the near future and to introduce processing of personnel dose control data by microcomputer.

DRK/2/003 RADIOISOTOPE PRODUCTION

COMPLETED: **91-05-16** TOTAL COST: **$77,465**

TO MODERNIZE EXISTING LABORATORY FACILITIES FOR RADIOISOTOPE PRODUCTION, PARTICULARLY THE INSTRUMENTATION FOR QUALITY CONTROL.

The Institute of Radiochemistry, Pyongyang, sought Agency assistance to upgrade existing laboratory equipment for radioisotope production, particularly instrumentation for quality control. The Agency provided the Institute with equipment, including a UV-visible spectrophotometer, multichannel analyser, semiconductor detector, gamma counter and spare parts for their instruments. A long term expert service also advised the counterparts in irradiation techniques for production of isotopes by their 4 MW research reactor, and trained them in production of technetium-99m by sublimation generator and in the technology for production of chromium-51, iodine-131, carrier-free phosphorus-32 and microcolloid gold-198. The expert

also advised the local staff on separation techniques and purity assay, especially in quality control practice. At present, all equipment is being operated by the counterparts for production and quality control of the radioisotopes technetium-99m, gold-198, iodine-131, phosphorus-32 and chromium-51, which are used in nuclear medicine. The Institute is also able to produce radioisotopes for industrial and biological applications, as well as standard sources for radiation calibration and measurement. It is expected that the Institute will expand its radioisotope production to meet the local demand for radioisotopes in various fields.

ECUADOR

ECU/0/004 NUCLEAR INFORMATION SERVICES

COMPLETED: **91-12-31** TOTAL COST: **$48,988**

(1) TO INTRODUCE A COMPUTERIZED SYSTEM CAPABLE OF DEALING EFFECTIVELY WITH SCIENTIFIC AND TECHNICAL INFORMATION AND ITS DISSEMINATION. (2) TO DEVELOP MANPOWER FOR NUCLEAR INFORMATION MANAGEMENT.

The project was approved in 1987 to meet the demand for nuclear information services from scientists and researchers in Ecuador by equipping the Nuclear Information Centre at the Ecuadorian Atomic Energy Commission (CEEA) with essential material and equipment, along with expert advice, in order to computerize the operations of the Centre and create databases on information processing for the library. Provision of a CD-ROM and the training of staff members in all aspects of International Nuclear Information System (INIS) procedures has made information retrieval possible using the INIS CD-ROM database. The project has succeeded in setting up a system to perform computerized searches for bibliographic references and information required by Ecuadorian researchers in nuclear science. Furthermore, Ecuador now contributes to the INIS database.

ECU/5/008 AGRICULTURAL CHEMICALS AND RESIDUES

COMPLETED: **91-12-10** TOTAL COST: **$308,390**

TO STRENGTHEN THE CAPABILITY FOR ANALYSIS OF AGROCHEMICAL RESIDUES IN FOOD, SOIL, WATER AND OTHER ENVIRONMENTAL CONSTITUENTS.

This long term project was first approved in 1985 to collaborate in the activities initiated by the Ecuadorian Atomic Energy Commission and the Ministry of Agriculture to study the problems caused by the intense use of agricultural chemicals and pesticides. This was to be accomplished by evaluating current practices and analysing pesticide residues, with a view to making the chemicals safer to use. The Agency provided essential equipment, including a liquid and a gas chromotograph, laboratory equipment and supplies, a scintillation counter and liquid scintillation analyser. Almost seven months of expert services and 35 months of staff training were also provided. A well equipped laboratory was set up and the staff gradually gained confidence in working with radioisotopes to analyse residues in food, soil, water and other environmental elements. The results of the research have been published in scientific journals. The practical data of residues in corn, tomato, palm oil and vegetables as well as data on the behaviour of DDT in the Ecuadorian

environment, were made available to the Ministry of Agriculture. Current problems are being tackled, and, in the long term, the application of findings are expected to contribute significantly to an improvement in food quality and environmental protection programmes. The success of this project has attracted the attention of university research groups in Ecuador, and their collaboration should provide additional support for continuing work in this field.

ECU/8/005 RADIATION TECHNOLOGY

COMPLETED: **91-12-31** TOTAL COST: **$1,263,941**

TO INSTALL AND OPERATE AN ELECTRON ACCELERATOR FOR RADIATION CURING OF PLASTIC COATINGS ON METALS AND FABRICS AND FOR RADIO- STERILIZATION OF MEDICAL SUPPLIES.

This long term project was first approved in 1980 to provide, install and put into operation an electron accelerator in order to supplement the irradiation facilities of the National Polytechnic School (EPN) in Quito. As envisaged, the linear accelerator, purchased with non-convertible currency, is adequate to induce polymerization in plastic coatings on metals, fabrics and other materials and to radiosterilize medical products. The EPN provided all necessary infrastructure, including radiation shielding, ventilation, water cooling and conveyor systems, TV camera and communication networks all of which were designed and built by local staff. The Agency provided all basic components of the electron beam accelerator ELU 6U (LINAC), including a bending magnet for vertical beam operation and basic accessories for the first two years of operation. Technical protocols containing technical details and results of measurements for all stages of installation and operation were prepared by counterparts and supplier's representatives with the assistance of IAEA experts. The LINAC facility was inaugurated in April 1990, after which additional expert advice and training were provided to cover routine operation, maintenance and safety. The EPN now possesses a powerful tool for radiation research in the areas of chemistry, biology, and physics, which also has a substantial capacity (4-5 kW of radiation power) for industrial applications, especially services in industrial sterilization. The Agency has agreed to assist in establishing systems for the most effective applications of the facility in a follow-up project.

ECU/9/008 ENVIRONMENTAL RADIOACTIVITY MONITORING

COMPLETED: **91-01-08** TOTAL COST: **$54,720**

TO MONITOR BACKGROUND RADIOACTIVITY LEVELS IN THE AREA SURROUNDING THE SITE OF A FUTURE NUCLEAR RESEARCH REACTOR.

The Agency was requested by the Ecuadorian Atomic Energy Commission (CEEA) to assist in establishing the basis for its environmental radiation monitoring programme for Ecuador, with particular reference to the plan to establish a nuclear research centre. An expert advised on programme design, and permissible radionuclide levels in foodstuffs and environmental samples were established. Project personnel were trained in the use of the equipment which was provided under the project and by CEEA; this included a high sensitivity semiconductor detector and multichannel analyser. In addition,

recommendations were made for the construction of a low level laboratory. Some environmental reference data were determined. A project proposal for continuation of such environmental studies has been put forward for the 1991-92 programme (ECU/9/009). This project was primarily funded through an extrabudgetary contribution of the United Kingdom, with the remainder (20%) provided from Agency funds. A project-related fellowship was funded by Spain.

EGYPT

EGY/0/009 ENERGY PLANNING

COMPLETED: **91-12-02** TOTAL COST: **$10,164**

TO USE THE IAEA MAED COMPUTER MODEL IN A NATIONAL ENERGY AND ELECTRICITY DEMAND FORECASTING STUDY.

Three counterparts from the Egyptian Electricity Authority were familiarized with the MAED Computer Model and collaborated with two Agency experts in its use for a national energy and electricity demand forecasting study initiated by the Authority. Although the final report of the study has not yet been produced, the Egyptian Electricity Authority has acquired a useful tool together with the skill to use it for energy and electricity demand forecasting studies.

EGY/1/016 NEUTRON SCATTERING

COMPLETED: **91-09-24** TOTAL COST: **$54,804**

TO PROVIDE AN ALIGNMENT SYSTEM TO AUGMENT THE NEUTRON SCATTERING EQUIPMENT PROVIDED UNDER A PREVIOUS PROJECT IN ORDER TO FACILITATE STUDIES ON THE DYNAMICS OF SOLIDS AND LIQUIDS USING INELASTIC SCATTERING OF SLOW NEUTRONS.

The Reactor and Neutron Physics Department of the Nuclear Research Center in Egypt received through Agency assistance under a previous project a double rotor neutron monochromator manufactured by the Institute of Theoretical and Experimental Physics, Moscow. Under this project an alignment system suitable for the double rotor system was provided. Three experts from the Institute of Theoretical and Experimental Physics, Moscow were provided to complete the installation of the system, to train personnel on its use and to advise on the experimental studies to be carried out. The principal counterpart was awarded a scientific visit to the Institute in Moscow. As a result of the project the experimental infrastructure necessary for research using neutrons was developed. A pulsed neutron beam with low background without fast neutrons was produced at the research reactor. Experimental studies on the dynamics of solids and liquids were launched and are being continued. Seven publications on research using the equipment were produced.

EGY/1/017 PLASMA PHYSICS

COMPLETED: **91-09-24** TOTAL COST: **$57,566**

TO PROVIDE EQUIPMENT AND EXPERT ASSISTANCE TO OPERATE THE THETATRON.

An Agency expert assisted in re-assembling the 3.5 m theta pinch which was originally sited in Culham, UK. The expert reviewed the status of the experiments and advised on future developments. As part of the effort to upgrade the diagnostic facilities, the Agency provided a computerized data acquisition system. Two Agency experts assisted in the operation and testing of the data acquisition system, in training local specialists in its use, in connecting the system to the diagnostic tool and to the mainframe computer of the Nuclear Research Centre, Cairo, and in recommending scientific programmes for further use of the system. The 3.5 m theta pinch was made operational to its full power and produced plasma. The data acquisition system made it possible to perform systematic experimental analyses. The diagnostic facilities of the laboratory were upgraded and modernized and the laboratory is now engaged in training and research, some of its results having been published in scientific journals. Since the laboratory is the only one in the country, it is also used by all the national universities.

EGY/1/019 NEUTRON RADIOGRAPHY

COMPLETED: **91-09-24** TOTAL COST: **$35,949**

TO ESTABLISH A LABORATORY FOR NEUTRON RADIOGRAPHY DIRECTED TO INDUSTRIAL APPLICATIONS.

Under this project an expert was provided to assist the local staff in the design of a neutron radiography laboratory and in identifying the equipment needed for the laboratory. During the mission detailed drawings of the collimators and beam shieldings were completed and recommendations on items of neutron radiography equipment were made. The local staff constructed the facility in accordance with the design made by the expert and the Agency supplied the recommended equipment. The expert was provided again to assist in the commissioning of the facility. As a result of the project neutron radiography was introduced as an additional method to the other techniques used in non-destructive testing. Thus, the programmes of training specialists and of providing non-destructive testing services to local industries was expanded. Neutron radiography was also employed in reactor-based research on metallurgy and testing of corrosion, thereby increasing the utilization of the reactor.

EGY/4/023 PRODUCTION OF RADIOISOTOPES

COMPLETED: **91-11-13** TOTAL COST: **$299,482**

TO PRODUCE RADIOISOTOPES AND RADIOPHARMACEUTICALS, INCLUDING LABELLED COMPOUNDS, LOCALLY FOR USE IN NUCLEAR MEDICINE.

This project was the first phase of assistance to a programme for the production of iodine-131 and technetium-99m carried out by the Radioisotope

Production Department of the Egyptian Nuclear Research Centre, Cairo. Most of the equipment and materials required for production and quality control were provided, and generator production cells were constructed. Expert assistance was provided for installing and testing the equipment and for training local personnel in production procedures and quality control. The groups involved in the production of iodine-131 and technetium-99m generators carried out simulated production, handling runs with the equipment in order to gain experience and to identify difficulties in remote handling. They were advised to continue these activities and record their findings for at least 20 to 30 simulated batch production operations. The data will be evaluated with the assistance of an expert. As a result of this project the personnel have acquired the necessary expertise in operating the technetium-99m generator and iodine-131 production plants regularly and safely. The activities would be continued in a second phase, assisted by the project EGY/4/034, to achieve a steady and expanded production programme designed to fully meet the needs of the country.

EGY/4/031 NUCLEAR INSTRUMENTATION

COMPLETED: **91-10-15** TOTAL COST: **$39,924**

TO PRODUCE MODULAR INSTRUMENTS FROM THE DESIGN OF PROTOTYPES TO SMALL SERIES PRODUCTION.

Two experts were provided to train the staff of the Department of Electronics and Scientific Instruments of the Nuclear Research Centre, Cairo, to design modular units for nuclear instrumentation and to produce printed circuit boards. The experts also assisted the counterparts in setting up facilities for a computer and for the production of printed boards. Test equipment and components were also provided. Twenty staff members were trained. Computer-aided design and production of printed circuit boards, as well as the design for HV power supply, AC-DC convertor and function generator, were initiated. As a result of the improved capability brought about by the project, repair and maintenance services are being provided to other Departments within the Nuclear Research Centre as well as to hospitals and other institutions in Egypt using nuclear instrumentation.

EGY/9/020 RADIOLOGICAL SAFETY

COMPLETED: **91-09-27** TOTAL COST: **$74,155**

TO IMPROVE RADIOLOGICAL SAFETY BY STRENGTHENING RADIATION PROTECTION REGULATORY ACTIVITIES.

This project, which was financed by an extrabudgetary contribution from the USA, was designed to assist the Nuclear Regulatory and Safety Commission in drafting regulations and guidelines on basic safety standards for radiation protection and to advise on steps needed to implement the IAEA Basic Safety Standards. Five experts assisted in defining Egypt's specific safety requirements for the use of radiation and radioactive materials for medicine, industry and research. Equipment, including a neutron counter, monitoring and laboratory equipment, was provided to improve the Radiation Protection Services. As a result of the project, regulations defining licensing procedures to implement IAEA Safety Series No.9 were developed. The project contributed towards

strengthening and integrating radiation protection regulatory activities in different task areas in order to improve radiological safety in Egypt.

EGY/9/021 OCCUPATIONAL RADIATION PROTECTION

COMPLETED: **91-10-02** TOTAL COST: **$64,611**

TO ESTABLISH AN INFRASTRUCTURE FOR RADIATION MONITORING AS RELATED TO MINING AND MILLING OF AND EXPLORATION FOR RADIOACTIVE ORES.

Two Agency experts conducted training courses in Occupational Health and Safety in Mining and Processing Radioactive Ores and in Ventilation and Air Monitoring Methods. The experts also provided advice and training in calibration of instruments and monitoring procedures in laboratories and in the storage of radioactive ores. Monitoring equipment was provided and the counterparts trained in its use. Twenty staff from the Nuclear Materials Authority and the Nuclear Regulatory and Safety Centre were trained. Ventilation improvements recommended by the expert were implemented. The Nuclear Materials Authority acquired equipment and trained their personnel to implement radiation protection programmes in mining and milling radioactive ores.

EL SALVADOR

ELS/1/002 NUCLEAR SCIENCE LABORATORY

COMPLETED: **91-06-01** TOTAL COST: **$205,097**

TO START AN UNDERGRADUATE COURSE IN NUCLEAR PHYSICS AND TO ESTABLISH A BASIC LABORATORY.

The project was established in 1985 to provide assistance to the University of El Salvador in initiating an undergraduate course in nuclear physics at the Department of Physics and to establish an electronics unit for the maintenance of the Department's nuclear instruments. The training of three fellows (10 man-months) contributed to the excellent academic level of the course in both theoretical and practical terms. Maintenance of the equipment has not only satisfied the needs of the University but also provided services to the Ministry of Public Health and the Ministry of Agriculture, where other Agency-supported projects have been operational. Owing to an earthquake, work on the application of nuclear techniques in element and trace element analysis could not be completed, although the situation is expected to improve as soon as construction of the new laboratory is completed. Additional needs in electronics maintenance services are being met under Project ELS/4/003.

ELS/4/002 MAINTENANCE OF NUCLEAR INSTRUMENTS

COMPLETED: **91-06-01** TOTAL COST: **$71,277**

TO ESTABLISH A UNIT FOR PREVENTIVE MAINTENANCE AND REPAIR OF ELECTRONIC INSTRUMENTS.

The Nuclear Medicine Department of the Hospital Rosales, San Salvador, requested Agency assistance in establishing a unit for maintenance and repair of nuclear instruments and to support the additional infrastructure needed to expand its services through the incorporation of additional equipment. This unit has been established and several old nuclear instruments (a scanner, a renograph, and a thyroid probe) have been repaired and are now operational. The maintenance unit also serves the Radiation Protection Service of the Hospital. The old nuclear equipment, repaired during the implementation of the project, is now being used to train the staff involved in the on-going expansion of the Nuclear Medicine Department.

ELS/6/009 NUCLEAR MEDICINE SERVICES

COMPLETED: **91-06-01** TOTAL COST: **$35,420**

TO FACILITATE THE CONTINUATION OF NUCLEAR MEDICINE DIAGNOSTIC SERVICES AT THE NUCLEAR MEDICINE UNIT, HOSPITAL ROSALES.

As a consequence of an earthquake, the services of the Nuclear Medicine Department at the Hospital Rosales, San Salvador, had been suspended. The Agency, after an appeal by the Secretary General of the United Nations and upon the request of the Government of El Salvador, established in 1987 a project financed by the Reserve Fund to assist in the resumption of services by supplying radioisotopes to the Nuclear Medicine Department of the Hospital, the only service available for such a purpose in the public sector. During 1989 and 1990, additional funds were obtained to ensure the correct utilization of equipment, taking into account radiation protection parameters. The project also assisted in facilitating the establishment of an infrastructure to expand services in in-vitro clinical diagnosis which are now in full operation and are being supported by the current project ELS/6/010.

ETHIOPIA

ETH/5/008 ISOTOPES IN AGRICULTURE

COMPLETED: **91-12-31** TOTAL COST: **$177,832**

TO INCREASE THE PROTEIN YIELD OF PULSE CROPS AND FODDER THROUGH BIOLOGICAL NITROGEN FIXATION AND THE JUDICIOUS USE OF NITROGEN FERTILIZER.

This project was initiated in 1985 to optimize the proportion of nitrogen derived by grain legumes from fixation. The laboratory at Holetta is now capable of using the nitrogen-15 isotope technique to quantify, under field conditions, the proportion of plant nitrogen that is derived from the atmosphere through symbiotic nitrogen fixation for various important legumes (haricot bean, cowpea, pigeon pea, mungbean, faba bean and field pea). The technique has allowed preliminary identification of legumes with superior nitrogen fixing capability and identification of some of the factors affecting this capability, thus minimizing plant dependence on soil and expensive fertilizer nitrogen. The Agency provided equipment and laboratory supplies, as well as on-the-job training by experts. One research scientist received 12 months training in nitrogen fixation at the University of Reading, United Kingdom. The head of the Department of Soil Science and Water Management of the Institute of

Agricultural Research, Addis Ababa, was awarded a project-related scientific visit to research institutes in Australia, New Zealand and Thailand.

GHANA

GHA/1/007 SECONDARY STANDARDS DOSIMETRY LABORATORY

COMPLETED: **91-08-29** TOTAL COST: **$518,845**

TO ESTABLISH AN EFFECTIVE RADIATION PROTECTION SERVICE AND A SECONDARY STANDARDS DOSIMETRY LABORATORY.

Thermoluminescence dosimetry (TLD) techniques have been developed for implementing a personnel monitoring service for those who are occupationally exposed to ionizing radiation in Ghana. Currently about 500 radiation workers are being monitored using the computerized Harshaw TLD 4000 system and accessories supplied under the project. A Food and Environmental Dosimetry Laboratory has been set up and measurement protocols developed for analysing the radioactivity contamination of imported foods and determining the level of radionuclides in local foods and environmental samples using the low level gamma spectrometry system and accessories supplied under the project. Protocols have also been developed for carrying out inspections on radiation-emitting facilities and quality control of medical X-ray equipment. 50% of the 120 X-ray facilities in the country have been inspected; 40 sealed and 20 unsealed sources have also been inspected at least once. Experience gained in the inspection of X-ray facilities has led to the development of consultancy services on the Safety and Design of Medical X-ray Diagnostic Installations in Ghana. Five nationals have been trained as radiation protection officers through on-the-job training, inter-regional courses and workshops. Local training courses are given to X-ray personnel by the radiation officers. Assistance has also been given in drafting the Radiation Protection Act which is awaiting ratification by the Government.

GHA/5/014 BIOLOGICAL NITROGEN FIXATION IN LEGUMES

COMPLETED: **91-12-31** TOTAL COST: **$73,087**

TO STUDY BIOLOGICAL NITROGEN FIXATION IN LEGUMES WITH A VIEW TO DEVELOPING METHODS FOR INCREASING PROTEIN YIELD AND REDUCING THE NEED OF NITROGENOUS FERTILIZER APPLICATIONS.

The most important pieces of equipment supplied under the project included an autoclave, a centrifuge and an incubator with refrigerator and freezer. Although no fellowships were provided under the project, the national counterpart and two other staff members received appropriate training with the assistance of the Agency. The major results of the project have been the use of the nitrogen-15 technique to quantify nitrogen fixation in field-grown legumes in Ghana, screening of legume germ-plasm genotypically and phenotypically for superior nitrogen fixation support, and evaluation of all factors responsible for increasing atmospheric nitrogen gas fixation, and hence plant yield, quantitatively. The data obtained may now form the baseline to exploit the process of biological nitrogen fixation in order to increase the yield of food legumes grown in Ghana.

GHA/5/015 MUTATION BREEDING

COMPLETED: **91-09-25** TOTAL COST: **$54,344**

TO STRENGTHEN THE LOCAL CAPABILITY FOR RADIATION-INDUCED MUTATION OF CASH CROPS WITH A VIEW TO OBTAINING IMPROVED VARIETIES FOR DISTRIBUTION TO FARMERS.

The project, initiated in 1988 has been operational for three years. Three expert missions were provided for a total of 60 days, essential equipment, such as microscopes, an incubator and a refrigerated centrifuge, was supplied, and one six-month fellowship awarded. This Agency assistance has led to the field establishment of plantlets of cassava, yam, plantain and banana which had been raised in-vitro. Yam tubers are being used along with nodal segments and shoot tips of vines for in-vitro mutation breeding programmes. Radiosensitivity in-vitro studies have been completed for all the crops under review. These activities may now be sustained with input from the National Nuclear Research Institute.

GREECE

GRE/3/007 URANIUM EXPLORATION AND EVALUATION

COMPLETED: **91-12-02** TOTAL COST: **$177,537**

TO STRENGTHEN THE LOCAL CAPABILITY FOR TREATMENT AND INTERPRETATION OF EXISTING GEOLOGICAL DATA THROUGH THE ESTABLISHMENT OF A COMPUTERIZED DATA PROCESSING SYSTEM.

The capability of the Institute of Geology and Mineral Exploration in Athens for treatment and interpretation of existing geological data has been strengthened by the establishment of a computerized data processing system and the expertise provided under the project. Two expert missions were organized, one on geophysics and the other on borehole logging. Exploration data processing was improved by the provision of hardware and adequate software. The major item of equipment provided under the project was a very advanced and automated, fully computerized, borehole logging system mounted on a four-wheel drive vehicle. The logging system has improved and speeded up explorations for coal, uranium and other mineral deposits. The transfer of technology during the installation and commissioning of the system was also of considerable value to the counterparts. The equipment provided has been used for uranium exploration as well as for the study of old and new wells in prospecting for coal and mixed sulphide deposits.

GRE/8/006 ISOTOPES IN HYDROLOGY

COMPLETED: **91-06-01** TOTAL COST: **$168,912**

TO STRENGTHEN THE CAPABILITY OF THE ISOTOPE HYDROLOGY LABORATORY FOR SUPPORTING RESEARCH PROGRAMMES THROUGH THE UPGRADING OF ANALYTICAL FACILITIES.

The Isotope Laboratory at the Nuclear Research Centre Demokritos, Athens, has

been upgraded by the provision of the SIRA 10 mass spectrometer, which is now used for analysis. With Agency expert assistance, a programme of systematic hydrological study with the use of isotopes was initiated. A scientific visit was awarded to advanced laboratories in the United Kingdom. An improvement in scientific capabilities, particularly in radiotracing and analysis of environmental isotopes, has been achieved and resulted in tracer and isotope hydrological studies of various regions of Greece.

GRE/9/013 ENVIRONMENTAL RADIOACTIVITY

COMPLETED: **91-10-15** TOTAL COST: **$27,946**

TO UPGRADE ENVIRONMENTAL RADIOACTIVITY CONTROL.

This was part of a more general project, supported by the Greek Atomic Energy Commission, which included modernization of the existing sampling network, installation of a new gamma monitoring network and further computerization of data treatment and storage. Under this project a complete system for high resolution alpha- and beta spectrometry was provided. The detection part of the system was combined with an existing MCA (not PC-based) to form a classical high-resolution system. The PC-based analyser part of the system (with supporting software) was combined with an existing HpGe detector to form a modern high-resolution gamma spectrometry system capable of analysis down to the X-ray energy region. The complete system has been calibrated and has been in use since early 1990. The personnel involved in the gamma spectrometry methodology (two technicians and one PhD fellow) received theoretical and practical training in the use of the Minigam gamma-analysis software and it thus became possible to operate the system at a higher level after September 1990. The Agency also supplied an uninterruptable power supply, which provides protection against short (up to one hour) AC power dropouts and significantly reduces loss of data. The equipment provided is used for routine control measurements (especially for control of imported and exported food) and for measurements related to the applied research projects of the Laboratory (e.g. survey of the natural radioactivity of the soil, studies on marine radioactivity). As a result of this project, the capability of the Environmental Radioactivity Laboratory of the Demokritos Nuclear Research Center to perform routine environmental radioactivity control in Greece and to carry out related applied research has been strengthened.

GUATEMALA

GUA/5/007 CONTROL OF THE MEDITERRANEAN FRUIT FLY

COMPLETED: **91-12-02** TOTAL COST: **$227,442**

(1) TO STRENGTHEN THE MEDFLY CONTROL PROGRAMME AND TO PROVIDE MATERIALS FOR EXPERIMENTS (2) TO ADVISE ON THE PREPARATION OF DIET AND ON LARVAL DIET RECYCLING (3) TO ESTABLISH AND TRAIN LOCAL STAFF IN QUALITY CONTROL PRACTICES RELATED TO DIET RECYCLING.

The project, funded by the USA and executed by the US Department of Agriculture under a subcontract with the Agency, contributed greatly to strengthening the Mediterranean fruit fly control programme in Guatemala.

The project developed methods and procedures to assess pupal size in mass rearing, to compare various colours of fluorescent Day-Glo dye for use in release/recapture tests, to detect medfly populations with Jackson traps and to monitor for field dispersal and longevity tests. Evaluations were made of the dispersal ability of mass reared flies produced from recycled diet and of the quality of sterile medflies of different sizes. Recapture data using male-only releases were compared with male/female releases. The performance of Jackson traps baited with Trimedlure was compared with that of McPhail traps baited with Nulure in a year-long test in a coffee plantation. The Agency awarded fellowships to two counterparts for two years in the United Kingdom and one year at the IAEA's Laboratories, Seibersdorf.

GUA/8/007 ISOTOPES IN HYDROLOGY

COMPLETED: **91-02-11** TOTAL COST: **$142,736**

TO UNDERTAKE STUDIES ON WATER RESOURCES FOR AGRICULTURE AND ON GEOTHERMAL RESOURCES IN THE ALTIPLANO.

The General Directorate of Nuclear Energy and the National Institute of Seismology, Vulcanology, Meteorology and Hydrology implemented the footnote-a project which was upgraded in 1986. The project has contributed to significant advances in determining water resources for agriculture and geothermal resources as a source of energy. Hydrogeological and environmental isotopic investigations were carried out to obtain a better understanding of the availability of groundwater and the interchange between different groundwater reservoirs. Studies were also made of geothermal resources in the Altiplano region of Guatemala. The Agency provided experts on water sampling, isotope hydrogeology and hydrogeochemistry; equipment included items required to set up an analytical hydrochemistry laboratory. One fellowship and two scientific visits were awarded for training counterpart staff. Two Agency Research Contracts were also awarded.

HUNGARY

HUN/4/007 PRODUCTION OF COBALT-60 SOURCES

COMPLETED: **91-06-01** TOTAL COST: **$209,699**

TO INCREASE THE LOCAL CAPABILITY FOR THE PRODUCTION OF COBALT-60 BY ACTIVATION IN NUCLEAR POWER REACTORS.

The Institute of Isotopes and the Central Research Institute for Physics of the Hungarian Academy of Sciences, Budapest, in collaboration with the Paks nuclear power plant, were assisted by the Agency under this multi-year project in producing cobalt-60 by activation in nuclear power reactors. The Agency provided manipulators and windows for hot cells. Expert advice was given on the design of hot cells and the manufacture of radiation sources. A two-months fellowship provided the counterpart with up-to-date and practical information on the production of cobalt-60. The project not only achieved its objective by meeting local demand for cobalt-60 but also enabled the Institute of Isotopes to supply the source for other Agency-assisted projects.

HUN/4/008 PROCUREMENT ASSISTANCE FOR HUNGARY

COMPLETED: **91-06-01** TOTAL COST: **$30,871**

TO OPEN A FUNDS-IN-TRUST ACCOUNT FOR PURCHASING SPARE PARTS NECESSARY FOR IMPLEMENTATION OF SCIENTIFIC ACTIVITIES IN SEVERAL HUNGARIAN INSTITUTES.

Several research institutes which were providing the Agency with training services requested, through the Hungarian authorities, a Funds-In-Trust project to enable them to purchase spare parts and equipment. The funds were made available through the hard currency they received from the Agency for training fees. The procurement assistance rendered by the Agency thus provided these institutes with spare parts and equipment not locally available and improved their technical capabilities.

INDONESIA

INS/1/016 RADIONUCLIDE STANDARDIZATION

COMPLETED: **91-12-17** TOTAL COST: **$114,005**

TO ESTABLISH A CAPABILITY FOR THE STANDARDIZATION OF RADIONUCLIDE MEASUREMENTS AT THE NATIONAL LEVEL.

The Centre for Standardization and Radiological Safety Research, Jakarta, under the National Atomic Energy Agency (BATAN), is responsible for the measurement of natural radioactivity and its standardization as a national reference laboratory. To achieve high-accuracy radioactivity measurements and radionuclide determination, an expansion and upgrading of the laboratory was needed. Under this project, initiated in 1986, two Agency experts undertook three missions to advise on the laboratory set-up and on calibration and standardization. Equipment provided included an analytical analyser, an electrometer, a germanium semiconductor detector with a computer system, and a beta-gamma coincidence counter. Two counterpart staff were trained abroad on long term fellowships and one was awarded a scientific visit. The laboratory is now well set up. The counterpart has already issued some standard sources such as caesium-137 and 134, iodine-125 and 131, barium-133, technetium-99m, americium-241 and cobalt-60, which are being used at other establishments of BATAN and at the Nuclear Medicine Centre of the Fatmawati Hospital, Jakarta. Seven scientific publications have resulted from activities under the project.

INS/1/018 NEUTRON ACTIVATION ANALYSIS

COMPLETED: **91-12-17** TOTAL COST: **$39,133**

TO STRENGTHEN LOCAL CAPABILITIES FOR NEUTRON ACTIVATION ANALYSIS OF BIOLOGICAL AND MINERAL SAMPLES.

The Jogyakarta Nuclear Research Centre has undertaken a project on determination of multi-elements and trace elements by neutron activation analysis. The services include characterization of uranium ore and other

minerals, analysis of biological samples, of food samples for nutritional studies, and of environmental samples, all deriving from various institutes, universities and hospitals within the framework of the Centre's collaboration with external institutions. To meet this demand, it was necessary to upgrade the Centre's analytical capabilities. Under this project, initiated in 1989, an Agency expert undertook two missions and gave advice on various aspects of neutron activation analysis. Two counterparts were also trained abroad on long term fellowships and one was awarded a scientific visit under the Agency's manpower development programme. The Centre has now improved its capability to provide neutron activation analysis services.

INS/4/017 FUEL ELEMENT TECHNOLOGY

COMPLETED: **91-12-17** TOTAL COST: **$150,579**

TO DEVELOP THE TECHNOLOGY FOR FABRICATING FUEL ELEMENTS USING LOCAL URANIUM OXIDE.

The Research Centre for Nuclear Techniques, Bandung, has embarked on an R&D programme in order to acquire a capability for nuclear fuel element fabrication starting from uranium dioxide powder produced locally. Under this project, initiated in 1982, five Agency experts undertook six missions and advised on quality control in nuclear fuel fabrication, performance of tests on welds of fuel rods and their evaluation, and on the pelletization of uranium dioxide fuel. Equipment supplied included a sintering furnace, an automatic titrator, a sectioning system, a laboratory ball mill, pellet drying and loading equipment, a water vaporizer and a moisture meter. As a result of the project, the Research Centre is now capable of uranium dioxide pellet fabrication, short fuel pin fabrication and end-plug to tube welding, according to the nuclear requirements. This represents a great advance in nuclear fuel fabrication for the research reactors in the country. As a result of work performed under the project, 38 scientific papers have been presented at national seminars.

INS/4/025 QUALITY ASSURANCE AND QUALITY CONTROL PROGRAMMES

COMPLETED: **91-12-17** TOTAL COST: **$151,989**

TO ACQUIRE EXPERTISE IN QUALITY ASSURANCE AT A NUCLEAR FACILITY AT SERPONG, USING NON-DESTRUCTIVE TESTING TECHNIQUES.

The National Atomic Energy Agency (BATAN) has established a sophisticated and multidisciplinary nuclear complex at Serpong, West Java, with the central facilities of a 30 MW(th) multipurpose research reactor, a Fuel Element Production Centre, a Radioisotope Production Laboratory and a Radioactive Waste Management Centre. To facilitate smooth operation, BATAN planned to introduce quality assurance (QA) programmes using non-destructive testing (NDT) methodology. Under this project, initiated in 1989, the Agency supplied some NDT equipment and organized two workshops, one on auditing nuclear facilities and another on QA in the design, manufacture and procurement of nuclear power plants. Seven experts advised on the technique of non-destructive examination, the QA programme and its implementation, and the establishment of a non-destructive examination laboratory. Two counterparts were awarded scientific visits. As a result of this project, the NDT Laboratory of

the Component Development and Engineering Centre of BATAN at Serpong now possesses all necessary equipment for the present requirements for training personnel. About 30 persons are already qualified and certified in different NDT methods. The project has contributed to the present status of BATAN's QA programme and provided a basis for the further development of an overall QA programme for the first Indonesian nuclear power plant.

INS/5/020 SOIL WATER MANAGEMENT STUDIES

COMPLETED: **91-12-17** TOTAL COST: **$68,728**

TO DEVELOP MORE EFFICIENT WATER MANAGEMENT METHODS THROUGH ISOTOPE-AIDED STUDIES ON SOIL-WATER RELATIONSHIPS.

The Faculty of Agriculture, Brawijaya University, Malang, intended to study soil-water relationship using a neutron probe, with a view to improving water management as related to agricultural production. The project, originally approved under footnote-a was subsequently funded by the United Kingdom. The Agency provided two experts who undertook three missions and advised the counterpart on the project planning and the water balance studies, also assisting in calibrating the neutron moisture meters, setting up field experiments and interpreting data. One expert also conducted a two-week training course for local scientists on crop water use efficiency. Equipment supplied included neutron moisture meters with accessories. Two counterpart staff were trained abroad on long term fellowships. With the assistance provided, a number of research activities have been conducted by the faculty staff and students, using the neutron probe. These studies are expected to develop cropping systems capable of efficiently using the available water and thereby increasing crop yields.

INS/8/015 RADIATION PROCESSING WITH AN ELECTRON BEAM MACHINE

COMPLETED: **91-12-31** TOTAL COST: **$459,344**

TO STRENGTHEN RADIATION PROCESSING TECHNOLOGY AND PROMOTE ITS APPLICATION THROUGH PROVISION OF A LIQUID NITROGEN PLANT AND SPARE PARTS FOR AN ELECTRON BEAM ACCELERATOR.

Indonesia, one of the main producers of tropical hardwood, has initiated a project on radiation processing for surface coating of wood panels. Under a UNDP-assisted Regional Co-operative Agreement project on the industrial applications of isotopes and radiation technology, an electron beam accelerator was installed at the Centre for the Application of Isotopes and Radiation, Jakarta, in 1984. Under the present project, initiated in 1987, the Agency provided a liquid nitrogen plant and some spare parts necessary for smooth operation of the accelerator. Two Agency experts advised on the operation and maintenance of the accelerator and on the radiation curing of wood panels. The project has helped the counterpart to formulate a suitable process for radiation curing technology for surface coating on particle board, plywood and parquet flooring, which is being demonstrated in national and regional executive management seminars. The service is also being provided to local wood industries. The results of these activities have been reported in seven scientific papers presented at national seminars and scientific meetings.

INS/9/007 REACTOR SAFETY

COMPLETED: **91-12-10** TOTAL COST: **$142,793**

TO REVIEW AND EVALUATE THE QUALITY ASSURANCE PROGRAMME AND THE FINAL SAFETY ANALYSIS REPORT FOR A 30-MW RESEARCH REACTOR.

In July 1987, the National Atomic Energy Agency (BATAN) commissioned a 30 MW(th) multipurpose research reactor, which uses materials testing type fuel elements with low enriched uranium, at Serpong, 25 km south-west of Jakarta. The law obliges constructors of reactors to submit a quality assurance programme covering the design, manufacture, construction and testing of structures, systems and components, pre-operational testing, initial fuel loading tests and initial criticality tests. The Agency was requested to provide the Atomic Energy Control Bureau (AECB) with the services of experts to assist local staff in verifying whether all these quality assurance requirements for the reactor had been met and, in particular, to assist the staff in acquiring a thorough understanding of the methods of evaluating the initial test programme and its implementation during the commissioning stage as related to evaluation of the reactor safety. Under this project, initiated in 1984, six Agency experts undertook ten missions to advise and train the counterpart staff on commissioning procedures, particularly safety analysis of fuel behaviour, quality assurance programme review and auditing requirements, and surveillance of testing and commissioning activities. These expert missions covered every stage of commissioning, from the very beginning until power operation. Most of the expert missions addressed regulatory aspects of commissioning and operation. Three counterpart staff were trained abroad on long term fellowships. As a result of the project, the counterparts at the AECB have developed considerable experience of quality assurance regulatory audits and inspections in relation to nuclear safety, which is already being utilized. Experience has also been acquired in auditing and inspecting other nuclear installations of BATAN, such as those for radioactive wastes, radioisotope production and fuel element fabrication.

INS/9/010 UNDERGROUND WASTE DISPOSAL

COMPLETED: **91-12-10** TOTAL COST: **$55,628**

TO ESTABLISH A SPENT FUEL MANAGEMENT STRATEGY FOR STORAGE REPOSITORIES IN ROCK FORMATIONS.

The Radioactive Waste Technology Centre, Serpong, under the National Atomic Energy Agency (BATAN), is equipped with a waste treatment plant, including an interim storage facility, a compactor, a cementation unit and an incinerator. The Centre is responsible for the treatment of radioactive wastes (including spent fuels) generated in different installations of BATAN in Serpong and other parts of the country and for their interim storage prior to disposal in a shallow ground burial depository for which investigations are under way for site selection. The Agency was requested to provide expert assistance to help develop criteria for the waste disposal site and to evaluate the safety impacts of siting and operating low level waste disposal sites. Under this project, initiated in 1986, four Agency experts undertook six missions and advised on waste disposal site selection criteria, identification and preparation of a safety analysis report, development of the plans for site characterization activities necessary to locate a repository, and the use of analytical models for

calculating groundwater flow. Two counterpart staff were trained abroad on long term project-related fellowships. As a result of the project, the Government has been helped to improve its methodology and approach to identifying, characterizing and selecting an appropriate site for radioactive waste disposal.

INTERREGIONAL

INT/0/040 MICROCOMPUTERS IN NUCLEAR EXPERIMENTS

COMPLETED: **91-07-26** TOTAL COST: **$125,831**

TO ASSESS THE TECHNICAL FEASIBILITY OF ESTABLISHING A COMPUTER-BASED INFORMATION EXCHANGE SYSTEM SERVING LABORATORIES AND RESEARCH INSTITUTIONS IN DEVELOPING MEMBER STATES.

The original objective of the project was to create a supporting service for all TC projects that use a personal computer. A second task was added in course of project implementation: development of nuclear application software. Both tasks were implemented. The support for PC users is, in fact, an activity that will continue after the project is closed, using the spare and replacement parts accumulated while the project was active. The second (additional) task resulted in the development of several software packages for quantitative analysis; they are being distributed to the TC projects.

INT/0/045 PRE-PROJECT ASSISTANCE

COMPLETED: **91-01-08** TOTAL COST: **$373,974**

TO ASSIST MEMBER STATES IN IDENTIFYING APPROPRIATE PROJECT ACTIVITIES AND DESIGNING PROJECTS IN A WAY THAT WILL ALLOW EFFECTIVE IMPLEMENTATION.

A total of 111 expert missions involving 135 experts or Technical Officers were undertaken under this project, approved in 1987, with the aim of assisting Member States in formulating and reviewing requests for Agency project assistance. The project resulted in the formulation of 85 projects for inclusion in the TC programme; 26 of the requests reviewed were considered premature and were therefore not recommended. Fifty-one Member States benefitted from the assistance provided under this project.

INT/5/084 BIOLOGY & BIOCHEMISTRY OF MICROBES FOR BIOMASS DEGRADATION

COMPLETED: **91-10-15** TOTAL COST: **$785,515**

(1) TO ISOLATE, IDENTIFY AND CULTURE MICROORGANISMS, PARTICULARLY THOSE OCCURRING SYMBIOTICALLY WITH AFRICAN TERMITE, WHICH DEGRADE CELLULOSE TO SIMPLE MOLECULES. (2) TO INDUCE MUTATIONS IN MICROORGANISMS WHICH INCREASE CELLULOSE DEGRADATION.

Financed by extrabudgetary resources from Italy, a research programme was carried out, partly at the Agency's Laboratories in Seibersdorf and partly at the

International Centre of Insect Physiology and Ecology in Nairobi. The programme focussed on research, the culture and identification of organisms, and the separation, purification and characterization of cellulose-degrading enzymes. The Agency provided personnel for co-ordination and planning as well as equipment and miscellaneous supplies. Fungi, bacteria and Actinomycetes in guts of higher termites, Macrotermes michealseni, were isolated and identified. Five Actinomycetes and six bacterial species were isolated from worker termite guts and the symbiotic fungus Termitomyces spp. were cultured in artificial media. The project provided guidelines for similar areas of study and training programmes. Although the objectives were very broad, it was possible to focus on specific aspects and to make progress in these areas.

INT/5/094 FATE OF TRYPANOCIDE DRUGS IN CATTLE

COMPLETED: **91-11-13** TOTAL COST: **$1,348,245**

TO DETERMINE THE FATE OF TRYPANOCIDE DRUGS IN CATTLE INFECTED WITH TRYPANOSOMES, USING RADIOLABELLED DRUGS.

A long term expert was assigned to assist in a study on the fate of trypanocide drugs in cattle, using radiolabelled compounds, and to train project personnel in methods of investigation including the application of radiolabelled compounds. Excellent facilities were established, including a modern radioisotope laboratory where the fate of trypanocide drugs in cattle could be investigated. Training was provided not only to the project personnel but also to fellows from other African countries. Five trypanocide drugs were selected for investigation. It is expected that the findings on completion of the project will provide a basis for more effective administration of trypanocide drugs. The work is continuing under Project KEN/5/013.

ISLAMIC REPUBLIC OF IRAN

IRA/4/016 NUCLEAR REACTOR DESIGN

COMPLETED: **91-12-31** TOTAL COST: **$45,088**

TO DESIGN AND CONSTRUCT A SUBCRITICAL ASSEMBLY AND A ZERO POWER EXPERIMENTAL REACTOR.

Expert services were provided to advise in the preparation of technical specification for the supply of elements for the research reactor and to advise on conversion of the reactor frame from high enriched uranium to low enriched uranium. The Agency also assisted Iran in the transfer of fuel from Argentina at no cost to the Agency. Advice on planning activities for the design of a zero power reactor and on selection of the reactor computer codes was also given. Fellowship training for one national specialist was provided.

IRA/4/018 REVIEW OF BIDS FOR A VARIABLE ENERGY CYCLOTRON

COMPLETED: **91-12-10** TOTAL COST: **$1,610**

TO REVIEW THE BIDS AND ADVISE ON THE SELECTION OF A VARIABLE ENERGY CYCLOTRON.

Iran is giving high priority to the construction of a cyclotron for nuclear medicine. The Agency was requested to help the counterpart review the bids and to give advice on the selection of a variable energy cyclotron. This was achieved during a meeting sponsored by the Agency and held in Vienna.

IRELAND

IRE/1/002 DOSIMETRY LABORATORY

COMPLETED: **91-09-12** TOTAL COST: **$49,372**

TO ESTABLISH A DOSIMETRY SERVICE FOR RADIATION PROTECTION.

In 1987, the Nuclear Energy Board in Dublin requested Agency assistance to set up a Secondary Standards Dosimetry Laboratory (SSDL) for the calibration of personnel dosimeters and radiation monitoring instruments. The Laboratory was also intended to facilitate the implementation of radiation protection regulations to conform with international standards. The project was approved in 1989. Equipment, which included an ionization chamber for dosimetry calibration sources, filters and other accessories, and a laser guidance device for precision settings, was procured for the Board. About one quarter of the money spent was provided as trust funds by the Irish authorities. An Agency expert undertook two missions to advise on the project and instructed the counterpart staff on calibration settings and maintenance of the instrumentation for the integrity of the SSDL measurements. The counterparts are using the SSDL equipment for a countrywide personnel dosimetry service for which the Board is responsible, as well as for environmental radioactivity measurements.

JAMAICA

JAM/4/002 RESEARCH REACTOR CENTRE

COMPLETED: **91-12-31** TOTAL COST: **$521,084**

TO FACILITATE SITE SELECTION, NUCLEAR SAFETY, ORGANIZATION OF LABORATORIES, AND COMMISSIONING AND TESTING OF A RESEARCH REACTOR AND ITS COMPONENTS.

This project was initiated in 1982 with an estimated duration of six years, funded by the IAEA and an extrabudgetary contribution from the USA. The main objective was to assist the staff of the Centre for Nuclear Sciences of the University of the West Indies to develop an adequate framework for the installation, operation and utilization of a research reactor for analytical work, directed towards local and regional problems. The main emphasis was on the development and application of neutron activation analysis methods, the

introduction of small scale radioisotope production, the application of X-ray fluorescence analysis and the establishment of a radiation monitoring service. The 20 kW slowpoke reactor, with analytical facilities, is operating normally with no unusual problems. More than 8000 samples had been analysed by November 1991. The data are part of the geochemical survey of Jamaica, which is a valuable tool in mining, agricultural, earth and environmental studies. The Departments of Chemistry, Agronomy and Geology of the University also participate in joint research programmes. An Electronics Unit, also established with the assistance of the Agency through this and other projects, provides repair and maintenance services. The staff of the project, although few, are highly qualified and well trained and the project has made important contributions to science, technology and education in Jamaica.

JORDAN

JOR/1/003 X-RAY FLUORESCENCE

COMPLETED: **91-01-17** TOTAL COST: **$105,983**

TO PERMIT A WIDER RANGE OF STUDIES IN INDUSTRIAL, AGRICULTURAL, ENVIRONMENTAL PROTECTION AND MEDICAL FIELDS THROUGH THE ESTABLISHMENT OF NEW INSTRUMENTAL METHODS FOR PRECISE DETERMINATION OF TRACE ELEMENTS.

This project, first approved for inclusion in the 1987 programme, was a follow-up of an earlier project (JOR/1/002, Nuclear Science, 1978-80). Through JOR/1/003, the Government of Jordan sought Agency assistance to upgrade the facilities of the analytical laboratory at the Department of Physics, University of Jordan, for the determination of trace elements in different matrices by the application of X-ray fluorescence and proton-induced X-ray emission (PIXE) techniques. (The Federal Republic of Germany had earlier donated and installed a Van de Graaff accelerator at the University, to be used for PIXE and other studies). An X-ray fluorescence system, including a water-cooler, a computer system and a multichannel analyser, as well as air-particulate sampling equipment, were provided. An expert assisted with the installation of the analytical system and trained the counterpart staff on utilization and maintenance. Two further expert missions were organized to advise the counterparts on various analytical techniques for the quantitative determination of trace elements in dust, cement, water, tobacco, food and other samples. The counterparts are now undertaking routine analyses of industrial samples for quality control, as well as applied research in physics, chemistry, geology, agriculture and environmental pollution. The liquid nitrogen plant has been repaired through another project (JOR/2/002), thus enabling maximum use to be made of the new analytical facilities at the University.

KENYA

KEN/1/003 RADIOCHEMISTRY

COMPLETED: **91-10-15** TOTAL COST: **$70,231**

TO ESTABLISH A RADIOCHEMISTRY LABORATORY.

Financed by an extrabudgetary contribution from the United Kingdom, an expert was provided to advise the local staff on establishing a radiochemistry laboratory, on items of equipment to be purchased and on the establishment of a training programme to be carried out in the laboratory. Fume hoods, scintillation detectors with scalers, hand-monitoring equipment and ancillary laboratory equipment were provided. The laboratory is being used for practical teaching of radiochemistry to undergraduates and graduates and provides training in safe handling of radioactive material and in the use of detection equipment including monitors. The project has resulted in improved teaching of radiochemistry at the University and increased understanding and use of nuclear technology in the country.

KEN/8/005 ASSESSMENT OF WATER RESOURCES

COMPLETED: **91-06-01** TOTAL COST: **$64,454**

TO IMPROVE WATER RESOURCES MANAGEMENT PRACTICES.

Three expert missions were undertaken to assist in the initiation of a sampling programme, using isotopes, and to advise on the elaboration and further development of such a programme. The experts provided training to local staff in sampling techniques and interpretation of environmental isotope data. This in-service training was supplemented by the award of a fellowship for the chief counterpart at the Agency's Laboratories, Seibersdorf. Equipment including a spectrometer, a computer system and hydrology apparatus was provided and provision made for isotope analysis. As a result of this project a sampling programme has been initiated and local staff have been trained to sustain it. A second phase of assistance has been proposed which will provide for expansion of the sampling programme, analysis of samples, and interpretation of data to be utilized for the elaboration of rational water resource management practices.

MALAYSIA

MAL/0/007 NUCLEAR POWER PLANNING

COMPLETED: **91-12-31** TOTAL COST: **$171,785**

TO ADVISE ON THE POSSIBLE ROLE OF NUCLEAR POWER IN MALAYSIA.

In 1984 the National Electricity Board (NEB) of Malaysia asked the Agency for assistance in reviewing the nuclear option in Malaysia. The Board also asked for help in preparation of an Energy and Electricity Demand Study and to assess the local industrial capability. Further assistance was sought on the assessment of studies on manpower and financing requirements. The NEB later sought Agency assistance in acquiring the computer software ENPEP (Energy and Power Evaluation Package) along with other modules. Advice was also sought on the identification of problem areas in public acceptance of the nuclear power option. During this multi-year project, 14 experts and technical staff of the Agency undertook 15 missions to review and give advice on studies on the nuclear option, on the possible role of nuclear power, on the impact and requirements of a nuclear power programme, and on manpower assessments for the nuclear power programme. The Agency's experts and technical staff also assisted in the acquisition of the ENPEP software and in

giving the necessary training; they also reviewed the report "Integrated Energy Analysis for Malaysia", for which the ENPEP model, prepared by a Malaysian team, was used. Malaysian staff were trained on testing the IMPACTS module of ENPEP. The NEB also acquired both the financial model (FINPLAN), which helped in the compilation of financial impact studies, and the IAEA's MAED model for analysis of their energy demand. Two counterparts undertook a training session at Argonne National Laboratory (ANL) on testing the IMPACTS module of ENPEP. Seven national consultant missions by counterparts participated in discussion meetings at the Agency and at ANL. Three fellowships were awarded for training in the USA. The project helped Malaysia to review the nuclear option and to facilitate the preparation of reports and studies aimed at clarifying the possible role of nuclear power and the impact and requirements of a nuclear power programme. Agency support is being continued under Project MAL/9/009, on the selection of suitable sites for nuclear power plants.

MAL/1/005 NEUTRON ACTIVATION ANALYSIS

CANCELLED: **91-12-31**

TO SET UP A NEUTRON ACTIVATION ANALYSIS FACILITY BASED ON AN ISOTOPIC NEUTRON SOURCE.

Reason for cancellation: This project was approved in 1981 as a footnote-a project and was made operational on receipt of an in-kind offer from the Japanese Government to cover the expert component of the project. As difficulties were encountered in fielding expert missions, the objectives of the project are now covered under the ongoing project MAL/1/009.

MAL/1/006 FAST-NEUTRON ACTIVATION ANALYSIS

COMPLETED: **91-01-15** TOTAL COST: **$44,915**

TO UPGRADE EXISTING NUCLEAR REACTOR FACILITIES FOR THE PRODUCTION OF RADIOISOTOPES.

This project was originally intended to support the provision of a twin-tube pneumatic transfer system to be used for fast neutron activation analysis in connection with the neutron generator provided by the Agency under an earlier project to the National University of Malaysia. Approved in 1983 as a footnote-a project, it was funded extrabudgetarily by the USA. Following the decision to dispense with the activation analysis programme, and in deference to the strong representations made by the Malaysian authorities, the project objectives were changed, with the approval of the USA, and the pneumatic transfer system was redesigned for radioisotope production, using the research reactor at the Tun Ismail Atomic Research Centre. $12 000 was allocated from Agency resources to accommodate the required modifications. The pneumatic transfer system has been installed in the nuclear reactor. It facilitates the production of radioisotopes by decreasing sample transfer time and reducing exposure dose to personnel. Several radioisotopes are currently being produced for use in medicine, industry and agriculture. The local production of radioisotopes has considerably reduced the need for imports, and has contributed to better utilization of the reactor.

MAL/2/002 RADIOISOTOPE PRODUCTION

COMPLETED: **91-12-31** TOTAL COST: **$468,424**

TO ESTABLISH A LABORATORY FOR ISOTOPE PRODUCTION.

The reactor at the Tun Ismail Atomic Research Centre (PUSPATI) became operational in 1982. One of its main functions is the production of radioisotopes for use in medicine, agriculture, industry and research. In 1981 PUSPATI requested Agency assistance in setting up a radioisotope production facility. After a programming mission by an Agency staff member, the project was approved in 1982. Basic equipment, including an atomic absorption spectrophotometer, an ultraviolet/visible light spectrometer, a gamma-ray spectrometer, a freeze drying unit, shielded radioisotope production cells, a microscope, microtome autoradiography apparatus, a high performance liquid chromatography system equipped with a radioactivity monitor, a hot cell line for production of iodine-131 by dry distillation, and an automated bacteria detector. Twelve counterpart staff members received training abroad through project-funded or project-related fellowships and scientific visits. Three staff members participated in Agency training courses. Seven experts gave on-the-job training in radioisotope production, molybdenum-technetium generator technology, preparation and quality control of radiopharmaceuticals, and production of iridium-192 sealed sources for medical applications. This project was also supported by a Research Contract. As a result of this project, a laboratory was set up at PUSPATI for production of radioisotopes and for preparation of radiopharmaceuticals, which is now well prepared to meet the national demand for high quality radioisotopes and labelled compounds for use in medicine, industry, agriculture and research. The laboratory is already producing a series of radioisotopes and two radiopharmaceuticals: MDP kits for bone scanning and sodium pertechnetate. The staff is now well trained to embark on more ambitious development programmes. The research undertaken has resulted in 23 scientific publications and reports.

MAL/2/003 LATEX MATURATION STUDIES

COMPLETED: **91-01-15** TOTAL COST: **$77,535**

TO SUPPORT THE DEVELOPMENT OF METHODS FOR SHORTENING THE LATEX MATURATION PROCESS AND MAKING BETTER USE OF COMPOUNDING INGREDIENTS.

Under this project, funded extrabudgetarily by the USA and implemented at the Rubber Research Institute of Malaysia, a high pressure/high temperature liquid chromatography system and a thin layer chromatography system were provided. With this equipment, the Institute aimed to study the basic mechanisms of rubber chemistry using radiotracers such as sulphur-35, carbon-14 and tritium. A fraction collector and a computer system were also provided. Two scientists received basic training in radioisotope methodology under the Agency's fellowship programme. Promising work has already been started, and it is expected that the details of the rubber maturation processes that will result from this research will make it possible to increase the curing rate of latex and improve the product, thereby improving marketability.

MAL/5/018 NITROGEN-15 FERTILIZER STUDIES

COMPLETED: **91-12-31** TOTAL COST: **$427,818**

(1) TO TRAIN LOCAL STAFF IN THE USE OF ISOTOPES. (2) TO DEVELOP A RESEARCH PROGRAMME ON TREE CROPS.

The project was approved in 1985 to train local staff in the use of isotopes in soil/plant studies and to develop a research programme to optimize the use of nitrogen (N) and phosphorus (P) fertilizers in view of the fact that the greater part of the national income comes from agriculture, with a high consumption of N and P fertilizers. (Losses through the application of urea are estimated to reach 16 million dollars in the rubber plantation sector alone. The project was partly funded by the Agency and partly from funds-in-trust. Eight experts undertook ten missions to provide training, to assist in developing the research programmes and to advise on the interpretation of results of isotope-aided studies on the use of fertilizer and water by tree crops and crops such as rice, tobacco and sugar cane. Equipment supplied included a metallic sample preparation line for N-15 analysis using the emission spectrophotometer, muffle furnace and N-15 and P-32 labelled fertilizers. Five project-funded and project-related fellowships were awarded for training abroad and two scientific visits were arranged. The well equipped facilities of the counterpart institutions (the Nuclear Energy Unit, Bangi, Selangor, the Malaysian Agriculture Research and Development Institute, Kuala Lumpur, and the Agriculture Research Centre, Tuaran, Sabah) helped to implement these activities. Under this project, the capability of scientists at the three counterpart institutions to conduct independent research work, in soil/plant studies using mainly N-15 and P-32, were strengthened. Research programmes using these isotopes have already been initiated with crops such as rubber, cocoa, tobacco and rice in order to find efficient ways of using fertilizers and thereby reducing production costs. The activities are continuing under Project MAL/5/020.

MAL/5/019 RADIATION-INDUCED MUTATION BREEDING

COMPLETED: **91-12-31** TOTAL COST: **$41,903**

TO DEVELOP SEMIDWARF/DWARF MUTANTS OF RICE WITH PROMISING AGRONOMIC CHARACTERISTICS SUCH AS HIGH YIELDS, QUALITY AND RESISTANCE TO DISEASE.

Lodging and susceptibility to pests and diseases are characters which strongly limit rice production in Malaysia. This project, funded by an extrabudgetary contribution from the USA, was initiated in 1986 to obtain desired plant characters by means of mutation breeding techniques. Two Agency experts gave advice and on-the-job training in studies on the use of radiation-induced mutations for improving rice and groundnut and on the development of new varieties with high yield, resistance to disease and high quality. One counterpart staff member received training abroad under a project-related fellowship and another was awarded a scientific visit to the USA, funded by the US Government. Equipment provided included a laminar flow hood, a growth chamber and a PC with printer. As a result of this project, more than 100 semidwarf, stiff straw mutants were selected following gamma irradiation of seeds of the popular rice variety MR52. These very promising results encouraged the counterpart to initiate a programme on mutation breeding of groundnut. Several mutants, potentially resistant and tolerant to Cercospora

leaf disease, were selected in addition to other mutants with improved, important agronomic characters such as high yield, earliness or large seeds. The most prominent mutants of both crops are now under government trials or are being used in cross breeding programmes. The activities are being continued under Project MAL/5/020.

MAL/8/003 NUCLEAR APPLICATIONS IN INDUSTRY

COMPLETED: **91-12-31** TOTAL COST: **$325,621**

TO INTRODUCE RADIOISOTOPE TECHNIQUES FOR NON-DESTRUCTIVE TESTING, PROCESS CONTROL AND QUALITY CONTROL IN INDUSTRY.

This project was first approved in 1982 in order to develop radioisotope techniques for non-destructive testing (NDT), process control and industrial quality control at the Standards and Industrial Research Institute of Malaysia (SIRIM) and at the University of Technology, Kuala Lumpur. During this long term project, three experts undertook four missions to train SIRIM staff and to assist them in the industrial use of NDT techniques. The experts also assisted in the installation and optimum use of the X-ray fluorescence (XRF) spectrometer and the X-ray diffraction (XRD) unit which had been provided by the Agency for mineral analysis. Following reorganization of the programme components, the XRF and XRD units were later shifted to the Nuclear Energy Unit (UTN), where they have been installed and are now being used for mineral analysis. Project-related fellowship training was awarded to one staff member. The project was partly funded ($144 430) by an extrabudgetary contribution from the USA and partly from Agency funds. SIRIM and UTN have now acquired the necessary experience and expertise and are offering NDT services to local industries. A national qualification and certification scheme for NDT personnel has been established in Malaysia, and NDT courses are organized regularly. Design and development of some indigenous NDT equipment are also being undertaken at SIRIM and UTN. The XRD unit is intended to be used for characterization of minerals in the ceramics industry. The XRF unit is analysing rare earth elements. The availability of XRD and XRF techniques for analysis would benefit the programme of the Kelantan State Economic Development Corporation (PKINK) to evaluate deposits with a potential to provide the raw material for use in ceramic applications. These activities are being continued under Projects MAL/8/006 and MAL/8/010.

MAL/8/004 RADIATION PROCESSING FACILITY

COMPLETED: **91-12-31** TOTAL COST: **$301,752**

TO UNDERTAKE MANPOWER DEVELOPMENT AND SMALL SCALE EXPERIMENTS IN RADIATION PROCESSING OF RUBBER, WOOD, MEDICAL SUPPLIES, ETC., TO COMPLEMENT RCA/UNDP ACTIVITIES.

The project was started in 1983 to increase local expertise and capability in radiation processing technology for the vulcanization of natural rubber, radiation processing of wood and polymer materials and radiation sterilization of medical supplies. It was intended to establish a radiation processing centre at the Nuclear Energy Unit (UTN) of the Tun Ismail Atomic Research Centre consisting of a cobalt-60 facility and an electron beam facility. The project is also intended to complement the RCA/UNDP/IAEA project on the use of nuclear

methods in industry (RAS/79/061) and to establish the necessary infrastructure for the requirements of the radiation processing centre. Equipment provided included a small, self-shielded laboratory cobalt-60 gamma source for experiments and training, calibration and testing equipment for plastic, a laboratory hot roll mill, a differential thermal analyser, and equipment for process control. A laboratory unit for ultraviolet radiation curing was also provided. Seven experts undertook eight missions and assisted in developing expertise in process control of radiation sterilization, in radiation chemistry of polymers, in radiation microbiology and in radiation effects on plastic materials as well as in the management and operation of the radiation sterilization facility. Four counterparts received training abroad under project-related fellowships while three were awarded scientific visits. The assistance provided under this project, together with a similar regional project supported by the UNDP and executed by the Agency, have contributed to building up the infrastructure to support the high capacity gamma irradiation facility which was commissioned at the UTN in 1989 and the electron beam irradiation facility which was recently commissioned on the same premises as the UTN's gamma irradiation facility. Agency support is being continued under Project MAL/8/010.

MAL/8/007 FOOD IRRADIATION

COMPLETED: **91-12-31** TOTAL COST: **$101,973**

TO DEVELOP FOOD IRRADIATION TECHNOLOGY.

This project was made operational in 1986 partly by an extrabudgetary contribution from the United Kingdom (87%) and partly from Agency funds. As part of Malaysia's efforts to increase food production for self-sufficiency and export of surplus, the Nuclear Energy Unit (UTN) of the Tun Ismail Atomic Research Centre has undertaken to co-ordinate activities in the food irradiation sector among government institutions, universities and the local food industry. A batch-type gamma irradiation facility was constructed at the UTN to demonstrate to local industry the efficacy of irradiation on a number of food commodities. During implementation of the project, two experts undertook two missions to evaluate the infrastructure for setting up a commercial food irradiator in Malaysia and to help plan pilot-scale R&D. The experts had discussions with various authorities and organizations dealing with food irradiation, including the Pepper Marketing Board and the Health Ministry, to review the status of food irradiation and the approval and clearance of irradiated food for the general market. Three walk-in freezers were provided. Two fellowships were awarded for training abroad, and seven scientific visits were granted. These activities have also been supported by a Research Contract. The project has strengthened the national effort towards developing food irradiation technology and transferring this technology to industry.

MAL/9/006 NUCLEAR LICENSING AND REGULATIONS

COMPLETED: **91-01-15** TOTAL COST: **$9,771**

TO ESTABLISH SAFETY REGULATIONS AND PROCEDURES REQUIRED UNDER THE NATIONAL ATOMIC ENERGY LICENSING ACT OF 1984.

The national counterpart was the Atomic Energy Licensing Board. The first

expert mission sent by the Agency in 1985 prepared complete drafts of two regulations, one on general radiation protection based on the Agency's Basic Safety Standards, and the other on radiation protection in the mining and milling of radioactive ores. These were reviewed further by later expert missions and were adapted to the local situation. Four fellowships were provided for training selected members of the Board's staff abroad, as were two scientific visits; these supported development of manpower for the national services concerned with radiation protection and safety regulations. A national authority and regulations have been established and the regulatory organization is carrying out the functions relating to licensing and inspection. The project has accomplished it's objectives, and draft Radiation Protection Regulations have been established. Activities have continued under Project MAL/9/007 to establish various codes of practice and procedures as well as the technical infrastructure needed for a nationwide radiation protection service.

MAURITIUS

MAR/5/005 INSECT CONTROL BY STERILE-INSECT TECHNIQUE

COMPLETED: **91-06-01** TOTAL COST: **$66,144**

TO CONTROL THE FRUIT FLY (PTERANDRUS ROSA) BY MEANS OF THE STERILE-INSECT TECHNIQUE.

This was an R&D project to train scientists in the sterile-insect technique (SIT) and to demonstrate the technology. Expert services together with laboratory equipment and supplies were provided. In-service training by experts was supplemented by three fellowships and one scientific visit. A useful amount of background data was obtained. A census was made by trapping the entire island for three species of fruit fly. Fruit infestation data were obtained. Local staff acquired skill in SIT and the efficacy of the technology was demonstrated for a future large scale control/eradication programme. There are sound economic grounds for investment in such a programme.

MEXICO

MEX/4/034 IN-CORE FUEL MANAGEMENT

COMPLETED: **91-12-31** TOTAL COST: **$453,105**

TO CONTROL FUEL INVENTORY AND OPERATIONAL PROCEDURES.

The Federal Electricity Commission (CFE) requested Agency assistance to establish, within its Department of Nuclear Engineering, a working group to support operations at the Laguna Verde Nuclear Power Plant, particularly those related to fuel inventory and fuel management. The project was approved in 1984 and funded through extrabudgetary contributions from the USA between 1984 and 1988 amounting to almost half a million dollars. The project helped to establish an independent fuel management system to support safe and economic operation of the nuclear power plant. The necessary computer software and codes to assess thermohydraulic and neutronic core characteristics were provided. The working group received specific training and acquired the capability to analyse fuel bids presented by prospective suppliers in qualitative and quantitative terms and to evaluate tests for startup and normal operation of Unit 1 of the nuclear power plant. It is expected that

this fuel management system will be used routinely by CFE in the years to come.

MEX/5/012 RUMINANT REPRODUCTION STUDIES

COMPLETED: **91-01-08** TOTAL COST: **$90,127**

TO DETERMINE REPRODUCTIVE HORMONE LEVELS IN RUMINANTS.

The studies of reproductive problems of ruminants in the tropics was initiated in the 1970s with FAO collaboration by the Faculty of Veterinary Medicine of the Autonomous National University of Mexico (UNAM). In 1984, the Government requested Agency assistance to introduce radioimmunoassay methods to study progesterone levels as a part of the on-going studies. In 1985, the Faculty constructed a laboratory for these studies, following the advice of two Agency consultants. After provision of the necessary items of equipment, including a gamma spectrometer, a spectrophotometer (for associated enzyme-linked immunosorbent assay (ELISA) studies), a refrigerated centrifuge and supporting equipment, experts gave on-the-job training and advice on programme management. In addition, three research contracts were awarded to counterpart staff, and the ARCAL programme offered support in terms of progesterone kits and chemicals. Two fellowships were awarded (one funded by the USA), and three scientific visits were arranged. The results of the studies conducted with Agency assistance have been documented in 16 publications which have appeared in recognized scientific journals and in 18 articles included in proceedings of international meetings. UNAM is applying the results obtained on its experimental farm and these results are also being applied on a large number of small farms and cattle enterprises throughout Mexico.

MEX/8/014 ISOTOPES IN ENVIRONMENTAL STUDIES

COMPLETED: **91-01-08** TOTAL COST: **$62,721**

TO STUDY CONSERVATION AND MANAGEMENT OF LAKE CHAPALA.

The contribution of the United Kingdom, given in 1984, made it possible to implement this project to assist the Mexican Ministry of Agriculture and Water Resources in its multi-disciplinary study of the lake dynamics, ecology and pollution relating to Lake Chapala, the largest lake in Mexico (1650 square km), through which the Santiago River flows. Agency assistance to support isotope studies on water movement and sediment deposition had been requested. A computerized alpha and gamma measurement system to enable data to be recorded and analysed was provided, and two experts assisted in setting up the analytical system and advising on the overall programme. An Agency research contract, financed by the Federal Republic of Germany, was awarded in 1988 to one project-related investigator. The extended studies on Lake Chapala are under way, with the aim of improving water resource management.

MEX/8/015 CARBON LABORATORY

COMPLETED: **91-01-08** TOTAL COST: **$44,552**

TO DEVELOP CONCEPTUAL MODELS OF GROUNDWATER SYSTEMS THROUGH THE APPLICATION OF ISOTOPE TECHNIQUES; TO ESTABLISH A CAPABILITY FOR DETERMINING THE AGE OF WATER IN VARIOUS AQUIFERS USING CARBON-14 METHODS.

The Mexican Ministry of Agriculture and Water Resources requested Agency assistance to introduce carbon-14 measurement techniques for groundwater dating. The project was approved in 1987. A benzene sample-preparation line was provided, and an expert assisted in setting up the equipment, training in its use, and subsequently reviewing the programme and operation of the carbon laboratory. The work accomplished is contributing to the development of models of groundwater recharge in Mexico on which management of this resource can be based.

MALI

MLI/5/008 MUTATION BREEDING OF RICE AND FONIO

COMPLETED: **91-10-24** TOTAL COST: **$97,669**

TO INITIATE A MUTATION BREEDING PROGRAMME IN RICE AND FONIO IN ORDER TO IMPROVE THE VARIETIES OF THESE CROPS.

During the implementation of this project the Government changed the emphasis from fonio to sorghum. Local varieties of rice and sorghum, two of the most important food staples in Mali, are very susceptible to various diseases which severely affect the yield and quality of both crops. To develop disease-resistant varieties and to improve the quality of the crops, the SOTUBA Agricultural Research Station, Bamako, has initiated a large scale programme and requested assistance from the Agency and other international organizations. Three experts were provided and one fellowship for training abroad was awarded. This assistance, with the provision of some equipment, enabled the Institute to develop a mutation breeding programme for improving local varieties of various crops, in particular rice and sorghum. Promising induced mutants of dwarf rice and sorghum have been obtained at two experimental research stations. Large scale trials of these mutants have been carried out over the past two years and the results are being evaluated.

MLI/6/002 NUCLEAR MEDICINE

COMPLETED: **91-07-26** TOTAL COST: **$349,782**

TO SET UP A NUCLEAR MEDICINE SERVICE AT POINT G HOSPITAL, BAMAKO, AND TO TRAIN LOCAL STAFF IN NUCLEAR MEDICINE TECHNIQUES.

Since 1979, the Agency has been assisting the Government of Mali in establishing the only nuclear medicine service in the country where in-vitro and in-vivo investigations can be performed. Through training of seven local medical doctors and technicians and provision of equipment and supplies, the

nuclear medicine service at Point G Hospital is now capable of routinely performing nuclear medicine diagnostic tests of major organs, such as kidneys, liver, brain and thyroid, and of providing radioimmunoassay services for hormonal studies. All patients are now referred for examination to this service only. Expert services provided during the last three years of the project have improved the nuclear medical service and broadened the range of investigations by developing new scintigraphic imaging procedures and new diagnostic methods. Quality control and data processing procedures have also been introduced.

MLI/7/002 STERILIZATION OF MEDICAL SUPPLIES

COMPLETED: **91-10-24** TOTAL COST: **$62,498**

TO INTRODUCE NUCLEAR TECHNIQUES FOR THE STERILIZATION OF MEDICAL SUPPLIES.

Through provision of equipment and on-the-job training, the project has enabled the Point G Hospital, Bamako, to develop microbiological control methods and assessment criteria for pre- and post-sterilization of medical supplies. Much emphasis was placed on locally produced medical supplies such as gloves, syringes and cotton, which are now routinely checked. On-the-job training in radiation chemistry and safe packing of medical articles was also provided by Agency experts. A related Research Contract was awarded.

MLI/9/002 RADIATION PROTECTION

COMPLETED: **91-07-26** TOTAL COST: **$105,211**

TO ESTABLISH A RADIATION PROTECTION CENTRE CAPABLE OF PROVIDING ADEQUATE PERSONNEL MONITORING SERVICES.

Expert services, equipment and in-service training were provided at the Point G Hospital, Bamako, and one staff member was awarded two scientific visits. A radiation centre has been established in Bamako which is now fully operational, providing protection services to all radiation workers and performing safety inspections and calibration of medical equipment.

MONGOLIA

MON/9/003 RADIATION MONITORING

COMPLETED: **91-12-31** TOTAL COST: **$80,692**

TO DEVELOP PROGRAMMES FOR MONITORING AND CONTROLLING RADIOACTIVE POLLUTANTS IN FOOD PRODUCTS AND WATER SUPPLIES AND FOR THE RADIATION PROTECTION OF WORKERS.

The Radiological Laboratory of the State Institute of Public Health, Epidemiology and Microbiology of Mongolia requested Agency assistance to develop a radiation monitoring programme and to establish a viable radiation protection

service. During implementation of this project, initiated in 1986, one expert undertook two missions to assist the local staff in drawing up a comprehensive radioactivity monitoring programme, to advise on the requirements for a radiation protection programme, and to train the counterpart staff in the use of instruments for measuring radioactivity and interpretation of the measurements. A workshop on radiation protection for patients and workers was organized and three more experts lectured and conducted the practical session exercises. Equipment provided included multichannel analysers, scintillation detectors, thermoluminescence dosimeters, and portable radiation monitoring equipment. In addition to a scientific visit, one fellowship was granted for training abroad. This project has contributed to the establishment of a systematic measurement of radiation background in Mongolia and environmental monitoring throughout the country. It has also helped to establish radiation protection services for radiation workers. These activities are being continued under Project MON/9/004.

MOROCCO

MOR/5/013 RADIOISOTOPES IN AGRICULTURE

COMPLETED: **91-07-26** TOTAL COST: **$273,023**

TO INCREASE SUGAR CANE, LEGUME AND WHEAT YIELDS THROUGH EFFICIENT USE OF FERTILIZERS USING TRACER TECHNIQUES.

After the training abroad of five local staff members and provision of equipment and supplies, the Central Radioelement Station of the National Agricultural Research Institute, Tangiers, can now use tracer techniques to study, under field conditions, soil/water/fertilizer/plant relationships and to optimize the use of expensive fertilizers. Such studies have been carried out on various plants, such as sugar cane, legumes and wheat, and have led to the development of new cultivation practices characterized by a decrease in the use of fertilizers and an increase in crop yield. Expert services and equipment for use of the nitrogen-15 isotope technique led to preliminary identification of legumes with superior fixing capability as well as to identification of some of the factors affecting this capability. Continuity of the studies on atmospheric nitrogen fixation is being secured under the regional project which benefits Morocco.

MOR/5/015 IMMUNOASSAY LABORATORY

COMPLETED: **91-06-01** TOTAL COST: **$129,908**

TO ESTABLISH A TEACHING AND RESEARCH LABORATORY FOR RADIO- AND ENZYME-IMMUNOASSAY TECHNIQUES AS APPLIED TO ANIMAL REPRODUCTION AND DISEASE DIAGNOSIS IN SUPPORT OF ONGOING WORK IN ANIMAL SCIENCE.

Expert advice, equipment (beta-gamma counter) and training have permitted the establishment of a research laboratory for radio- and enzyme-immunoassay techniques for animal reproduction and disease diagnosis. This laboratory is now routinely supporting current work in animal science and is being used as a training facility for national and foreign scientists. Major parasitological diseases affecting livestock in Morocco have been studied by means of immunoassay techniques. Locally prepared vaccine has been developed

and adopted after being fully evaluated. One fellowship and one scientific visit were awarded.

MOR/8/003 ISOTOPE TECHNIQUES IN HYDROLOGY

COMPLETED: **91-06-01** TOTAL COST: **$114,655**

TO INTRODUCE ISOTOPIC HYDROLOGY AND SEDIMENTOLOGY INTO THE UNIVERSITY CURRICULUM AND TO PROMOTE THE USE OF ISOTOPIC TECHNIQUES IN DETERMINING THE FEASIBILITY OF ARTIFICIAL RECHARGE OF GROUNDWATER AND IN DEVELOPING RATIONAL WATER MANAGEMENT SCHEMES.

The project provided expert advice, equipment and training (gamma spectrometer) which enabled the counterpart to introduce isotopic hydrology into the curriculum of the University of Mohammed V, Rabat, and to carry out sedimentological studies to assess erosion and sedimentation problems in the country. Isotopic hydrology is now taught on a routine basis and students are actively engaged in field experiments. Radioisotope-based studies of the sources of reservoir sediments and soil erosion of one main reservoir and its neighbouring rivers have been completed. One fellowship and one scientific visit were awarded.

MYANMAR

MYA/1/012 NUCLEAR PHYSICS

COMPLETED: **91-12-31** TOTAL COST: **$127,396**

TO DEVELOP MANPOWER FOR UNIVERSITY LEVEL TEACHING AND RESEARCH AND TO STRENGTHEN LABORATORY FACILITIES FOR THE APPLICATION OF NUCLEAR TECHNIQUES TO RESEARCH PROBLEMS, WITH PARTICULAR EMPHASIS ON EXPLORATION AND EXPLOITATION OF NATURAL RESOURCES.

The project was approved in 1987 in order to strengthen the capabilities of the Physics Department, University of Yangon, to provide academic training in applied nuclear physics and to provide nuclear analytical services to outside users, including the Ministry of Mines. Analytical services were to be provided by means of fast neutron activation analysis and radioexcited X-ray fluorescence analysis techniques. The Agency provided a refurbished neutron generator with dynamic vacuum system, a Si(Li) radiation detector, a complete gamma-ray counting system, a desktop computer system for data acquisition and analysis, and related accessories. The neutron generator was installed by an engineer from the suppliers, and training on the use of the machine was given at the same time. Additional staff training was provided during two missions undertaken by the Agency's Technical Officer, who conducted tests on the Si(Li) detector and installed several pieces of software on the personal computer, to facilitate nuclear analysis. Two fellowships were awarded under the project, and a third fellow received group fellowship training in nuclear instrumentation at the Agency's Laboratories at Seibersdorf. While the capability of the Physics Department has substantially strengthened through the provision of equipment and training, no further development could be observed as the counterpart institution was closed for more than two years.

MYA/7/004 TISSUE STERILIZATION

COMPLETED: **91-12-31** TOTAL COST: **$117,137**

ESTABLISHMENT OF A HUMAN TISSUE BANK.

This project, approved in 1982, was the pioneering effort in establishing human tissue banks in Asian countries. The project was motivated through the Research Contract Programme of the Agency and was approved following the recommendation of a pre-project assistance mission fielded by the Agency. The project owes its success to a dynamic counterpart well prepared to execute such an activity, and to the provision of excellent laboratory equipment, including spectrophotometer (UV-VIS), a freeze drying unit, desktop computers, a refrigerated van and laboratory supplies. Four experts carried out five missions to help establish the laboratories and train the staff on various aspects of human tissue grafts. Until the beginning of 1988, the project was considered to have been highly successful in achieving several of its objectives. Indigenous procurement of various types of tissue grafts followed by hygienic processing and terminal sterilization with cobalt-60 gamma radiation in prepacked condition had been established. Skills in radiation sterilization processing of biological tissue allografts and xenografts were strengthened, and capability was acquired to assess undesirable radiation-induced damage to essential tissue graft factors. Finally, a radiation sterilization procedure was developed for safe clinical use of the technique. Sterile tissue grafts were also supplied to other hospitals in Myanmar. Unfortunately, following the death of the project counterpart, the project could not sustain itself. It is understood that the Government has taken new initiatives recently to reactivate the programme.

MYA/9/002 ENVIRONMENTAL RADIATION MONITORING

COMPLETED: **91-12-31** TOTAL COST: **$277,105**

TO ESTABLISH A RADIATION MEASUREMENT LABORATORY FOR ENVIRONMENTAL RADIATION MONITORING AND RADIATION DOSIMETRY.

The project was originally approved in 1984 in order to establish a laboratory for environmental radiation monitoring. Following the Chernobyl accident in 1986, the counterpart was able to initiate fallout measurements through determination of radioactivity in rainwater and air samples taken from three different locations. At the same time, the Government introduced routine monitoring of radioactivity in samples of milk and milk products imported from European countries in order to help allay public fears of possible dumping of contaminated products into the country. Under this project, the Agency supplied a low level alpha-beta counting system, a high resolution gamma spectrometer, a thermoluminescence dosimeter reader, a complete tube-excited X-ray fluorescence system, and a desktop computer system for automated acquisition and analysis of data. The installation of equipment and staff training in thermoluminescence dosimetry and X-ray analysis were conducted during six missions by four Agency experts. Participation in fellowships or training course programmes was not possible since nominations were not received. However, two of the project staff who were nominated at a later stage are being trained under a follow-up project. The thermoluminescence dosimetry laboratory established under the project is expected to help in the introduction of personnel dosimetry services.

NIGERIA

NIR/0/003 NUCLEAR SCIENCE LABORATORIES

COMPLETED: **91-10-24** TOTAL COST: **$153,013**

TO ORGANIZE AND STRENGTHEN THE EXISTING NUCLEAR ANALYTICAL LABORATORIES; TO ESTABLISH A MAINTENANCE CAPABILITY WITH THE AIM OF IMPROVING TEACHING AND RESEARCH STANDARDS.

This project, initiated in 1988, has fully met its objective of strengthening the facilities of the existing nuclear analytical laboratories for teaching and research purposes. With Agency assistance the facilities for both X-ray fluorescence analysis and fast neutron activation analysis have been upgraded. Radioisotope and X-ray excited systems and equipment for sample preparation have been introduced. The systems were set up, checked and calibrated with pure chemical compounds as well as with standard reference materials. The quantitative analysis software packages QXAS and COREX were successfully installed. Three local staff members were trained in X-ray fluorescence for a total of about fifteen and a half months. Elemental analysis of geological and biological samples has started. A sealed neutron generator introduced by the Centre for Energy Research and Training, Zaria, several years ago had never been operational. With Agency assistance, the neutron generator was repaired and 14 MeV neutrons were produced in Nigeria for the first time. Subsequently a new neutron tube was installed and higher neutron flux obtained. Expert missions totalling over five months enabled the local staff members to become familiar with the installation and adjustment of the neutron tube as well as with the use of the program GAMANAL for analysis of the gamma-ray spectrum. Some experiments on the analysis of geological samples, soil, environmental samples, plants and soya beans have started. It is expected that the new follow-up project NIR/0/004 will help to expand the existing facilities and consolidate what has already been achieved.

NIR/1/007 NUCLEAR ANALYTICAL TECHNIQUES

COMPLETED: **91-06-01** TOTAL COST: **$68,972**

TO UPGRADE THE EXISTING NEUTRON GENERATOR AND X-RAY FACILITIES FOR USE IN MULTI-DISCIPLINARY RESEARCH AND IN SUPPORT OF ANALYTICAL ACTIVITIES IN MINING, AGRICULTURAL AND OTHER SECTORS.

The Centre for Energy Research and Development, University of Ile-Ife, had acquired facilities including a neutron generator and X-ray fluorescence equipment. This project was designed to put these facilities into operation and to advise on their utilization. Spare parts were provided for the neutron generator and an Agency expert helped to set it up. Additional equipment, including a multichannel analyser with data processing, was provided and another expert gave training in X-ray fluorescence analysis. The chief counterpart received training abroad through a fellowship. These facilities are now fully operational and are used continuously in multi-disciplinary research and in carrying out routine analysis of mining, agricultural and other samples.

NIR/5/014 RADIOIMMUNOASSAY IN ANIMAL PRODUCTION

COMPLETED: **91-10-24** TOTAL COST: **$196,577**

TO USE RADIOIMMUNOASSAY TO INCREASE ANIMAL PRODUCTION AND IMPROVE ANIMAL HEALTH.

The project, initiated in 1986, dealt mainly with the effects of trypanosomiasis on animal reproduction, the sero-surveillance of rinderpest, and the suitability of locally available agricultural by-products and feed supplements. Two fellows were trained for a total of twelve months; eleven expert missions were undertaken and major pieces of equipment, including a gas chromatograph, a gamma counter and a liquid scintillation counter, supplied. Work on trypanosomiasis in small ruminants involved comparison of a trypanotolerant breed of sheep (West Africa Dwarfs) with a susceptible breed (Yankassa) through measurement of reproductive performance. Preliminary studies showed considerable advantage of using cross bred animals in trypanosome-infested areas. Radioimmunoassay kits are still being provided through the regional project RAF/5/006. Serological monitoring of rinderpest was emphasised as part of the national rinderpest control programme. A detailed survey of antibody levels against rinderpest virus was conducted in Kaduna State and the findings were passed to the rinderpest National Co-ordinator to assist similar studies in other regions in Nigeria. The nutrition component of the project focussed on an evaluation of the nutritive value of locally available forages and agro-industrial by-products and on the reproductive efficiency of indigenous sheep and goats. Feeding strategies were then developed for improving ruminant productivity in areas of fluctuating nutrient supply. In addition, this project, by providing equipment and specialized training, has laid a solid foundation for livestock research in Nigeria.

NIR/5/017 FOOD IRRADIATION

COMPLETED: **91-10-03** TOTAL COST: **$40,269**

TO CONDUCT STUDIES ON THE ECONOMIC FEASIBILITY OF PILOT-SCALE FOOD IRRADIATION WITH THE AIM OF COMMERCIALIZING FOOD PRODUCTS.

Five expert missions were undertaken for a total of three man-months. The experts visited several institutes, lectured in seminars, and discussed possible R&D programmes including identification of products that could be economically irradiated in Nigeria. They also studied siting feasibility for the establishment of a pilot irradiation facility and concluded that the Centre for Energy Research and Development, Obafemi Awolowo University, Ile-Ife, was the most suitable location. One staff member received 12 months fellowship training. As a result of this project, the economic feasibility of food irradiation in Nigeria was established, a site was selected for a pilot irradiation facility, and local manpower was trained.

PAKISTAN

PAK/0/003 INIS DATA BASE

COMPLETED: **91-12-17** TOTAL COST: **$234,059**

TO ESTABLISH (1) A DATABASE FOR MANAGEMENT AND DISSEMINATION OF INIS AND OTHER TECHNICAL INFORMATION AND (2) ON-LINE DATA ACQUISITION FOR NUCLEAR SPECTROSCOPY EXPERIMENTS.

A data acquisition/processing facility was set up at the Pakistan Institute of Nuclear Science and Technology (PINSTECH) in 1978 under Project PAK/4/015. To expand its computing facility by establishing a database for the management and dissemination of the International Nuclear Information System (INIS) and other technical information, the Agency was requested to provide additional assistance. This project was originally approved in 1982 with footnote-a status and was upgraded in 1984. Under this project, the Agency has supplied a mini-computer system and an expert to advise on its management. Two counterparts were also trained abroad under project-related long term fellowships. Acquisition of the equipment and training led to the development of a package, PINSTECH Storage and Retrieval Software (PSRS), for the maintenance of bibliographic databases. With this software, the Scientific Information Division can perform retrospective searches and selective dissemination of information services (SDI). Currently, over 200 researchers in Pakistan are receiving monthly INIS SDI services by means of this software. Other features of the software include a database of the tables of contents of 300 journals, a database of technical reports, and a database of PINSTECH publications for library automation. Later, when the INIS CD-ROM became available, a CD-ROM player, allowing easy access to the database, was provided. These information services have helped the Institute to make research available to scientists and engineers, which is essential for the development of nuclear science and technology.

PAK/3/005 URANIUM PROSPECTION

COMPLETED: **91-12-17** TOTAL COST: **$171,510**

TO EXPLORE NUCLEAR MINERALS IN VARIOUS PARTS OF THE COUNTRY.

In support of Pakistan's nuclear energy programme, the Atomic Energy Minerals Centre (AEMC), Lahore, is carrying out a country-wide survey for nuclear raw materials, which includes prospecting, exploration and mineralogy. The Agency had been supporting this activity since 1977 through a number of TC projects and one UNDP-funded project. Under this project, initiated in 1977, the Agency provided eight international experts and three staff members who undertook 14 missions for a total of over 23 man-months. These missions covered exploration methods in sandstone, metamorphic and igneous terrains, as well as uranium mineralogy and project planning and evaluation. The missions resulted in an evaluation of the metamorphic and igneous terrains, and in recommendations on exploration methodologies, on the generation of a new exploration project, and on the AEMC's management structure. Six counterpart staff were trained abroad on long term fellowships and two were awarded project-related scientific visits. The Government also contributed significantly to this activity by making available a large group of geologists, chemists, and other supporting professionals and staff in exploration activities.

Necessary technical infrastructure (field equipment, mineralogical and chemical laboratories, and a metallurgical laboratory)is available and is being maintained with Government funding. With Agency assistance and Government support, the uranium occurrences in Siwalik sandstone area in West Dera Ghazi Khan have been developed into ore bodies that are already being mined. Other prospective areas are still under investigation by the AEMC following the experts' recommendations and with Agency assistance and support under a new project, PAK/3/008, initiated in 1991.

PAK/4/023 KANUPP ELECTRONIC SYSTEMS DEVELOPMENT

COMPLETED: **91-12-17** TOTAL COST: **$175,821**

TO SET UP A MICROPROCESSOR DEVELOPMENT FACILITY FOR THE LOCAL DESIGN AND DEVELOPMENT OF MICROPROCESSOR-BASED REACTOR CONTROL SYSTEMS.

The project aimed at assisting the Government in setting up a microprocessor development laboratory at the Karachi Nuclear Power Plant (KANUPP) to enable local scientists and engineers to design and develop their own microprocessor-based reactor control systems. The immediate objective of this project, first approved in 1981, was the acquisition of the capability to replace obsolete parts of KANUPP's existing regulatory computer system that are no longer being manufactured. The Government also provided some funds-in-trust in support of this activity. Under this project, the Agency has supplied a microprocessor logic development system and some peripheral equipment and spare parts, and an Agency expert advised the counterpart on planning for the design and development of the microprocessor-based reactor control system. Two counterpart staff were trained abroad on project-related long term fellowships and one was offered a project-related scientific visit. With the Agency assistance provided, a microprocessor applications laboratory has been set up which is now engaged in the design and development of microprocessor-based solutions for backfitting the nuclear power plant's obsolete computer and other electronic systems.

PAK/4/029 NUCLEAR EQUIPMENT MAINTENANCE

COMPLETED: **91-12-10** TOTAL COST: **$29,785**

TO ESTABLISH FACILITIES FOR MAINTENANCE AND REPAIR OF ELECTRONIC INSTRUMENTS.

The Electronics Division of the Pakistan Institute of Nuclear Science and Technology, Islamabad, is responsible for the repair and maintenance of a large variety of modern, sophisticated instruments (mostly microprocessor based), including nuclear medicine equipment, used by the research laboratories of the Institute, and it became necessary to upgrade existing facilities to meet increasing demands. The Agency provided maintenance equipment, including a logic analyser and a computer system, which has helped to provide efficient services for the maintenance of nuclear equipment. The counterpart has computerized the maintenance programme and spare parts inventory control, which has modernized the system.

PAK/6/011 RADIATION THERAPY

COMPLETED: **91-12-11** TOTAL COST: **$14,337**

TO STRENGTHEN THE CAPABILITY OF THE ATOMIC ENERGY MEDICAL CENTRE BY INTRODUCING MORE SOPHISTICATED RADIATION THERAPY TECHNIQUES.

The Atomic Energy Medical Centre, Jamshoro, which is equipped with two cobalt-60 and one caesium-137 teletherapy units, had been applying simple techniques of external radiation therapy for cancer, using standard lead blocks for protecting critical tissues such as lungs, thyroid and kidneys. Since a growing number of patients now report to the Centre at an earlier stage of the disease than was previously the case, more sophisticated techniques were needed. The Agency provided hot wire cutting equipment for styrofoam, which is used in fabricating lead shielding blocks for protecting the important radiosensitive organs during large field treatments such as the "Mantle" technique of radiotherapy for Hodgkin's lymphoma. Also supplied was a set of accessories for the Theratron cobalt-60 machine, which restricts the patient's movements in order to obtain port films for treatment planning. These facilities have improved the scope of radiotherapy techniques available at the Centre.

PAK/8/006 GAMMA RADIOGRAPHY

COMPLETED: **91-12-10** TOTAL COST: **$34,455**

TO SUPPORT TRAINING IN NON-DESTRUCTIVE TESTING.

The Non-Destructive Testing (NDT) Laboratory of the Radioisotope Application Division, Pakistan Institute of Nuclear Science and Technology, Islamabad, had been conducting eight-week Industrial Training Courses for NDT workers throughout the country in addition to providing NDT services to local industries. To support this activity, the Agency provided the necessary gamma ray projector with cobalt-60 source, which is already being used for training NDT personnel and for services to local industries. One counterpart was trained abroad on a long term project-related fellowship.

PAK/9/011 SITE SAFETY REVIEW MISSION TO CHASMA NUCLEAR POWER PLANT

COMPLETED: **91-12-10** TOTAL COST: **$34,376**

TO REVIEW THE GEOLOGICAL, GEOCHEMICAL, SEISMOLOGICAL AND METEOROLOGICAL STUDIES CARRIED OUT ON THE CHASMA NUCLEAR POWER PLANT SITE.

The Pakistan Atomic Energy Commission (PAEC) plans to install, over a period of time, a number of nuclear power plants at Chasma, about 26 km south of the city of Mianwali in the northern region of the country. Detailed investigations of the site have been undertaken by the PAEC since 1975, including studies of the geological, geotechnical, seismological and meteorological aspects of the site. Local and international firms and consultants carried out the work. To ensure that the site meets internationally accepted guidelines as recommended by the Agency, assistance was requested from the Agency in the form of an up-to-date review of the studies

carried out so far. Under this project, financed from the Reserve Fund, an Agency team of eight international experts visited the site from 1 to 8 November 1990, reviewed the existing documents and advised the PAEC on the safety of the proposed Chasma Nuclear Power Plant in relation to site characteristics. The recommendations made by the expert team are being considered by the competent authorities in Pakistan.

PANAMA

PAN/5/004 GENETIC IMPROVEMENT OF BANANAS, PLANTAINS AND SUGAR-CANE

COMPLETED: **91-12-31** TOTAL COST: **$217,881**

TO IMPROVE RESISTANCE TO FUNGUS DISEASE IN BANANAS, PLANTAINS AND SUGAR CANE THROUGH SOMATIC MUTATION.

In 1983 the Government of Panama requested the Agency to provide assistance to the Instituto de Investigación Agropecuarias de Panama (IDIAP) to improve fungus resistance in bananas, plantains and sugar cane by breeding these crops through the combined techniques of induced mutations and in-vitro culture. The project, approved in 1983, was almost completely financed by the USA. Under the project, an in-vitro culture laboratory was established at the National University in Panama and was later moved to DIVISA, an experimental research facility of IDIAP. Two researchers were trained in various European laboratories under project-related fellowships. Several experts provided training in different technologies. The project has upgraded breeding activities by transferring the capability to induce somatic mutations in combination with in-vitro plant tissue culture techniques. The technology needed for mutation breeding of bananas, combined with in-vitro culture techniques, has been successfully transferred to IDIAP and the technology will be extended to include plantains and sugar cane.

PAN/9/003 FILM DOSIMETRY

COMPLETED: **91-07-26** TOTAL COST: **$91,771**

TO IMPROVE RADIATION SAFETY SERVICES THROUGH THE UPGRADING OF QUALITY CONTROL PROCEDURES, DOSIMETRY AND THE CALIBRATION OF MONITORING INSTRUMENTS AND THROUGH THE ESTABLISHMENT OF RADIATION PROTECTION REGULATIONS FOR THE ENTIRE COUNTRY.

In 1986 the Government of Panama sought Agency assistance to upgrade the radiation protection programme at the Departamento de Seguridad Radiologica del Complejo Hospitalario Metropolitano de la Caja de Seguridad Social. In the same year, a Radiation Protection Advisory Team (RAPAT) mission strongly recommended that radiation protection in Panama be improved. The project, approved in 1987, reinforced the only film dosimetry service established in Panama since 1975 and helped to establish an adequate national radiation protection scheme. The Agency provided experts to train local personnel in quality control relevant to dosimetry services and to draft regulations for a radiation protection programme. Three fellowships were awarded for advanced training, one each in Brazil, the USA and the Agency's laboratories at Seibersdorf. To upgrade the dosimetry service, a gamma

beam calibrator, a system of diagnostic X-rays for quality assurance, a coding system for monitoring film, and a personal computer with multichannel analyser capabilities, were provided by the Agency. The counterpart reconditioned a laboratory for spectrometry and radiochemistry and increased the number of people working in the radiation protection team. More than 500 persons working with ionizing radiation in Panama now receive an improved dosimetry service which has been mechanized to a large extent. A radiation protection manual for the Caja de Seguro Social has been adopted, and draft national regulations for radiation protection have been presented to the Ministry of Health. This work is being complemented with a project (PAN/9/004) to establish a programme for the monitoring and control of radioactive contamination.

PERU

PER/3/012 URANIUM EXPLORATION

COMPLETED: **91-02-13** TOTAL COST: **$145,871**

TO DETERMINE THE GEOLOGICAL, STRUCTURAL, MORPHOLOGICAL AND POSITIONAL CHARACTERISTICS OF VARIOUS URANIUM ANOMALIES.

The project, originally approved in 1985, was a follow-up on two earlier UNDP-funded projects; it aimed at studying the economic potential of the uranium deposits at Macusani in the Quenamare basin. The staff of the Raw Materials Unit of the Peruvian Nuclear Energy Institute, assisted by Agency experts, assessed the geological exploitability of the deposits, defined possible ore processing procedures that could be applied for the recovery of uranium from its ores, and applied borehole logging procedures to identify the deposits. These activities were successfully completed in 1988. Equipment provided included drilling machinery and related items for borehole logging, as well as spares. In 1988, the project was continued at the request of the counterpart institution so that expert services could prepare the call for international bids for exploitation of the Macusani deposits. The project succeeded in transferring expertise and technology to the Peruvian Nuclear Energy Institute.

PER/5/012 MEDFLY CONTROL

COMPLETED: **91-06-01** TOTAL COST: **$1,512,447**

TO INTEGRATE STERILE INSECT TECHNIQUE WITH OTHER PEST MANAGEMENT PROCEDURES AIMED AT CONTROL AND/OR ERADICATION OF CERATITIS CAPITATA.

This project was established in 1982 through a large scale extrabudgetary contribution from Italy with aim of demonstrating the feasibility of the sterile insect technique for control and eradication of the medfly Ceratitis capitata in the Departments of Tacna and Moguegua in Southern Peru. The project assisted in the study of the ecology of the insect in the area and in establishing sterilization doses and rearing procedures. A pilot installation at the University of La Molina to produce up to eight million sterile insects per week was designed, constructed and put into operation. Entomological equipment, vehicles and yeast were provided by the Agency. On-the-job training by long term experts transferred the technology and set up appropriate quality control for sterile flies and their dissemination. The success of the project was demonstrated by a substantial increase in olive production in the Tacna

Region. The project suffered from continuous changes of staff and from the fact that during implementation three different institutions acted as counterpart institutions. However, since the professional in charge of the rearing plant remained, a healthy insect colony was maintained. Production was periodically increased to deal with sporadic appearances of the insect in neighbouring valleys. Although most of the activities carried out with extrabudgetary funding had been concluded in 1987, Agency assistance was requested in 1989 to maintain the post of a technician in charge of the rearing plant. This allowed negotiations with Chile to be initiated for the supply of sterile insects to fruit plantations in Northern Chile. Funds were also approved in 1990 for re-installation of the gamma irradiators, and a maintenance programme was defined and became operational, which reduced rearing costs by 18%. Two or three million sterile insects can now be produced per week, for dissemination and for evaluation of field data. It has paved the way for an extension of activities to Northern Chile.

PER/5/016 REPRODUCTIVE EFFICIENCY OF ALPACAS AND LLAMAS

COMPLETED: **91-02-13** TOTAL COST: **$106,267**

TO ESTABLISH A FUNCTIONAL LABORATORY FOR RADIOIMMUNOASSAY; TO DEVELOP A CAPABILITY FOR USING RADIOIMMUNOASSAY TECHNIQUES IN STUDIES OF HORMONE LEVELS OF ANDEAN CAMELOIDS WITH A VIEW TO IMPROVING REPRODUCTIVE EFFICIENCY.

Although the Andean cameloids (alpacas and llamas) provide the main economic support and protein source for Peru's high altitude population, their reproductive efficiency is insufficiently understood. The IVITA Experimental Station of the University of San Marcos, which has studied these animals since 1961, had access to some 5000 alpacas and 1000 llamas and had excellent animal handling facilities and infrastructure for field work. It was therefore decided to establish a radioisotope laboratory there so that radioimmunoassay (RIA) techniques could be used to evaluate hormone levels and profiles. Agency assistance was sought, and the project was approved in 1987. Expert RIA services were provided, together with some laboratory equipment, including a beta/gamma counter and RIA kits. Data obtained under this project have shown the possibility of increasing the reproductive efficiency of these species. Unfortunately, owing to civil unrest, one of the expert missions had to be cancelled and the IVITA Experimental Station had to be evacuated. However, emergency laboratories are operating in the neighbouring city of Lima, where research is proceeding. The timely training of staff enabled them during 1990 to report data of interest for increasing the alpaca population not only in Peru but also in other Andean countries.

PER/6/009 MEDICAL APPLICATION OF RADIOISOTOPES

COMPLETED: **91-02-11** TOTAL COST: **$95,100**

TO ESTABLISH QUALITY CONTROL PROCEDURES TO COMPLEMENT AND SUPPORT EXISTING NUCLEAR MEDICAL DIAGNOSTIC SERVICES.

The project was established in 1982 to complement activities initiated under a UNDP-financed project, phases I and II of which are already completed. The aim was to improve quality control for in-vitro and in-vivo nuclear medical

diagnostic procedures at the Nuclear Medicine and Biology Centre operated by the Peruvian Institute of Nuclear Energy in Lima and, later, at the centres established in Arequipa and Trujillo. The project provided expert services for upgrading radioimmunoassay diagnostic procedures for thyroid hormones and permitted the initiation of studies of reproductive hormones. In Arequipa and Trujillo, the Agency assisted in the installation of two gamma cameras and improved their utilization by providing accessories that increased data reliability. Three fellowships were awarded for training abroad. The project has resulted in upgrading the work of three nuclear medical diagnostic centres that are actively serving a sector of the population not usually covered by the national social security system.

PER/8/005 ISOTOPES IN HYDROLOGY

COMPLETED: **91-08-05** TOTAL COST: **$168,078**

TO STUDY AND QUANTIFY THE WATER RESOURCE POTENTIAL OF THE LA YARADA AQUIFER BY APPLICATION OF ISOTOPIC TECHNIQUES.

The La Yarada aquifer, in Southern Peru, supplies water to the population of the Tacna Department and is also used for irrigation. Problems of over-exploitation and sea water intrusion have recently been encountered. The Agency fielded several experts and consultant missions to assist the staff of the Tacna Development Corporation (CORDETACNA) in an investigation involving the use of environmental isotopes (deuterium, oxygen-18, tritium and carbon-14) and chemical analyses of the water. Results obtained show that no local recharge exists at present; the origin of the groundwater is the infiltration of river water during the sporadic rainy periods. At present all rain water is directly collected for supply to the population and hence there is no recharge. The mountain level at which the groundwater of the La Yarada aquifer was generated could be identified on the basis of its isotopic composition, while the existence of a deep aquifer was also identified. However, owing to an insufficient number of wells tapping this aquifer, no precise conclusions could be drawn as to the origin and age of this water. Training in isotope hydrology was given to three project staff members, and the laboratory for chemical analysis of water was upgraded within the framework of this project, including provision of an atomic absorption spectrometer. Lecturers were provided for a national training course in nuclear techniques in hydrological studies.

PER/8/006 GROUNDWATER HYDROLOGY (PHASE II)

COMPLETED: **91-12-10** TOTAL COST: **$107,092**

TO INTRODUCE ISOTOPE TECHNIQUES IN ONGOING STUDIES OF AQUIFERS IN THE NORTHERN COASTAL DESERT AREAS OF PERU.

This project was approved for 1989-90 and involved assistance to the Peruvian Institute of Nuclear Energy as well as to a project of the Ministry of Agriculture dealing with the extension of the agricultural frontier by irrigation technology. Both institutions intended to develop water resources in the northern coastal region of Peru, the Sechura desert and areas around the cities of Piura and Tumbes. Expert services were provided in hydrogeology and well logging and the counterpart was trained at the Agency's Laboratories, Seibersdorf, in

environmental isotope techniques. Equipment supplied included a radiometric survey system, geophysical equipment and a computer system. The environmental isotope study of groundwater in the Sechura-Tumbes area was developed in conjunction with other classical hydrogeological tools to obtain information on the origin and replenishment of aquifers already under investigation. Results of the isotope study have clearly shown a relationship between the aquifer formations of the basin and the rivers flowing from the Andean mountains. On the basis of these results, Peruvian authorities are planning the development of irrigation perimeters supplied by groundwater exploitation in this region.

PER/9/014 RADIATION PROTECTION

COMPLETED: **91-12-17** TOTAL COST: **$35,620**

TO SET UP A CYTOGENETIC LABORATORY FOR THE ANALYSIS OF CHROMOSOMAL ABERRATIONS IN WORKERS OCCUPATIONALLY EXPOSED TO IONIZING RADIATION.

Under its regular programmes for 1985, 1986 and 1987 the Agency assisted the Biological Dosimetry Department of the Peruvian Institute of Nuclear Energy (IPEN) to set up a cytogenetic laboratory for analysis of chromosomal aberrations in workers occupationally exposed to ionizing radiation. The main counterpart was trained through an Agency fellowship and an expert was sent in 1986 and 1989 to assess and plan implementation of the techniques and operation of the laboratory. The Agency supplied mainly optical and measuring equipment. Although the objectives were accomplished, the future development of the laboratory and its usefulness to the country will entirely depend on the support that IPEN can provide by purchasing chemicals and minor accessories necessary for routine operation and providing training for additional staff.

PHILIPPINES

PHI/1/012 SECONDARY STANDARDS DOSIMETRY LABORATORY

COMPLETED: **91-06-01** TOTAL COST: **$106,259**

TO EXPAND THE FACILITIES OF THE RADIATION PROTECTION LEVEL SECONDARY STANDARDS DOSIMETRY LABORATORY TO COPE WITH A WIDER RANGE OF DOSIMETRY SERVICES IN THE COUNTRY, AS REQUIRED IN RESEARCH, INDUSTRY AND RADIATION PROCESSING.

To provide a wider range of dosimetry services throughout the country, the Philippine Nuclear Research Institute (PNRI) sought Agency assistance to expand the present facilities of their secondary standards dosimetry laboratory (SSDL). The Agency has provided the laboratory with a spectrophotometer, a thermoluminescence dosimeter, chemical dosimetry systems, a gamma ray detector and monitor, a standard for beta radiation, and calibration sources. The Agency has also provided expert services to assist the counterparts in TLD dose measurements, high level dose metrology and chemical dosimetry for radiation processing. Three staff members were trained abroad in TLD application at radiation protection level, high dose measurement and SSDL instrumentation; two of them are now in charge of the SSDL project and the radiation protection unit of PNRI, respectively. The SSDL of PNRI is fully

operational for protection level and calibration. The laboratory has been routinely certifying an average of 20 radiation monitoring instruments per month, used by 215 licensed radioisotope users. The services offered have adequately met the radiation protection regulations for users. SSDL activities have also expanded to include high dose metrology. The laboratory has set up a facility for high dose calibration which is in good working order and has developed relevant dosimetry methods for standardizing industrial application as well as dose quality control of the Multi-Purpose Irradiation Facility at PNRI. The laboratory has also been involved in training a number of radiation workers and radioisotope users in dosimetry and calibration. It is expected that the project will continue to promote more accurate and reliable radiation dosimetry for radiation protection and to support industrial radiation processing activities in the Philippines.

PHI/2/007 RADIOIMMUNOASSAY

COMPLETED: **91-09-12** TOTAL COST: **$44,230**

PRODUCTION AND USE OF RADIOLIGAND ASSAY REAGENTS FOR THE DETECTION OF HEPATITIS B SURFACE ANTIGEN AND OTHER ASSAYS.

The project was initiated at the Philippine Nuclear Research Institute (PNRI) in 1984, supported by an extrabudgetary contribution of $43 400 from the USA. The initial aim of the project was to establish radioimmunoassay (RIA) for thyroid-related hormones based on solid phase methodology and for hepatitis B surface antigen and amoebiasis. The Agency supplied equipment to the biomedical and RIA laboratory at PNRI which included a micropipetting system, a deep freezer, a microbalance, an automatic solution dispenser and RIA reagents. Agency experts undertook two missions to advise on the use of RIA to improve swamp buffalo production and medical diagnostic procedures and on the development of solid phase RIA assays, with special emphasis on thyroid-related hormones. The counterparts, in co-operation with smallholders of swamp buffalo, determined buffalo reproductive efficiency by RIA. This work is now being successfully continued under Project PHI/5/019 on nuclear techniques in animal science. In the meantime, an alternative non-isotopic method for measuring hepatitis B surface antigen has been developed by the Philippine General Hospital, where 300 000 hepatitis tests are now being performed annually by this new method, which has made RIA unnecessary. The project has therefore been reformulated and focussed on establishment of RIA for thyroid-related hormones based on solid phase methodology. The project was supplemented by considerable inputs from the regional RIA project for training local staff. With assistance from the Agency, the RIA laboratory at PNRI has established bulk reagent-based assays for thyroid-related hormones T3, T4 and TSH. The counterparts have successfully introduced the solid phase separation system, which is most suitable for Philippine conditions. Primary reagents such as antibodies and tracers are also locally produced. PNRI is now serving as a central production centre from which reagents can be distributed nationwide to user laboratories in order to improve and upgrade health care services.

PHI/3/007 URANIUM EXPLORATION DATA BANK

COMPLETED: **91-07-26** TOTAL COST: **$35,141**

TO DEVELOP A MICROCOMPUTER DATA MANAGEMENT SYSTEM FOR PROCESSING FIELD AND ANALYTICAL DATA FROM URANIUM GEOCHEMICAL EXPLORATION AND TO PRODUCE GRAPHIC OUTPUTS (MAPS) FOR THE EVALUATION/ASSESSMENT OF MINERAL FEATURES AND REGIONAL TRENDS.

The Nuclear Materials Research Group of the Philippine Nuclear Research Institute (PNRI) intended to create a computerized databank of all information related to uranium exploration in the Philippines and to produce appropriate reports and maps. The project was initiated in 1987, financed from the Reserve Fund. The Agency provided equipment, including an AT-compatible microcomputer with basic software, plotter, digitizer, AUTOCAD software, and portable scintillometers for field survey. A number of technical reports on exploration for uranium and other industrial minerals were produced, and computer-generated colour-coded geochemical symbol maps showing mineral features and regional trends, the first such maps to be produced in Philippines, were also produced by the counterparts. The counterparts are continuously developing computer programs and systems for use in the management and analysis of regional geochemical data for evaluation and assessment of mineral resources. The information produced also serves as baseline information for environmental studies and monitoring and for agricultural studies. The maps, covering 45% of the country, were the result of a regional geochemical survey. The staff of the Research Group is now capable of managing a computerized databank for uranium exploration.

PHI/5/017 PESTICIDE RESIDUES

COMPLETED: **91-11-12** TOTAL COST: **$244,648**

TO ESTABLISH GUIDELINES FOR PESTICIDE RESIDUE LEVELS IN FOOD AND ENVIRONMENT.

The project, originally approved in 1981 with footnote-a status, was initiated in support of the Philippine National Food Quality Control Programme as a means of establishing guidelines for pesticide residue levels in foodstuffs by means of nuclear and associated techniques. The project was made operational through an extrabudgetary contribution ($75 000) from the USA in 1981 and later from Agency funds during 1987-1990. The project was implemented at the National Sciences Research Institute (NSRI) at Diliman and the National Crop Protection Centre (NCPC) at Los Banos, both of which operate under the University of the Philippines. Equipment provided to NSRI and NCPC includes liquid scintillation counters, radiation survey monitors, a high performance liquid chromatograph, gas chromatograph, biological oxidizers, a fume hood, a deep freezer and carbon-14 labelled pesticides. Five Agency experts undertook six missions (nine man-months) to NSRI and NCPC between 1985 and 1990. The experts advised on pesticide chemistry and controlled release pesticide formulations, guided research activities, assisted in the interpretation of data obtained, and trained local scientists in pesticide residue analysis. Six fellowships were awarded for training abroad. The research at NSRI and NCPC was intended to evaluate current practices of pesticide use, employing nuclear and chromatographic techniques. The behaviour of pesticides in the rice and fish production system as well as food contamination by

agrofungicide and protectant chemicals are being studied by the counterparts. The data and results generated from the research have been used by regulatory authorities for guidelines for food quality control and environment protection. Analytical procedures of various pesticide residues have also been developed and are being used by interested institutions. The Agency's assistance has significantly contributed to the transfer of technology and to the creation of well trained teams, with well equipped pesticide and radioisotope laboratories, capable of tackling local pesticide residue problems. These activities have resulted in a number of publications and are being continued under Project PHI/5/021.

PHI/6/014 NUCLEAR MEDICINE (CARDIAC FUNCTION STUDY)

COMPLETED: **91-06-01** TOTAL COST: **$262,483**

TO IMPROVE PREVENTION, DIAGNOSIS AND PROPER TREATMENT OF CARDIAC COMPLICATIONS IN CASES OF DIABETES MELLITUS AND THE SERIAL ASSESSMENT OF PRIMARY HEPATOMA UNDER CHEMOTHERAPY.

The Philippine General Hospital of the University of the Philippines sought Agency assistance to improve diagnosis of coronary heart disease associated with Diabetes mellitus. This project was funded by an extrabudgetary contribution from the USA ($48 000 for equipment) in 1983 and was subsequently funded by the Agency. The Agency provided the Hospital with a GE scintillation gamma camera with ADAC image processing computer system, a liquid scintillation counter, a high voltage circuit board and spare parts. A short term fellowship in the USA was awarded to train local staff to use the GE gamma camera and ancillary data processing system. Although the activities were well planned, the project suffered a significant setback owing to delays in construction of the building intended to house the equipment and problems with the gamma camera itself. Since 1986, 23 photomultiplier tubes and many other components of the camera have been replaced. The camera and ADAC computer system were finally installed at their permanent site in the new Hospital building in 1989. The camera performs reasonably well and can be used for patient studies, particularly where no high resolution is required. The Agency also provided expert services to train local staff in quality control studies and imaging procedures. The Hospital is now well equipped, with a GE gamma camera provided by the Agency and a SPECT gamma camera provided by the Philippine Government. A range of cardiac function studies is being routinely performed. The nuclear medicine services are valuable for public health, and the facilities at the Philippine General Hospital are also used for training nuclear medicine students. It is expected that the counterparts will continue the cardiac studies and further improve nuclear medicine services.

PHI/7/004 RADIATION STERILIZATION OF HUMAN TISSUE

COMPLETED: **91-12-17** TOTAL COST: **$42,487**

TO INCREASE THE AVAILABILITY OF RADIOSTERILIZED HUMAN BONE AND TISSUE FOR MEDICAL PURPOSES THROUGH THE ESTABLISHMENT OF A NATIONAL BONE AND TISSUE BANK.

The Philippine General Hospital of the College of Medicine, University of the

Philippines (UP-PGH), in collaboration with Philippine Nuclear Research Institute and the National Orthopaedic Hospital (NOH), requested Agency assistance to establish a tissue bank to supply radiation-sterilized bone and tissue allografts to medical centres in the Philippines. Under this project, initiated in 1987, the Agency supplied equipment to UP-PGH including a freezer, two freeze drying units, a laminar flow hood and a computer system. A staff member was trained abroad and a scientific visit was granted. Further assistance was received from the Agency under a Research Contract. A tissue bank has now been established at the Department of Orthopaedics of UP-PGH and tissue allografts (bones and amnions) are available for clinical use. The safety and reliability of the radiation-sterilized tissue allografts have been proven by the surgeons, mainly from UP-PGH and NOH, who have been using them. The project has stimulated scientific studies on bone, ligament and cartilage transplantation, using the available equipment and the expertise of the tissue bank staff. The counterparts are introducing tissue bank technology to the rest of the country and are supplying other medical centres with radiation-sterilized bone and tissue allografts. There is a marked saving in time and costs, and the risk of infection in patients has been greatly reduced. Four reports based on research and clinical work at UP-PGH have been published in scientific journals and presented at international meetings.

PHI/9/017 DETERMINATION OF RADON AND THORON LEVELS

COMPLETED: **91-12-17** TOTAL COST: **$119,658**

TO MONITOR RADON AND THORON LEVELS IN THE ENVIRONMENT AND IN COAL AND URANIUM MINES.

The Philippine Nuclear Research Institute (PNRI) sought Agency assistance to determine the levels of radon and thoron in air samples from ambient environment and representive dwelling places (geothermal stations, underground mines, etc.) in order to assess the collective dose received by Filipinos and the occupational exposure due to radon and thoron. Under this project, initiated in 1986, the equipment provided included a pylon radon detector, Eberline WL monitors, a silicon surface barrier detector with alpha spectrometer, CR 39 track detectors, a vacuum pressure pump and radioactive calibration sources. Two experts carried out three missions to PNRI during 1988-1991, assisting counterparts in the design and operation of occupational, national and regional surveys of radon exposure. They also advised on intercalibration and intercomparison of radon and thoron measurement systems with the results of PNRI and informed the staff of international developments in assessing dose and risk factor associated with exposure to radon and its short-lived decay products. They also trained staff in sampling and monitoring techniques for radon and thoron measurements. Two scientific visits were supported under an Agency regional fellowship project. A national survey of radon in houses is in progress with the co-operation of the Philippine National Census and Statistics Office, involving a population-based radon sampling strategy including 2500 households in the Philippines by means of the nuclear track etch technique. As no uranium mines are operating at present, activity concentrations of radon and its decay products are being measured in a non-uranium underground mine to assess occupational exposure of workers. As a result of this project, PNRI has established a well equipped radon monitoring laboratory with well trained staff capable of measuring radon and its decay products in environmental and occupational dose assessments. The main constraint is lack of local funding for on-site measurement of occupational exposure in underground mines and

for environmental monitoring outside metropolitan Manila. It is anticipated that PNRI will receive sufficient local financial support to enable the monitoring programme to be continued after completion of the project.

POLAND

POL/2/010 EXPLORATION FOR AND EVALUATION OF NATURAL RESOURCES

COMPLETED: **91-02-11** TOTAL COST: **$89,097**

TO STRENGTHEN THE NATIONAL CAPABILITY FOR THE DEVELOPMENT OF NUCLEAR BOREHOLE LOGGING EQUIPMENT AND NUCLEAR INSTRUMENTS FOR ON-LINE GEOLOGICAL SAMPLE ANALYSIS WITH A VIEW TO EVALUATING NATIONAL MINERAL RESOURCES.

The Institute of Physics and Nuclear Techniques of the Academy of Mining and Metallurgy, Cracow, was assisted under the project to acquire expertise in the design of nuclear borehole logging equipment and nuclear instruments for on-line analysis of geological samples. A computer system, radiation detectors, isotopes and an alpha spectrometer were supplied. A fellowship for training abroad and an Agency Research Contract for project-related studies were awarded. Agency support has strengthened and augmented the local capability for exploration and assessment of mineral resources in Poland, which are important to the economy.

POL/4/005 QUALITY CONTROL SYSTEM

COMPLETED: **91-01-25** TOTAL COST: **$199,877**

TO UPGRADE QUALITY CONTROL SERVICES IN SUPPORT OF THE NUCLEAR POWER PROGRAMME AND THE OPERATION OF NUCLEAR FACILITIES.

In 1987, as part of the national nuclear power programme, the Department of Quality Assurance Methods of the Institute of Atomic Energy (IAE), Swierk, sought Agency assistance to develop its capability to engage in quality assurance programmes for the national nuclear power programme and for the nuclear research facilities at IAE. Agency experts advised on in-service inspection and seismic aspects of siting in respect of the Zarnowiec Nuclear Power Plant that was under construction. Lecturers were provided by the Agency for two training seminars organized through the project, one concerned with quality assurance and control of civil engineering works (seven experts); one with quality assurance for mechanical equipment (six experts). Various items of non-destructive testing equipment were supplied. Eight scientific visits and two fellowships for training abroad were granted. Although the nuclear power programme is at present suspended, the training received is being applied to in-service inspection of existing nuclear research facilities and to quality control in support of industry.

POL/4/007 PROCUREMENT ASSISTANCE

COMPLETED: **91-06-01** TOTAL COST: **$24,155**

TO OPEN A FUNDS-IN-TRUST ACCOUNT FOR PROCURING ITEMS OF EQUIPMENT TO IMPROVE INFRASTRUCTURE AND INSTRUMENTATION AT THE MARIA RESEARCH REACTOR.

This Funds-In-Trust project was initiated at the request of the Institute of Atomic Energy, Swierk, in 1987. From funds received from Polish authorities, the Agency assisted the Institute to procure diverse equipment and accessories required to improve its infrastructure. Some equipment was also supplied in connection with maintenance of the Maria Research Reactor's nuclear instrumentation and electronics.

POL/4/009 MODERNIZATION OF MARIA REACTOR

COMPLETED: **91-12-31** TOTAL COST: **$1,646,893**

TO INCREASE PRODUCTION OF RADIOISOTOPES OF PARTICULAR INTEREST FOR THERAPEUTIC AND INDUSTRIAL PURPOSES AND TO IMPROVE THE SAFETY OF THE REACTOR.

The Institute of Atomic Energy, Swierk, which is the only institute in the country producing radioisotopes for use in medicine, industry, agriculture and science, requested Agency assistance in modernizing its research reactor (Maria). A Reserve Fund project was approved with the main objective of installing new beryllium (Be) reflector (29 Be blocks and 67 Be rods) in order to extend the reactor core and improve its neutron flux. The Agency assisted the Institute in the new core calculations as well as in the design of the Be reflector, which were supplied through extrabudgetary contributions from the USSR and Poland under the same project. A fellowship was awarded in reactor engineering. Installation of the new reflector was completed in 1990. Upgrading the Maria research reactor made it possible to increase the production of radioisotopes in Poland and enabled the Institute to carry out advanced research in neutron transmutation doping and materials testing. The extension of the reactor core also resulted in greater operational safety.

POL/5/007 ISOTOPES IN ANIMAL SCIENCE

COMPLETED: **91-01-22** TOTAL COST: **$167,318**

TO INCREASE MILK AND MEAT PRODUCTION AND ANIMAL FERTILITY THROUGH ISOTOPE-AIDED STUDIES ON ANIMAL NUTRITION, METABOLISM AND REPRODUCTION.

The Department of Animal Physiology of Warsaw Agricultural University, in collaboration with three other Polish institutes concerned with animal husbandry, were assisted in the application of isotope techniques that aimed at increasing milk and meat production as well as animal fertility. The Agency provided the counterparts with chemicals and specialized equipment not available in Poland to enable the experiments to be performed. The equipment included high pressure and high temperature liquid

chromatography apparatus and an emission spectrometer for following the uptake of nitrogen-15 labelled feeds from local fodder, industrial by-products and non-protein sources of nitrogen. Three Agency experts advised on studies of metabolic hormone levels in connection with meat and milk production, while training abroad was provided through one project-related fellowship and two project-funded scientific visits. The results were published in more than twenty scientific papers. The project succeeded in introducing into the country isotope techniques for the improvement of animal feeding practices in large scale animal husbandry. This in turn should lead to higher milk and meat production nation wide.

POL/9/008 ENVIRONMENTAL PROTECTION

COMPLETED: **91-06-01** TOTAL COST: **$69,048**

TO STRENGTHEN THE CAPABILITY OF THE CENTRAL LABORATORY FOR RADIOLOGICAL PROTECTION IN ENVIRONMENTAL RADIOACTIVITY MONITORING.

The Central Laboratory for Radiological Protection, Warsaw, requested the Agency in 1988 to provide it with a gamma spectrometry system and related accessories. The system was supplied in the same year. Additional supplies of isotopes and a computer system were provided in 1990. A related Research Contract was also supported by the Agency. The project strengthened the local capacity for effective environmental radioactivity monitoring, which is a regular activity of the Laboratory.

POL/9/010 ATMOSPHERIC DISPERSION MODELLING

COMPLETED: **91-05-14** TOTAL COST: **$70,271**

TO PERFORM A DIFFUSION EXPERIMENT TO DETERMINE REAL DISPERSION CONDITIONS OF GASEOUS AND AEROSOL CONTAMINATION DISTRIBUTION AT THE SITE OF THE ZARNOWIEC NPP.

Construction of the Zarnowiec nuclear power plant posed several environmental questions. This one-year project addressed the question of the actual dispersion characteristics of gaseous and aerosol contaminants of the plant after operation. The Agency provided the Central Laboratory for Radiological Protection in Warsaw with the equipment required to perform diffusion experiments, which included one stationary and one portable gas chromatograph, tracer SF_6 compound and various laboratory accessories. A related fellowship was also awarded. Owing to cancellation of the Zarnowiec NPP, the results of the diffusion experiments are not being used at present.

PORTUGAL

POR/1/004 STAINLESS STEEL PROPERTIES

COMPLETED: **91-09-12** TOTAL COST: **$100,552**

TO STUDY THE INFLUENCE OF HYDROGEN ON THE PROPERTIES AND STRUCTURE OF AUSTENITIC STAINLESS STEELS BY MEANS OF MOESSBAUER SPECTROMETRY.

This project, approved for the 1987 programme, had the initial objective of studying the properties and structures of stainless steels. Following the first expert mission to the project, during which the expert gave lectures and seminars on the various applications of the Moessbauer spectroscopy technique, the counterparts reviewed their work programme to focus on the use of iron-57 Moessbauer resonant absorption spectroscopy for specific problems in studying the structure and redox equilibria of iron in silicate glasses. The technique also proved suitable for ceramics, and a collaboration developed between the Moessbauer Laboratory at the Physics Department of the University of Coimbra and the Institute for Ceramics and Glass (also at Coimbra) and with the ceramics group at the New University of Lisbon. Similar contacts were made with the Chemistry Department, the Electron Microscope Section and Mechanical Engineering Department of the University of Coimbra to cross-check results with complementary techniques such as nuclear magnetic resonance and electron scanning microscopy. The equipment supplied under the project included a computerized Moessbauer spectroscopy system and radioisotope foils enriched with iron-57. Two counterpart staff visited the Carnegie Institute, Washington, to consult with specialists on the Moessbauer technique. The counterparts are continuing their investigations on various areas in Portuguese industry where the technique could be applied.

POR/5/002 NUCLEAR TECHNIQUES IN ANIMAL SCIENCE

COMPLETED: **91-01-18** TOTAL COST: **$68,680**

TO STUDY PROGESTERONE LEVELS IN MILK IN ORDER TO DETERMINE THE REPRODUCTIVE EFFICIENCY OF DAIRY COWS.

The project started in 1988 at the request of the National Station for Animal Selection and Breeding (ENSRA), Lisbon. The main aims of the project were to establish the technique of solid-phase radioimmunoassay (RIA) for measuring progesterone in the blood and milk of cattle, and to use this for field studies on the causes of reproductive inefficiency in dairy farms in Portugal. This was achieved through on-the-job training and advice supported by four expert missions and one fellowship. The Agency further provided ENSRA with related counting and laboratory equipment, and chemicals. The project has promoted wider application of RIA techniques in animal production, and has given local scientists the capability to assist farmers in Portugal to increase reproductive efficiency and milk production through improved management practices.

POR/8/002 IRRADIATION FACILITY

COMPLETED: **91-02-11** TOTAL COST: **$927,907**

TO ESTABLISH A GAMMA IRRADIATION FACILITY FOR THE STERILIZATION OF MEDICAL SUPPLIES.

Large scale commercial production of disposable syringes in Portugal started in 1984, and owing to restrictions on the use of ethylene oxide, which was previously used for sterilization, the Laboratorio Nacional de Engenharia e Tecnologia Industrial (LNETI), Sacavem, sought the Agency's assistance to establish a gamma irradiation facility to be used mainly for sterilizing disposable medical supplies and controlling microflora in cork products. This project, initiated in 1983, provided LNETI with a semi-industrial cobalt-60 gamma irradiator and auxiliary equipment. Other equipment included a universal tensile strength testing machine and accessories, a hydraulic press, a colorimeter, and a thermogravimetric analyser. Government inputs were also completely fulfilled. The USA made an extrabudgetary contribution of $37 000. Several expert missions advised on radiation engineering, radiation sterilization, management and operation of irradiators. One fellowship and one scientific visit were awarded. Under the project, a gamma irradiation facility has been established at LNETI, where it is undertaking routine irradiation of foodstuffs and sterilization of medical supplies. With additional equipment to be supplied under another project (POR/8/005), LNETI will be able to provide services in respect of sterilization of medical supplies, pilot-scale food irradiation, and several other industrial applications of irradiation.

REGIONAL AFRICA

RAF/3/002 ESTABLISHMENT OF RADIOMETRIC CALIBRATION FACILITIES

COMPLETED: **91-10-24** TOTAL COST: **$10,773**

TO ESTABLISH CALIBRATION PADS FOR GAMMA-RAY SURVEY INSTRUMENTS TO ALLOW PROPER CALIBRATION OF THESE INSTRUMENTS.

At the request of a Member State this project established spectrometric calibration facilities at the Eastern and Southern African Mineral Resources Development Centre (ESAMRDC) which is an intergovernmental institution serving countries in Eastern and Southern Africa. Some countries in this sub-region have uranium exploration programmes which require the use of gamma-ray spectrometers. The facilities established are capable of being used for both airborne and portable spectrometers. As a result of the project ESAMRDC is able to provide calibration facilities on request to countries in Eastern and Southern Africa. The use of calibrated spectrometers provide standardization of different surveys and assure uniform correlatable and comparable values.

RAF/5/004 NUCLEAR TECHNIQUES IN INSECT PHYSIOLOGY AND BIOCHEMISTRY

COMPLETED: **91-01-15** TOTAL COST: **$320,326**

TO PROVIDE ICIPE WITH FACILITIES FOR TRAINING SCIENTISTS FROM THE COTE D'IVOIRE, KENYA, UGANDA AND ZAMBIA IN THE USE OF RADIOISOTOPES IN STUDIES ON INSECT PHYSIOLOGY AND BIOCHEMISTRY.

Between 1983 and 1990, the International Centre of Insect Physiology and Ecology (ICIPE), Nairobi, was provided with equipment, radioisotopes and expertise to support training in the use and safe handling of radioisotopes in research on insect physiology and biochemistry. A fully functional 'C' type laboratory was established, with one room for radioisotope monitoring and counting and one room for the use of radioactive chemicals in experiments. Equipment was also provided to the Mbita Point Field Station for radiolabelling insects for field use. Two regional courses were held under the guidance of Agency experts on the use and safe handling of radioisotopes in insect science. The first, in 1987, was attended by 11 scientists from four African countries (Kenya, Tanzania, Uganda and Zambia); the second, in 1989, was attended by 10 scientists from six African countries (Chad, Kenya, Sierra Leone, Somalia, Sudan and Uganda).

REGIONAL EUROPE

RER/4/002 IN-SERVICE INSPECTION OF WWER-TYPE REACTORS

COMPLETED: **91-01-08** TOTAL COST: **$211,376**

TO CO-ORDINATE THE ESTABLISHMENT OF IN-SERVICE INSPECTION FOR WWER-TYPE REACTORS.

This regional project was initiated in 1989 upon the request of several countries operating WWER-type reactors to establish in-service inspection guidelines and criteria for such reactors as an important contribution to plant safety. The project, through implementation of several expert missions and eight workshops or training courses, provided assistance to Bulgaria, Czechoslovakia, Hungary and Poland (the Syrian Arab Republic participated only initially). Topics considered included the establishment of inspection requirements, basic equipment criteria, general manpower requirements, evaluation of local capabilities, definition of quality assurance programmes, and in-service inspection programmes. Since inspections are to be performed on Class 1 components, in particular the reactor pressure vessel, steam generators and primary circuit piping, pumps, valves and pressurizers, the workshops and on-the-job training organized under the project emphasized practical approaches to examination of these components. Inspection techniques for eddy current testing and other forms of non-destructive testing, as well as steam generator tube plugging, were presented in detail and "first-hand" studies were arranged by taking the participants to nuclear power plants under maintenance (Paks, Kozloduy, Krsko, Jose Cabrera and Almaraz). The overall response from the participating countries was very positive, and they all indicated that the experience gained was very valuable. The project has successfully contributed to the establishment or improvement of national infrastructures for in-service inspection of WWER-type reactors in the participating countries.

REPUBLIC OF KOREA

ROK/0/005 PUBLIC ACCEPTANCE OF NUCLEAR ENERGY

COMPLETED: **91-12-31** TOTAL COST: **$47,778**

TO ESTABLISH A LONG RANGE NATIONAL PUBLIC INFORMATION PROGRAMME FOR BETTER UNDERSTANDING OF THE USE OF NUCLEAR ENERGY FOR POWER GENERATION AND OTHER PURPOSES.

While the number of nuclear installations in Korea is increasing, the general public's concern over nuclear safety is growing. In 1988 the Government sought Agency assistance in developing a public information strategy and assisted organizations active in the nuclear field by promoting, developing and co-ordinating a nuclear public information programme. One scientific visit was organized for the study of public information strategies in various countries. The Korean Atomic Energy Research Institute (KAERI) received three expert missions concentrating, respectively, on nuclear public information, strategies against the anti-nuclear movement, and guidance on conducting an opinion survey. The first mission produced a number of recommendations on how to perform public information activities. The second mission analysed the origin, purpose and tactics of the anti-nuclear movement and made recommendations on how to counteract oppositional behaviour. As a consequence, several organizations concerned with nuclear energy have increased their efforts in public information. Funding and the range of activities of organizations active in the area of nuclear information have increased since the project began. The third mission dealt with public concern and how to provide information to satisfy it; a design was initiated for a questionnaire to survey public attitudes towards a nuclear waste facility. The activities begun under the project enjoy the continuous support of KAERI and other organizations active in the Korean nuclear energy programme.

ROK/3/006 URANIUM EXPLORATION

COMPLETED: **91-01-08** TOTAL COST: **$52,484**

TO REVIEW AND EVALUATE THE EXISTING GEOLOGICAL INFORMATION, TO PERFORM A FIELD STUDY OF CHOSEN AREAS, AND TO FORMULATE A PROGRAMME FOR THE NEXT STAGE OF EXPLORATION.

In view of the Republic of Korea's extensive and long term nuclear power programme, the Government intended to assess the country's nuclear raw materials potential. The Korea Institute of Energy Resources (KIER) has conducted a modest but continuous uranium exploration programme for several decades. However, to date, the most promising discoveries have been low grade, high cost, black shale deposits. This project was to consider whether the new techniques recommended for uranium exploration by a joint NEA/IAEA group of experts might be applicable. The project was funded extrabudgetarily by the Federal Republic of Germany. Two Agency experts undertook three missions to advise on the assessment of the uranium potential in crystalline (granite and metamorphic rocks) as well as in sedimentary geological environments, since these two environments would offer better possibilities for finding economic deposits. A more thorough and co-ordinated research in such environments has still to be done. The project has provided the Institute with improved awareness of the best procedures for testing

favourability in the target areas.

ROK/5/026 RADIOIMMUNOASSAY IN CATTLE PRODUCTIVITY STUDIES

COMPLETED: **91-01-08** TOTAL COST: **$59,306**

TO IMPROVE THE REPRODUCTIVE PERFORMANCE AND PRODUCTIVITY OF INDIGENOUS CATTLE THROUGH THE STUDY OF REPRODUCTIVE HORMONES BY RADIOIMMUNOASSAY.

Although indigenous cattle are the most important group of livestock in the Republic of Korea, their reproductive performance and productivity are low. A capability for using hormone assay techniques is needed for the study of these problems. Under this project, supported by extrabudgetary funds from the USA, an Agency expert undertook two missions to advise the Department of Veterinary Medicine of the Chonnam National University, Kwangju, on hormone assay techniques and on the use of hormone assay data in infertility studies. Some equipment, including an enzyme-linked immunosorbent assay (ELISA) unit, a multi-well gamma counter and a refrigerated centrifuge, were also supplied. The solid-phase radioimmunoassay and ELISA techniques have been established. Reproductive hormone levels, specifically of progesterone, are being measured in the blood and milk of Korean native cattle using traditional physiological and clinical methods in combination with the hormone assays. The findings were used to seek methods of improving reproduction through changes of management or, in some instances, through use of therapeutic drugs or exogenously administered hormones. Local scientists now have the equipment and expertise to use advanced techniques for studies relevant to local farming problems, and the infrastructure established through the project has made their active participation possible in an FAO/IAEA Regional Co-ordinated Research Programme on animal reproduction in Asia.

ROK/8/005 INDUSTRIAL APPLICATIONS

COMPLETED: **91-12-31** TOTAL COST: **$52,991**

TO PLAN AND PREPARE FOR THE CYCLOTRON PRODUCTION OF SHORT-LIVED ISOTOPES AND TO DESIGN THE LABORATORY.

The project was approved in 1982 and supported by an extrabudgetary contribution from the Federal Republic of Germany. Under this project, an ambitious programme for the cyclotron production of medically important radionuclides was initiated. The cyclotron was installed at the Cancer Research Hospital of the Korean Atomic Energy Research Institute and was made operational in 1986, with neutron therapy as its main task. In 1987, the target room was ready and became available for the production of radioisotopes. Four experts undertook four missions in order to strengthen local expertise in cyclotron operation and maintenance, to transfer the target technology for production of radioisotopes, and to demonstrate various means of producing the radionuclides gallium-67, titanium-201 and iodine-123. One of the experts helped to prepare the engineering drawings for production of rubidium/krypton generators by means of a gas target. Training abroad was provided by three project-related fellowships, one of which was supported by the USA, and by one project-related scientific visit. The Cancer Research Hospital is now producing titanium-201 and gallium-67 for diagnostic purposes.

In view of the decreasing use of the cyclotron for neutron therapy and the increased demand for cyclotron-produced radionuclides, the Hospital is considering a plan to expand the radionuclide production programme to meet the national requirements.

ROK/9/027 COMMISSIONING AND START-UP TESTING OF NUCLEAR POWER PLANTS

COMPLETED: **91-01-08** TOTAL COST: **$129,978**

TO STRENGTHEN THE LOCAL CAPABILITY FOR COMMISSIONING AND STARTUP TESTING OF NUCLEAR POWER PLANTS.

The Korea Institute of Nuclear Safety (KINS) is responsible for the regulatory aspects of nuclear safety for the country's nuclear power programme. Four 950 MW(e) PWR plants (two of Westinghouse design and two of Framatome design) were to be commissioned, one plant each year, under non-turn-key arrangements. The Agency was requested to assist with commissioning and startup testing, primarily with respect to mechanical, instrument, and control-equipment inspections. This project, first approved in 1985, was designed to assist KINS, as a technical support organization for the licensing authority, in surveillance and approval of the commissioning of several PWR nuclear power plants. Nine Agency experts undertook 15 missions to cover commissioning procedures, ranging from individual system startup to general procedure review, review of the Final Safety Analysis Report, and review of non-destructive testing procedures and methods. The missions assisted KINS in the commissioning reviews of Korean Nuclear Units (KNU) 6, 8, 9 and 10. However, problems were encountered in recruiting suitable experts exactly matching the plant construction schedule. Since there is little flexibility in the schedule for performing licensing inspections for startup and commissioning tests, a delay of one or two months may invalidate the usefulness of the hands-on advice which was sometimes needed. In addition, the fact that two of the plants are of United States origin and two are of French design also placed technical background constraints on the selection of experts. Allowing for these limitations, the project went well and has assisted KINS to develop expertise in commissioning tests and non-destructive examinations.

ROK/9/029 NUCLEAR REGULATORY SYSTEM

COMPLETED: **91-12-31** TOTAL COST: **$70,367**

TO IMPROVE THE SAFETY MANAGEMENT AND REGULATORY SYSTEM OF THE KOREAN NUCLEAR INDUSTRY.

The extensive nuclear programme of the Republic of Korea requires a high degree of safety in the operation and management of its nuclear facilities. The Korea Institute of Nuclear Safety (KINS) is responsible to the Government for the regulatory and licensing aspects of nuclear installations. Under this project, initiated in 1987, two Agency experts reviewed the licensing process and the duties of the parties involved and compared the existing Korean practices with those of other countries. The experts suggested a course of actions to strengthen the effectiveness of regulatory control in Korea. Another Agency expert analysed the situation for licensing and inspection procedures to control the installation and operation of the new PWR fuel factory. The expert selected was also an advisor to the licensing authority of the country from which the

design of the factory originated, and thus provided proof of licensability and gave advice on checking and inspecting the operation. One long term fellowship was awarded for training abroad. The experts' recommendations are being considered by the authorities in Korea.

ROMANIA

ROM/1/007 DOSIMETRY INSTRUMENTATION

COMPLETED: **91-06-10** TOTAL COST: **$657,034**

TO DEVELOP DOSIMETRY INSTRUMENTATION FOR RADIATION PROTECTION AND ENVIRONMENTAL SURVEILLANCE AS RELATED TO NUCLEAR POWER PLANTS.

Under this project, approved in 1984, the Institute of Atomic Physics, Bucharest, requested Agency assistance to set up a complex laboratory for quality control of the dosimetry instrumentation made for use in nuclear power plants and to strengthen the Institute's capability to produce nuclear devices for dosimetry. Agency expert support was used for implementation and applications of computer-aided design (CAD) to a calibration laboratory. The equipment provided consisted mainly of detectors, precision measuring instruments, computer systems including software for CAD, monitors for calibrations and radioactive sources. Scientific visits relating to calibration of tritium monitors and the use of CAD software were arranged. With the assistance provided, the Institute has set up the calibration laboratory, which performs gamma ray and neutron dosimetry, mechanical and vacuum tests, climate tests and electromagnetic susceptibility tests. The laboratory has so far certified more than 30 different types of radiation equipment for the Cernavoda Nuclear Power Plant.

ROM/1/010 PHYSICS OF MATERIALS

COMPLETED: **91-06-04** TOTAL COST: **$73,703**

TO STRENGTHEN THE LOCAL CAPABILITY IN THE APPLICATION OF NUCLEAR TECHNIQUES FOR THE STUDY OF MATERIALS.

This one-year project, approved early in 1990, enabled the Institute of Nuclear Physics and Engineering of the Institute of Atomic Physics, Bucharest, to make efficient use of proton induced X-ray emission (PIXE), proton induced gamma emission (PIGE) and Rutherford backscattering (RBS) methods for materials research. A group of qualified scientists was already working at the Institute, and the only support requested from the Agency was for items of advanced equipment: a complete data acquisition system including solid state detectors, associated electronics and a computer based multichannel analyser. These items were supplied. Three scientific visits were also awarded. The Institute now undertakes applied research on materials and provides research and development consultancy for both heavy industry and the semiconductor industry.

ROM/9/003 NUCLEAR SAFETY

COMPLETED: **91-02-11** TOTAL COST: **$389,881**

TO STRENGTHEN THE LOCAL CAPABILITY FOR NUCLEAR SAFETY, RADIOLOGICAL PROTECTION, FACILITY COMMISSIONING; TO TRAIN PERSONNEL FOR NUCLEAR POWER PLANT OPERATION AND MAINTENANCE FOR THE CERNAVODA NUCLEAR POWER PLANT.

Romania initiated a nuclear power programme in the 1970s based on CANDU-type reactors. Construction of five units, each of 600 MW(e), started in 1982 using mainly local contractors, with some assistance and major supplies coming from Canada and Italy. The Institute of Nuclear Power Reactors (INPR), Pitesti, and the Department of Electrical Energy sought Agency assistance in 1988, initially in connection with the development and testing of locally made fuel elements and nuclear safety. Later, INPR, in co-operation with the Cernavoda construction group, received Agency assistance in probabilistic safety analysis (PSA), radiological protection, and facility commissioning, as well as for the qualification of personnel for nuclear power plant operation and maintenance, and the planning of the Cernavoda Training Centre. During the three years of the project, 27 Agency expert missions were organized with the participation of more than 70 experts. The experts, through direct discussions or workshops, advised local personnel on the major issues of reactor safety, PSA, commissioning and startup, emergency planning and preparedness, operator training, and licensing of the plant. Eleven scientific visits and nine visits as national consultants further assisted the counterparts to acquire relevant information and know-how. Computer systems, plotters, and various books and essential publications not available locally were also provided. Four project-related Agency Research Contracts were granted. The first phase of the project is considered to have been very successful in assisting the Romanians to develop a good capability in testing fuel elements for CANDU-type reactors, to initiate PSA studies for Cernavoda, and to prepare the requirements for plant commissioning, safety standards, and operator training. During its second phase, started in 1991, extensive fellowship and group training, as well as expert services in nuclear safety, emergency procedures, and commissioning and acceptance tests, will be provided. A complete microcomputer system for the development of microsimulators is foreseen.

ROM/9/005 PRE-OSART MISSIONS TO CERNAVODA NUCLEAR POWER PLANT

COMPLETED: **91-01-08** TOTAL COST: **$14,649**

TO SUPPORT THE PRE-OSART MISSIONS TO CERNAVODA NUCLEAR POWER PLANT.

A pre-Operational Safety Review Team (OSART) mission was organized in 1990 under this Reserve Fund project. The mission comprised nine Agency experts who visited the site of Cernavoda nuclear power plant from 24 September to 12 October 1990. They reviewed project management, quality assurance, civil engineering works, the manufacture and installation of mechanical, electrical, and control and instrumentation equipment, and the preparations for radiation protection and emergency response. Their recommendations are being considered by the authorities. Follow-up OSART missions will be carried out in 1991 under a new project.

SENEGAL

SEN/5/018 BIOLOGICAL NITROGEN FIXATION

COMPLETED: **91-07-25** TOTAL COST: **$115,072**

TO IMPROVE PRODUCTION OF LEGUMES THROUGH SELECTION OF HIGH-YIELD VARIETIES WITH VERY HIGH CAPACITY FOR FIXING ATMOSPHERIC NITROGEN.

Provision of expert services, equipment and supplies has enabled the Central Research Station in Bambey to use the nitrogen-15 isotope technique to quantify, under field conditions, the proportion of plant nitrogen that is derived from the atmosphere through symbiotic nitrogen fixation in the case of various important legumes (groundnuts, black eye pea and cowpea) grown in Senegal. The technique has made possible preliminary identification of legumes with superior nitrogen fixing capability. Three promising varieties of each crop have been selected for further studies in different locations in Senegal.

SEN/5/019 ANIMAL PRODUCTION AND DISEASE DIAGNOSIS

COMPLETED: **91-07-26** TOTAL COST: **$82,972**

TO ESTABLISH A LABORATORY FOR PROGESTERONE ANALYSIS BY RADIOIMMUNOASSAY AND TO STRENGTHEN LABORATORY FACILITIES FOR DISEASE DIAGNOSTICS.

Equipment was provided for animal reproduction studies and disease diagnosis and for expert services in both fields. The laboratory for animal reproduction studies is now fully operational and routinely performs analysis of progesterone in support of studies on the reproductivity of local and imported animals. Assistance provided to the Department of Virology enabled the Agricultural Research Institute, Dakar, to improve and expand the range of disease analysis. Real transfer of know-how has been effected and the practical results of studies will be communicated to stock breeders and farmers.

SIERRA LEONE

SIL/0/004 NUCLEAR SCIENCE LABORATORY

COMPLETED: **91-06-01** TOTAL COST: **$149,899**

TO EXPAND THE RADIOISOTOPE UNIT OF THE UNIVERSITY OF SIERRA LEONE, PERMITTING MORE EFFICIENT WORK IN RADIOCHEMISTRY, GEOCHEMISTRY, HYDROLOGY AND ANIMAL PHYSIOLOGY.

A radioisotope laboratory was established with Agency assistance at the Physics Department of Fourah Bay College, Freetown, in order to expand teaching and research to include radiochemistry, geochemistry and hydrology, with the co-operation of other departments of the University. A nuclear spectrometer, a multichannel analyser with data processing, a liquid scintillation counter and radiation protection instruments were provided.

Several expert missions provided training and advice on the formulation of expanded programmes. Four fellowships were awarded for training abroad. The laboratory can now offer increased practical training to students and technicians and can carry out a greater number of experiments. It can also perform analytical services for other institutions in the country.

SINGAPORE

SIN/1/005 HIGH-DOSE GAMMA DOSIMETRY

COMPLETED: **91-01-08** TOTAL COST: **$20,499**

TO DEVELOP RELIABILITY IN GAMMA DOSE MEASUREMENTS AND IRRADIATION TECHNIQUES.

The project succeeded in establishing calibration procedures and measurement techniques required for accurate dose assessment of the cobalt-60 radiation source of the Department of Physics of the National University of Singapore. The Agency provided dosimetric and calibration equipment, including two oscillotitrators for benzene dosimetry, a radiochromic dye reader with accessories, radioisotope calibration sources, and personal digital dosimeters and survey meters. The Agency also provided experts to assist with high gamma dose measurements and in establishing a computer programme for dose rate distribution calculations for various irradiation configurations. The Agency's technical assistance has resulted in a significant improvement in high gamma dose dosimetry and in irradiation techniques, and the staff of the Department have been appropriately trained. The successful implementation of the project leads to greater precision in gamma dosimetry and an improved reliability of research results for radiation applications in various fields, which are particularly important when local results have to be compared with those of institutions elsewhere.

SRI LANKA

SRL/1/004 NUCLEAR TECHNIQUES IN INDUSTRY

COMPLETED: **91-12-17** TOTAL COST: **$68,108**

TO ESTABLISH A CENTRAL X-RAY FLUORESCENCE ANALYTICAL FACILITY TO SERVE NATIONAL INDUSTRIES.

The Atomic Energy Authority (AEA), in collaboration with the Radioisotope Centre (RIC) at the University of Colombo and several industrial institutions, sought Agency assistance to establish a central facility to provide X-ray fluorescence (XRF) analysis to local industry. The project was initiated in 1983 and funded by an extrabudgetary contribution of $61 800 from the USA. Under this project, the Agency provided some equipment to the AEA, including an X-ray generator, a multichannel analyser, a Si(Li) semiconductor detector, an amplifier, an XRF tube-exciting system and a total reflection system, as well as a computer system and software. A US expert assisted the counterparts to assemble the XRF system, which was made operational at RIC in 1985. In the meantime, the local staff was trained by the expert in qualitative XRF analysis. A long term mission was undertaken by an Agency expert in 1987 in conjunction with another TC project in Sri Lanka, and during that assignment

the tube-exciting XRF system was installed and quantitative analysis introduced to the counterparts. With the help of expert advice, the AEA organized a National Training Course on XRF analysis. One fellowship was also awarded. As a result of the project, the AEA has established an XRF facility at the RIC laboratory. Local staff is now capable of performing XRF analysis on samples of steel, alloys, geological samples and other products from local industry. Furthermore, the Ceylon Steel Corporation is now also capable of performing XRF analysis. It is expected that the AEA will strengthen maintenance and repair of the available equipment at RIC and designate sufficient staff to fully satisfy the needs of local industry.

SRL/5/020 MUTATION BREEDING

COMPLETED: **91-09-12** TOTAL COST: **$57,898**

TO INCREASE RICE PRODUCTION BY VARIETAL IMPROVEMENT THROUGH RADIATION-INDUCED MUTATION BREEDING.

The Central Agricultural Research Institute, Peradeniya, in collaboration with the Central Rice Breeding Station, sought Agency assistance in using radiation-induced mutation breeding for development of new high-yielding rice mutants with tolerance to environmental stress. Under this multi-year project, the Agency has provided the Institute with a 2500 Ci cobalt-60 gamma irradiation source and some laboratory supplies. Two experts assisted in developing radiation-induced mutation breeding techniques for rice cultivars. Two long term fellowships and a scientific visit were awarded. Through the Agency's technical assistance, a working laboratory and a greenhouse have been established at the Institute. The efforts of the counterparts during 1986-1990 led to the identification of several beneficial mutants in the Kaluheenati rice variety, such as early semi-dwarf, late semi-dwarf and very early semi-dwarf. These mutants were further tested and a preliminary yield trial was carried out with Kaluheenati mutants which showed better performance than the original variety. These mutants are now being tested in farmer's fields for adaptability. Some of the mutants could be released to the farmers in low temperature areas and others will be used in cross breeding programmes. In the meantime, the Institute helps breeders in other research stations who are working on various crops. Four research papers have been published in local and international scientific journals.

SRL/5/023 NITROGEN FIXATION IN MUNGBEAN

COMPLETED: **91-06-01** TOTAL COST: **$35,176**

TO SELECT VARIETIES OF MUNGBEAN WITH HIGH NITROGEN FIXING ABILITY AND TO IDENTIFY RHIZOBIAL STRAINS.

Mungbean is an important source of protein in Sri Lanka. The Faculty of Agriculture of the University of Ruhuna in Mapalana sought Agency assistance to increase mungbean yield by enhancing the fixation of atmospheric nitrogen by selected varieties of mungbean. The Faculty received equipment and chemicals from the Agency, including nitrogen-15 labelled fertilizer, an incubator, an autoclave sterilizer, a laminar flow hood, and laboratory equipment and supplies. The Agency's Seibersdorf laboratory has analysed N-15 in 750 samples from the counterpart. A fellowship and scientific visits

were awarded under the Regional Manpower Development Project to train local staff in biological nitrogen fixation. The research conducted on nitrogen fixation of mungbean by means of the N-15 isotope dilution technique has been very successful. Some 150 genotypes of mungbean (local as well as exotic) have been screened for high nitrogen fixing ability and high yield and a few promising cultivars have now been identified for further testing. The work with rhizobium inoculum has led to the identification of some elite strains capable of enhancing nitrogen fixation and the mungbean yield. As a follow-up of this research the counterpart plans to extend the testing of these mungbean cultivars and rhizobium strains in large scale experiments under farmer's field conditions. The impact of this project on the future mungbean production in Sri Lanka could therefore be substantial. The Faculty of Agriculture has now a well equipped laboratory for nitrogen fixation studies, enabling the staff to continue their research and field work.

SRL/6/011 RADIOISOTOPES IN MEDICAL DIAGNOSIS

COMPLETED: **91-09-12** TOTAL COST: **$30,893**

TO SET UP A NUCLEAR MEDICINE UNIT FOR MEDICAL DIAGNOSIS, RESEARCH AND TEACHING AT THE NEW MEDICAL SCHOOL IN GALLE.

The Faculty of Medicine of Ruhuna University, Galle, sought Agency assistance to set up a radioimmunoassay (RIA) laboratory to provide medical diagnostic services to hospitals and medical personnel in the Southern Province of Sri Lanka. Under this multi-year project the Agency supplied equipment, including an automatic gamma counter, a centrifuge, laboratory supplies and RIA reagents. An Agency expert assisted in setting up an RIA laboratory at the teaching hospital and trained the counterpart in RIA techniques and quality control procedures. A long term fellowship was also awarded. With the technical assistance provided under the project, a new RIA laboratory capable of providing clinical services and able to engage in teaching and research has been created at the teaching hospital of the Faculty of Medicine. This new centre supplements those already existing in the capital and in a major provincial hospital and is a step towards the creation of a national RIA service. The laboratory is functioning and has participated in and received inputs from the regional RIA project RAS/6/011. Activities are at present confined to assay for thyroid-related hormones but will be extended to include hepatitis B markers and other analyses from 1991 onwards. The RIA laboratory is also being used in support of research and teaching activities at the Faculty of Medicine.

SRL/6/015 RADIOIMMUNOASSAY IN MEDICAL DIAGNOSIS

COMPLETED: **91-12-31** TOTAL COST: **$60,602**

TO DEVELOP THE USE OF RADIOIMMUNOASSAY TECHNIQUES IN MEDICAL DIAGNOSIS.

The project was initiated in 1986 at the Department of Radiology and Pathology of the General Hospital in Colombo with the aim of applying radioimmunoassay (RIA) techniques for in-vitro medical diagnosis. Under this project, the Agency has provided equipment to the Hospital, including an automatic well scintillation counting system, an automatic gamma counter with

sample changer, a scintillation counter, a refrigerated centrifuge, a personal computer system, reagents and laboratory supplies. A long term expert service was provided in 1987 to assist the counterpart in setting up an RIA laboratory and introducing RIA techniques to local staff. The expert also conducted a workshop. Two fellowships were awarded to train local staff abroad. An RIA laboratory has now been set up and is using bulk reagents to make RIA kits, thus reducing the costs of medical diagnosis. The range of assays provided to patients includes T3, T4, TSH, FSH, LH, prolactin and thyroglobulin. The counterparts have introduced other tests and are participating in a co-operation research programme for assessment of thyroid hormone levels by RIA techniques. This project has contributed significantly to nuclear medicine diagnostics in Sri Lanka. The General Hospital has already provided diagnostic facilities to 9500 patients by performing 21 843 RIA tests (an average of 900 tests per month) with effective utilization of minimum manpower and other resources. It is anticipated that the Hospital will increase its nuclear medical diagnosis services to 10 000 - 15 000 patients per year in the near future.

SRL/8/011 NON-DESTRUCTIVE TESTING IN INDUSTRY

COMPLETED: **91-06-01** TOTAL COST: **$158,816**

TO DEVELOP A CAPABILITY FOR NUCLEAR NON-DESTRUCTIVE TESTING AT THE COLOMBO DOCKYARD, CEYLON PETROLEUM CORPORATION AND THE CEYLON BUREAU OF STANDARDS.

There is a growing demand for non-destructive testing (NDT) in Sri Lankan industry, but there is also a lack of qualified personnel and of certain essential equipment. The Atomic Energy Authority (AEA) therefore sought Agency assistance. The Agency supplied NDT testing equipment to the counterparts, including ultrasonic flaw detectors, industrial X-ray and gamma radiography equipment, an eddy current detector, and spare parts for radiography testing. Relevant books and journals were also provided. Three fellowships (24 man-months) were granted to train local staff in NDT abroad. With the NDT equipment provided by the Agency, and in co-operation with Colombo Dockyard Ltd, the Ceylon Petroleum Corporation and the Ceylon Bureau of Standards, the AEA organized eight national training courses during 1986-1990. The Agency provided eight expert missions (totalling eight months) to assist the AEA in organizing these courses, providing lectures, arranging experiments, training and qualifying examination of NDT personnel. During that period, 92 trainees were trained in radiography methods levels 1 and 2, surface methods level 2, and ultrasonic testing level 2. The project has made a real contribution towards improving NDT services for local industries. For instance, Colombo Dockyard Ltd has established quality welding procedures for high pressure pipelines for ship-building and repair, which are being carried out satisfactorily by trained NDT staff. The NDT Unit of the Sri Lanka Standards Institution routinely provides NDT services to users. It is anticipated that training will be extended up to level 3. A centre for NDT activities could be established with government support.

UNION OF SOVIET SOCIALIST REPUBLICS

SSR/9/002 RADIATION PROTECTION

COMPLETED: **91-07-29** TOTAL COST: **$50,022**

TO ADVISE ON LONG TERM MEASURES IN RADIATION MONITORING AND PROTECTION FOR MITIGATING THE EFFECTS OF THE CHERNOBYL ACCIDENT.

Following a request by the Government of the USSR on behalf of the RSFSR, and on the basis of the recommendations made by an international advisory team who visited the three Republics most affected by the Chernobyl accident, this project was initiated using the Reserve Fund. The assistance consisted mainly of equipment for radiation protection, monitoring, data acquisition and data processing. This emergency technical assistance provided the Measurements Laboratory, Novozybkov, with modern equipment for radiation protection and monitoring and paved the way for the initiation of a long term programme in the area to reduce the effects of the Chernobyl accident.

SUDAN

SUD/4/003 NUCLEAR INSTRUMENTATION

COMPLETED: **91-01-08** TOTAL COST: **$89,866**

TO ESTABLISH A CAPABILITY FOR TRAINING ELECTRONICS ENGINEERS AND TECHNICIANS AND FOR THE MANUFACTURE OF RELATIVELY SIMPLE NUCLEAR INSTRUMENTATION.

Prior to this project, the Agency had assisted the Sudan Atomic Energy Commission to set up a Central Service Facility for maintenance and repair of nuclear electronic and related equipment - a service extended to third parties. Under this project, training and equipment were sought to upgrade the workshop and enable its staff to produce simple, one-off nuclear electronic instruments and devices, and to provide training to electronic engineers and technicians. Equipment provided comprised a single- and a multichannel analyser, amplifiers, power supplies, a recorder, and instruments and components. Two experts in three visits assisted with project planning and training in nuclear electronic techniques. Part of the expert costs were funded from an extra-budgetary contribution of the United Kingdom. The workshop team constructed two complete spectrometers that are now fully operational. For 1991-92, a new project (SUD/4/004) has been approved to extend the capabilities of the workshop to service larger items of equipment and to produce small runs of modular equipment.

SUD/5/016 ANIMAL SCIENCE

COMPLETED: **91-10-24** TOTAL COST: **$88,624**

TO INTRODUCE THE USE OF RADIOIMMUNOASSAY AND RELATED TECHNIQUES IN STUDIES ON THE REPRODUCTIVE PERFORMANCE OF CATTLE AND CAMELS.

The project introduced the use of radioimmunoassay (RIA) and related

techniques in a research programme being carried out by the Faculty of Veterinary Science, University of Khartoum. Equipment for establishing an RIA Laboratory was provided. Five expert missions were undertaken to train local staff and to advise on the use of RIA techniques in studies on improving the productive performance of camels and indigenous cattle. Two counterparts were awarded fellowships. As a result of the project, RIA and related techniques are being used to improve the research programme. This has enabled progress to be made in the work on trypanosomiasis infection in camels and goats as well as on the reproductive efficiency of indigenous cattle. Baseline data was obtained and the influence of certain factors on reproduction was determined. The results of the studies have been published in scientific journals.

SUD/8/004 ISOTOPES IN HYDROLOGY

COMPLETED: **91-01-08** TOTAL COST: **$162,132**

TO APPLY ISOTOPE TECHNIQUES IN STUDIES OF GROUNDWATER RECHARGE AND DYNAMICS.

The Water Research Centre of the National Water Corporation, Khartoum, sought, for 1982, Agency assistance to introduce isotope techniques to study groundwater resources and, in 1985, to set up an environmental isotope laboratory equipped for tritium counting. Some tritium counting equipment was provided under bilateral arrangements, but the Agency provided ancillary equipment, including an automatic liquid scintillation counter and a freezer, as well as laboratory supplies, chemicals and some analytical services. Four Agency experts advised on studies of groundwater recharge, origin and flow patterns, laboratory planning, and low-level tritium counting, providing on-the-job training. Further training was given through one project-related fellowship and four project-funded fellowships at the Agency's Laboratory at Seibersdorf. The isotope laboratory is functional and is carrying out the required water analyses. A 1991-92 project (SUD/8/005) will be addressing replenishment of aquifers adjacent to the Nile and problems arising from drought and population growth as they affect water resources.

SYRIA

SYR/4/002 RESEARCH REACTOR

COMPLETED: **91-02-11** TOTAL COST: **$93,542**

TO DEVELOP A NATIONAL CAPABILITY FOR RESEARCH REACTOR UTILIZATION.

Under this project, first approved in 1984, six missions were sent to Syria to advise the counterparts on site selection. The Agency's assistance on site selection was accelerated during Syria's negotiations with USSR suppliers for a 10 MW reactor, but the negotiations later broke down. After intensive historical, earthquake and geological studies, three potential sites were identified near Damascus and one of them has been selected for the Miniature Neutron Source Research Reactor project. A training course on research reactor utilization was organized in Poland for 10 Syrian scientists. All objectives of the project will be incorporated into Project SYR/4/004, under which a miniature neutron source reactor is to be procured.

SYR/5/009 SOIL NITROGEN STUDIES

COMPLETED: **91-01-08** TOTAL COST: **$199,688**

TO STUDY PLANT/SOIL/WATER/FERTILIZER RELATIONSHIPS WITH THE AIM OF USING NITROGEN FERTILIZER WITH MAXIMUM EFFICIENCY.

Under this project, first approved in 1985, the Syrian Government requested Agency assistance to introduce studies on plant/soil/water/fertilizer relationships using nitrogen-15 labelling techniques. Three expert missions advised the counterpart staff on field experiments to study the effects of water and different rates of application of urea on nitrogen uptake in crops such as wheat, maize and sugarbeet. An emission spectrometer with accessories, a sample preparation line, a Kjeldahl apparatus, chemical supplies and N-15 labelled fertilizers were provided. An expert assisted in the installation and commissioning of the equipment. Quality measurements of N-15 levels in various plant samples were established as routine at the Agricultural Applications Laboratory of the Syrian Atomic Energy Commission, to the extent that the Agency approved commercial analysis of N-15 in leaf samples by the Syrian laboratory for a TC project in Jordan. The results of field experiments obtained through the analysis of N-15 in leaf samples are also being transferred to farmers, through field extension services, to enable them to increase their agricultural yields. Furthermore, there are plans to use the Laboratory for analysis of all plant samples in the new regional project (RER/5/004) on nitrogen fixation in the arid and semi-arid Middle East countries. Project-related fellowships were awarded to two counterpart staff for training at the Agency's Laboratories, Seibersdorf. A continuation project (SYR/5/010) is pending.

SYR/9/003 RADIATION PROTECTION

COMPLETED: **91-01-08** TOTAL COST: **$376,994**

TO SET UP RADIATION PROTECTION FACILITIES FOR ROUTINE MONITORING AND RESEARCH.

This project, first approved in 1982, was to support the establishment at the Syrian Atomic Energy Commission of a capability for personnel and environmental radiation monitoring and for calibrating radiation protection and dosimetric equipment, especially that used in radiotherapy. The Agency assisted the Commission to set up a Radiation Protection and Safety Department. This Department was also responsible for monitoring and mapping environmental radiation levels in the Syrian Arab Republic prior to a proposed nuclear power programme and for providing personnel dosimetry services for radiation workers in key establishments. Radiation monitoring equipment, including alpha, beta and gamma counting systems, a thermoluminescence dosimetry system and film badges, were provided. Later, more emphasis was given to the establishment of a Secondary Standards Dosimetry Laboratory (SSDL). An X-ray generator and other SSDL equipment, including an optical bench with a laser alignment system and a computer system for data compilation and analysis, were supplied. Expert missions gave advice on the project; one Agency staff member assisted in the installation and calibration of the SSDL system and trained the local staff in its operation and maintenance. Three project-funded and seven project-related fellowships were awarded for training in advanced laboratories; two scientific visits were

also granted. The project has provided the basis for routine application of radiation protection in the Republic. Agency assistance, particularly in the establishment of the SSDL, has enabled the counterparts to perform quality control measurements and calibrations and to provide services to Jordan.

THAILAND

THA/5/027 FISH PRODUCTION AND PRESERVATION

COMPLETED: **91-05-20** TOTAL COST: **$130,321**

TO INCREASE FISH PRODUCTION AND DEVELOP METHODS FOR PRESERVING FISH PRODUCTS.

The Department of Fisheries sought Agency assistance in controlling insects and microorganisms in various processed seafoods by irradiation. This multi-year project was funded by an extrabudgetary contribution from the USA (four expert man-months, $15 000 for equipment) and the UK (four expert man-months, $33 000 for equipment; 24 man-months fellowships). The Agency provided equipment for the laboratory of the Department of Fisheries, including a walk-in cooler, a sealing machine, a laminar flow hood, two freezers and laboratory supplies. Seven months of expert services helped the counterpart to conduct research and practical applications of irradiation on fish and fishery products, provided guidance on quality control of irradiated seafood, and advised on microbiological safety of irradiated seafood. Three fellowships and scientific visits were also awarded to local staff for training abroad in the use of irradiation for preservation of fish products. The main achievements of the project were: (1) Control of insect infestation in dried and smoked fish by irradiation together with proper packaging; this improved hygiene and extended shelf-life under ambient conditions. (2) Reduction of microorganisms in frozen seafood for export by irradiation with 2 kGy. (3) Control of salmonella in frozen and cooked shrimps by irradiation with 2 to 3 kGy. A multipurpose Thai Irradiation Centre was established in August 1989 and market testing and irradiation on a semi-commercial scale of various kinds of seafood have been carried out successfully. It is expected that the Department of Fisheries, in co-operation with the Office of Atomic Energy for Peace and the Food and Drug Administration, will further develop irradiation technology on a commercial scale.

THA/5/030 ENVIRONMENTAL POLLUTION

COMPLETED: **91-11-13** TOTAL COST: **$110,447**

TO MEASURE THE LEVEL OF TRACE ELEMENT CONCENTRATIONS IN ESTUARINE WATERS IN THE GULF OF THAILAND.

The project was implemented at the Office of Atomic Energy for Peace (OAEP), Bangkok, with the aim of measuring environmental pollution caused by heavy metals and trace elements in estuarine waters in the Gulf of Thailand. The project was approved in 1985 with footnote-a status and was subsequently made operational through an extrabudgetary contribution ($101 575) from the United Kingdom at the end of 1987. Under this multi-year project, the Agency provided equipment to the OAEP, including a gamma spectrometer, an atomic absorption spectrophotometer, water sampling equipment and laboratory

supplies. An expert carried out two missions in 1989 and 1990 to assist in sampling and analytical quality control procedures as well as in data handling and interpretation. The expert also provided training to OAEP staff in atomic absorption spectrometry (AAS) as a back-up facility for neutron activation analysis (NAA). A counterpart was also trained in trace element measurement under Agency fellowships funded by the United Kingdom. The project has contributed significantly to establishing an environment pollution monitoring laboratory at OAEP with an atomic absorption spectrophotometer and a neutron activation analysis facility. The scientists of OAEP now have adequate training in the basic techniques of AAS and in sample processing and they should be skilled enough to generate good quality data from environmental samples. The OAEP, in co-operation with the Marine Science Department of Chulalongkorn University, has conducted a preliminary survey in several rivers that discharge into the upper Gulf of Thailand. More than 200 water and sediment samples were collected and analysed for 16 heavy metals and trace elements by AAS and NAA respectively. The knowledge and techniques gained from the project are being applied to the continuous monitoring of environmental pollution in the Gulf of Thailand.

THA/5/037 MUTATION BREEDING OF CEREALS AND LEGUMES

COMPLETED: **91-06-25** TOTAL COST: **$31,465**

TO ESTABLISH A GAMMA GREENHOUSE AND TO ENSURE ITS SAFE AND EFFECTIVE UTILIZATION AS A TRAINING, DEMONSTRATION AND SERVICE CENTRE FOR RADIATION-INDUCED MUTATION PLANT BREEDING.

The Department of Applied Radiation and Isotopes of Kasetsart University is planning to set up a new gamma greenhouse at their Khamphaeg Saen Campus to replace one that has been extensively used since 1961. Under this project, initiated in 1989, a short term fellowship and scientific visits were awarded to train local staff in the use of chronic and acute gamma irradiation for mutation breeding of crops, and in the design, operation and maintenance of a gamma irradiator. An Agency expert assessed the intended construction site and advised the counterpart on the conceptual design of the greenhouse and on the operation of a central station to perform irradiation services for mutation breeding. In line with this expert's recommendations and the specifications provided by the counterpart, the Agency assisted in designing and drawing a set of the gamma irradiator for the planned greenhouse. The design of the irradiator was simplified by reducing the number of driving axes to one by using a rotating shutter source assembly. The report and drawings have been submitted to the counterpart for cost estimate purposes. This project has successfully prepared for the establishment of the planned gamma greenhouse. Construction will depend on further government support.

THA/6/017 MEDICAL PHYSICS (SSDL)

COMPLETED: **91-12-31** TOTAL COST: **$191,244**

TO ESTABLISH A MEDICAL PHYSICS SERVICE: SPECIFICALLY, RADIATION PROTECTION FOR NUCLEAR MEDICINE UNITS, PERSONNEL MONITORING AND PLANNING OF COMPUTERIZED RADIATION TREATMENT.

The project, initiated in 1984, was first financed by the Agency and was

subsequently supported by an extrabudgetary contribution of $57 500 from the USA in 1985 with additional funds from the Agency in the following years. The Division of Radiation Protection Services (DRPS), Medical Services Department, Ministry of Public Health, intended through this project to improve radiation protection in nuclear medicine, to develop computerized treatment planning in radiology, and to provide calibration of high energy photon and electron beams. The Agency provided equipment including an IBM peripheral system, a PC-AC microcomputer with software for graphics, a gamma irradiator and an XYZ radiation field analyser. Three Agency experts undertook four missions (seven man-months) to assist in the improvement of radiation protection, the development of computerized treatment planning in radiation therapy, and the establishment of a calibration system for high energy photon and electron beams for medical application. Agency experts conducted national training courses and a seminar designed for radiation therapists and nuclear physicists in nuclear medicine centres. Two fellowships were awarded for training abroad. As a result of the project, the Secondary Standards Dosimetry Laboratory (SSDL) of DRPS is now not only the national collaborating reference centre for high energy photon and electron beams but has extended its calibration services to nuclear medical units in other parts of the country. Computerized treatment planning for radiation therapy has also been developed and is being used by several hospital nuclear medical units. The SSDL of DRPS provides regular dosimetry calibration services and monitors personnel dosimeters used by nuclear medicine workers. The quality of radiation therapy and radiation safety in nuclear medicine in Thailand has been much improved.

THA/6/022 DYNAMIC STUDIES IN NUCLEAR MEDICINE

COMPLETED: **91-06-07** TOTAL COST: **$44,004**

TO INTRODUCE QUANTITATIVE RADIONUCLIDE DYNAMIC STUDIES IN MEDICAL DIAGNOSIS.

To meet the increasing demand for nuclear medicine services, the Chulalongkorn University Hospital sought Agency assistance for the introduction of quantitative radionuclide dynamic studies in medical diagnosis. Under this project, initiated in 1986, the Agency has provided a complete set of nuclear medicine clinical software suitable for a PDP 11/34 computer coupled to a Philips gamma camera. Expert services were provided to assist the counterparts in the use of the gamma camera and computer systems, particularly for clinical evaluation of computer-based studies. Local staff was trained in implementing clinical software for nuclear medicine dynamic studies and in expanding the range of computer-based functional scintigraphic studies. With government funding, a single photon emission tomography (SPECT) system was installed at the Hospital in 1988. An Agency expert trained the local staff in SPECT and its routine image studies; a quality control and assurance programme was also established for the system. Fellowships were awarded for training local staff in dynamic function studies using the new SPECT system. The counterparts have established a number of nuclear medicine procedures for diagnostic and research services. Whole body studies of bone, thyroid, kidney and blood pool, as well as nuclear cardiology, are regularly performed by the staff. Diagnosis and management of patients have improved with the increased efficiency of health care services. In addition, this well staffed and well equipped Nuclear Medicine Centre is training medical students and hospital staff from all parts of Thailand. The project has greatly improved the nuclear medicine services and research

capability of the Division of Nuclear Medicine of the Hospital.

THA/9/013 **RADIOACTIVE WASTE MANAGEMENT**

COMPLETED: **91-01-08** TOTAL COST: **$37,961**

TO ESTABLISH A CAPABILITY FOR THE MANAGEMENT OF LOW AND INTERMEDIATE LEVEL WASTES PRODUCED BY RADIOISOTOPE USERS, LABORATORIES AND PILOT PLANTS.

To assist the Office of Atomic Energy for Peace (OAEP) in establishing a capability for management of low level radioactive waste, the Agency has provided experts to advise on low level solid waste incineration and shallow land disposal under Project THA/9/009. To continue the activities initiated, the Agency provided under the present project an off-gas cleaning system, which was connected with the existing incinerator by OAEP staff. An Agency expert also advised on regeneration of ion-exchange resins. A long term fellowship for practical training was granted for a staff member of OAEP. Finally, a programming mission in 1989 made recommendations for the continuation of the radioactive waste management programme in 1991-92. The mission identified further needs and planned the future radioactive waste management activities with the project counterparts. The project has strengthened OAEP's capability for low level radioactive waste treatment. The continuation of the radioactive waste management activities in 1991-92 under a new project will involve the design and construction of new waste processing and storage facilities, site selection, and characterization studies for a site for shallow land disposal.

TUNISIA

TUN/9/006 **ASSESSMENT OF A TEACHING REACTOR**

COMPLETED: **91-10-15** TOTAL COST: **$7,986**

TO ASSESS THE PRESENT STATUS OF A TRAINING REACTOR AND TO ADVISE THE TUNISIAN AUTHORITIES ON THE SAFETY ASPECTS RELATED TO ITS INSTALLATION AND OPERATION.

The Tunisian Government was offered a zero power SUR training reactor by the Government of the Federal Republic of Germany in 1988. The reactor, located at the Technical University of Munich, was made critical in 1962 and shut down in 1984. At the request of the Tunisian Government, two Agency experts inspected the reactor at Munich and had water samples analysed upon their return to Vienna. After considering the findings, the Tunisian Government decided to consider alternatives to the SUR and requested further Agency expert assistance to advise on technical details of the research reactor and future utilization. Two Agency experts provided this assistance. Following these various expert missions the Tunisian Government received the requested technical information as an input into the decision-making process.

TURKEY

TUR/5/011 TRACE ELEMENTS IN FOODSTUFFS

COMPLETED: **91-12-31** TOTAL COST: **$85,911**

TO STUDY THE ROLE OF TRACE ELEMENTS IN DIET AND HUMAN HEALTH.

A co-ordinated study of the role of trace elements in diet and human health was performed with the participation of the Turkish Atomic Energy Authority, the Middle East Technical University, Ankara University School of Medicine, and Hacettepe University. This is the first comprehensive study of its kind to be carried out in Turkey, and it produced results for 22 minor and trace elements in typical diets (from the Ankara area), plus energy, fibre and phytate. Dietary intakes of most elements appear to be similar to those in other countries, with the exception of selenium (low) and mercury (high); these findings may, however, require further follow-up studies. The data provided by this project were used by a WHO/FAO/IAEA Expert Consultation in 1990. The Agency provided expert advice and equipment, including a pulse height multichannel analyser, and arranged a scientific visit for the counterpart to laboratories in Denmark, Finland and Norway. Two project-related research contracts were also awarded.

UKRAINE

UKR/4/002 INSARR MISSION TO WWR-M RESEARCH REACTOR

COMPLETED: **91-12-31** TOTAL COST: **$9,959**

TO CARRY OUT A COMPREHENSIVE SAFETY ASSESSMENT OF THE WWR-M RESEARCH REACTOR.

This Reserve Fund project was established at the request of the Ukrainian authorities in order to carry out a comprehensive safety assessment of the WWR-M research reactor at the Kiev Institute of Nuclear Research of the Academy of Sciences of the Ukrainian SSR. An Agency INSARR (Integrated Nuclear Safety Assessment of Research Reactor) team consisting of three external experts and two staff members was sent to the reactor site from 6 to 17 January 1991. The results of the mission's investigations and their recommendations were submitted to the Government in an Agency report. The overall conclusion of this report was that the safety features and operational procedures of the research reactor met acceptable standards. This generates confidence that the facility may continue to operate in a safe manner. The report also made a number of recommendations for improvements, in particular in relation to operational safety. The acceptance and implementation of the recommendations and suggestions included in the report are a matter for the relevant Ukrainian authorities to consider and decide upon.

UNITED REPUBLIC OF TANZANIA

URT/1/003 NUCLEAR PHYSICS

COMPLETED: **91-01-08** TOTAL COST: **$475,718**

TO STRENGTHEN THE ACTIVITIES OF THE NUCLEAR PHYSICS LABORATORY.

The project, initially approved in 1980, has enabled the Department of Physics at the University of Dar es Salaam to establish X-ray fluorescence analysis and Moessbauer spectroscopy in the teaching curriculum. The Agency provided the necessary items of equipment and experts to train staff in its use and to advise on curricula. The analytical techniques are being applied in studies of metal corrosion, heavy-metal pollution of lakes, tin ores and trace elements of nutritional interest. Two MSc graduates who used the techniques are now employed by the National Radiation Commission. Six of the departmental staff have been awarded fellowships abroad by the Agency to further their knowledge of the above analytical techniques or nuclear instrumentation. One of these staff became the Dean of the Faculty of Science at the University and is now a member of the newly formed Ministry of Science, Technology and Higher Education. The plant for producing liquid nitrogen that was installed under the project is no longer functioning owing to lack of spare parts from the supplier. These have been ordered through a related project (URT/1/005).

URT/6/004 RADIOIMMUNOASSAY LABORATORY

COMPLETED: **91-10-15** TOTAL COST: **$66,789**

TO ESTABLISH A RADIOIMMUNOASSAY LABORATORY.

The project, initiated in 1984, led to the establishment of a radioimmunoassay (RIA) laboratory at the Muhimbili Medical Centre, Dar-es-Salaam, to serve as a centre for services to patients and for training. Four fellows have been trained for a total of 42 months; essential items of equipment, including automatic and manual counters and a centrifuge, have been supplied, and two expert missions undertaken. The RIA laboratory is now well equipped and remains the only one in the country. It provides diagnostic and clinical RIA services to a large number of patients.

URUGUAY

URU/5/013 RADIOISOTOPES IN ANIMAL SCIENCE

COMPLETED: **91-12-31** TOTAL COST: **$139,279**

TO INTRODUCE NUCLEAR TECHNIQUES IN REPRODUCTION STUDIES AND PARASITOLOGY.

This project was initiated in 1981 through an extrabudgetary contribution from the USA. In 1982, the Faculty of Veterinary Medicine of the University of the Republic made available installations for the laboratory, and the Agency provided major equipment for radioimmunoassay (RIA) work and the necessary support for implementation of the project. The counterpart successfully

developed antisera against progesterone for use in the laboratory as well as antigamma globulins for immunoprecipitation in solid phase systems. A methodology for pregnancy diagnosis in dairy cattle based on the evaluation of progesterone and plasma analysis through RIA is now available to farmers and co-operatives. The preliminary results obtained from the research work conducted provided important data for the control and eradication of gastro-intestinal parasites in cattle and sheep. Thus the work accomplished should contribute to increased livestock production in Uruguay.

URU/6/017 RADIOPHARMACOLOGY (CIN)

COMPLETED: **91-12-31** TOTAL COST: **$124,886**

TO INCREASE THE SHELF-LIFE OF REAGENT KITS AND TO INTRODUCE NEW TECHNIQUES IN QUALITY CONTROL OF RADIOPHARMACEUTICALS.

This project was officially approved in 1986, although preliminary activities had started in 1985 with funds made available by the USA in view of the urgent need to improve the quality control of radiopharmaceuticals in Uruguay and to increase the shelf-life of reagent kits. The provision of liquid chromatography equipment and a freeze drying unit stimulated local support in setting up an infrastructure at the Nuclear Research Centre (CIN) in Montevideo. Expert services and training improved the quality of radiopharmaceuticals produced in Uruguay and led to the local production of pyrophosphate-SN, DTPA-Sn, MDP-Sn and CPI-Sn, which are now delivered regularly to users in the health sector. Results of research carried out during the project were presented at four international conferences and published in Agency TECDOC 532. The scientists at CIN are assisting other institutions in Montevideo in developing and testing other radiopharmaceuticals for eventual local use.

VENEZUELA

VEN/9/003 RADIATION PROTECTION REGULATIONS

COMPLETED: **91-12-10** TOTAL COST: **$59,178**

TO PREPARE FOR RADIATION SAFETY REGULATIONS AND DEVELOP THE COURSE SYLLABUS FOR TRAINING RADIATION SAFETY INSPECTORS.

This project was approved for 1986 to support the preparation of a national regulatory framework for radiation protection by the Division of Nuclear Affairs at the Ministry of Energy and Mines. An expert was sent in 1986 and 1987 and another expert prepared proposals for a training course on radiation protection. Additional Agency assistance in 1989 and 1990 led to a one-month pilot training course at the Instituto Tecnologico, Central University of Venezuela (UCV), Caracas, in October 1990, at which three experts assisted and some basic equipment, including detectors, was supplied by the Agency. As a result of this pilot course and the training material left by the experts, trained staff have been able, since 1991, to teach regular courses on radiation protection at the Instituto Tecnologico. The project also contributed towards the establishment of a Master Plan for Radiation Protection, which was elaborated by the Ministry of Energy and Mines following advice of the Agency experts.

VEN/9/005 LOW-LEVEL RADIATION LABORATORY

COMPLETED: **91-12-31** TOTAL COST: **$102,631**

TO ESTABLISH A LOW LEVEL RADIATION MEASUREMENT LABORATORY TO MONITOR THE ENVIRONMENT AND FOODSTUFFS FOR RADIOACTIVE CONTAMINATION AND TO TRAIN PERSONNEL.

In 1989, the Government proposed to establish an environmental background radiation measuring service at the Simon Bolivar University, Caracas, in order to determine natural radiation levels in the environment and radioactivity in imported foodstuffs. The project was approved for 1989-1990 and was financed through an extrabudgetary contribution from the USA with some additional assistance from the Agency. Expert services and equipment were supplied to the Nuclear Physics Laboratory of the University, including a low level alpha-beta measurement system, a multichannel analyser, computer system and software, IAEA reference materials and a survey meter. Although no training abroad was provided through the project, some project staff benefitted from training opportunities made possible by bilateral sources, and some training was provided by the expert. With assistance from the expert, who also established continuing contacts with his home institution, a low level radiation measurement laboratory has been established and measurement of environmental radioactivity has started.

VIET NAM

VIE/4/003 NUCLEAR INSTRUMENTATION

COMPLETED: **91-12-31** TOTAL COST: **$153,336**

TO PRODUCE A SMALL SERIES OF MODULAR COUNTING EQUIPMENT.

The project was established in 1983 as a continuation of an earlier project VIE/4/002, under which a nuclear electronic equipment repair and maintenance laboratory had been established. The aim of the present project was to upgrade the laboratory through design and construction of a range of nuclear instruments, both modular and stand-alone, to meet the needs of the Dalat Nuclear Research Institute and of hospitals in south Viet Nam. A printed circuit board (PCB) laboratory capable of producing double sided PCBs was established with the assistance of an Agency expert who also trained the counterpart staff in the use of several software packages for circuit design. The expert also introduced the subject of multichannel analyser interfacing with personal computers. The Agency provided a number of personal computers, test equipment (including sweep generators, function generators and oscilloscopes) and several kits, such as EUROCARD single channel analyser, to facilitate local manufacture of relatively simple but widely used nuclear instruments. Eight project staff members received long term fellowship training (94 man-months). One counterpart was awarded scientific visits to advanced institutes in three countries. As a result of the project, local capability has been acquired not only in repair and maintenance of sophisticated electronic instruments but also in the design and production of a range of units necessary for nuclear research.

VIE/4/007 NUCLEAR INSTRUMENTATION AND MICROCOMPUTER APPLICATIONS

COMPLETED: **91-12-31** TOTAL COST: **$64,512**

(1) TO DEVELOP A FACILITY FOR NUCLEAR INSTRUMENTATION SERVICING AND REPAIR. (2) TO INITIATE STUDIES ON THE APPLICATION OF SMALL COMPUTERS IN NUCLEAR EXPERIMENTS.

Following the success of a similar project at Dalat, this project was approved in order to provide repair and maintenance services for nuclear instruments used at the Vietnamese Atomic Energy Commission laboratories in the Hanoi area. The project also intended to develop specialized electronic units required for interfacing between nuclear experiments and personal computers. The Agency provided basic test equipment, personal computers, electronic components and spare parts. Two expert missions undertook staff training. The first mission helped to establish laboratories for repair and maintenance of nuclear equipment and to introduce the use of desk computers in the electronics laboratory. A local (Hanoi area) training course on the use of desktop computers was conducted by the expert during the mission; participants included scientists and technicians from two organizations in addition to the counterpart institute. Finally, a two-week national training course on the use of desktop computers in nuclear experiments, with special emphasis on nuclear spectroscopy, was organized to train staff from several other institutes in Viet Nam as well as the staff of the counterpart institute. Although a reasonable measure of success was achieved through the design and production of multichannel analysers, and in the interfacing of personal computers with nuclear experiments, the attention paid to the repair and maintenance functions by the counterpart still needs to be improved.

VIE/4/008 NUCLEAR TRACK DETECTORS

COMPLETED: **91-12-31** TOTAL COST: **$74,518**

TO SET UP AND EQUIP A LABORATORY FOR SOLID STATE NUCLEAR TRACK DETECTOR WORK.

The project was approved in order to establish solid state nuclear track detector (SSNTD) laboratories at the Vietnamese Atomic Energy Commission (VINAEC), Hanoi, so as to facilitate prospection for nuclear minerals and measurement of environmental radon as well as to carry out, to the extent possible, radiation protection work. The major items of equipment provided included a range of commercial track detectors, a research microscope with polarizing attachment, a low level counting system, a multipen recorder, and a personal computer with adequate hard disk memory and relevant attachments. One Agency expert carried out two missions in 1990. During the first, he trained the counterpart staff in radon/thoron measurements and in linking measured track densities to radon doses. He also delivered lectures on exploration for uranium and other minerals and on prediction of earthquakes by means of the SSNTD technique. In a follow-up mission by the same expert, the methodology introduced was further advanced in order to achieve the project's objectives. At the same time, the Agency's Technical Officer was invited to Viet Nam, and the first national training course was organized in order to introduce the technique to several universities and geological departments. The project has successfully introduced the SSNTD technique in exploration for uranium and other minerals and in initiating radon/thoron

studies. Radon measurement containers for in-soil use and radon diffusion chambers have been fabricated for environmental radon monitoring.

VIE/6/012 NUCLEAR MEDICINE (HUE)

COMPLETED: **91-01-15** TOTAL COST: **$84,918**

TO DEVELOP THE CAPABILITY FOR BOTH IN-VIVO AND IN-VITRO DIAGNOSIS AND FOR TEACHING MEDICAL APPLICATIONS OF NUCLEAR TECHNIQUES.

The project was approved in 1984 with the aim of establishing in-vivo and in-vitro techniques at the Department of Nuclear Medicine of the Medical University, Hue, to serve the population of central Viet Nam. Expert services were provided for about two months to establish quality control procedures for inspection and testing of equipment and techniques used in nuclear medicine, as well as radioimmunoassay (RIA) for diagnosis of several organ malfunctions. One project staff member was trained abroad for one year under a fellowship. Counterpart staff training was also carried out by an engineer from the supplier of the two-channel in-vivo scanning system. Major in-vivo equipment provided under the project included a scintiscanner, a renography system and a radioisotope dose calibrator. For the in-vitro investigations, RIA equipment was provided for thyroid-related hormone studies. Establishment of facilities under the project has permitted the introduction of routine renal investigation, as well as diagnostic and therapeutic services for thyroid disorders.

VIE/6/016 TECHNETIUM-99m PRODUCTION AND QUALITY CONTROL

COMPLETED: **91-12-31** TOTAL COST: **$78,986**

TO IMPROVE LABORATORY FACILITIES FOR PRODUCTION OF RADIOPHARMACEUTICALS INCLUDING BETTER QUALITY CONTROL.

This project was designed, through a pre-project assistance mission by an Agency staff member, to complement the radioisotope production activity initiated under a multi-disciplinary project VIE/0/002, with the aim of improving the Dalat Nuclear Research Institute's capability to achieve reliable quality control in the local production of radiopharmaceuticals. An Agency expert undertook a mission to advise the counterpart on the design of hot cells for the safe production of gel-type generators developed at Dalat. He also advised on equipment and technology for the production of these radioisotopes, a ventilation system for the hot cells, and the fabrication of lead bricks for shielding the facility. Hot cells were ordered through funds available under VIE/0/002. An HPLC system for quality control of radiopharmaceuticals was supplied under this project. The hot cells and the HPLC system were installed by engineers from the supplier firms, who also trained the counterpart staff in the use of the two facilities. One project staff member received fellowship training, and another attended an Agency Training Course. The project counterpart was awarded a scientific visit to the hot cell supplier institute. As a result of this project, the Institute is now producing good quality radioisotopes and radiopharmaceuticals for use not only in Viet Nam but also in neighbouring countries.

YUGOSLAVIA

YUG/8/012 SEMI-INDUSTRIAL IRRADIATION FACILITY UPGRADING

COMPLETED: **91-11-13** TOTAL COST: **$73,658**

TO PROVIDE A CO-60 SOURCE TO UPGRADE THE INSTALLATION.

Under this project, a 75 kCi cobalt-60 source was supplied to the Rudjer Boskovic Institute, Zagreb, to replace the existing source. The upgraded facility has improved the irradiation services available in Yugoslavia.

YUG/9/020 ENVIRONMENTAL MONITORING

COMPLETED: **91-09-25** TOTAL COST: **$23,707**

TO STRENGTHEN THE ENVIRONMENTAL MONITORING CAPABILITY.

Under this project, provision of equipment such as gamma spectrometry systems strengthened the environmental monitoring capability of the Institute of Endocrinology, Immunology and Nutrition, Zemun. By means of this equipment particular attention has been paid to gamma spectrometry determination of the level of caesium-134 and caesium-137 radionuclides activity in samples of food, such as meat and meat products, milk and dairy products, eggs, fruits, vegetables, animal fodder, medicinal and industrial herbs. The issue was highlighted following the Chernobyl accident, when radiological analysis was essential to any export, and for controlling the local market. The results of the measurements are being published by the Institute and its reports have been presented at conferences. Levels of radiocaesium activity in 1990 were markedly lower than in 1988-1989, especially in the samples of medicinal herbs, although standard deviation was still high in these species. The level of caesium-134 and caesium-137 activity in lichen (Lichen islandicus) decreases slowly and was very high in both 1989 and 1990, ranging above 1000 Bq/kg. As this species is used for pharmaceuticals, it must be constantly monitored for the level of radioactive caesium for several years after the Chernobyl accident. The level of caesium-134 and caesium-137 activities in all other samples of food and animal fodder is at present lower than in the preceding years and has almost reached the detection limit of the instrument.

YUG/9/026 GROUP TRAINING IN NUCLEAR SAFETY

COMPLETED: **91-03-11** TOTAL COST: **$72,879**

TO ASSIST IN TRAINING COURSES ON PREVENTION AND MANAGEMENT OF SEVERE ACCIDENTS.

Two National Training Courses have been organized for the Krsko Nuclear Power Plant staff and other specialists from the institutions working for that plant. The first course, on management of severe accidents, had 23 full time and 18 part time participants, with nine lecturers. The second course, on safety aspects of ageing phenomena, had 14 full time and 13 part time participants, with eight lecturers. The project resulted in transfer of knowledge to the utility, to the regulating bodies of Slovenia and Croatia, and to institutes supporting

the Krsko NPP, with the aim of improving nuclear safety in the country.

YUG/9/027 **OSART MISSION TO KRSKO NPP**

COMPLETED: **91-12-31** TOTAL COST: **$4,059**

TO CONDUCT AN OSART PREPARATORY AND FOLLOW-UP MISSION TO THE KRSKO NUCLEAR POWER PLANT.

The purpose of the Operational Safety Review Team (OSART) preparatory and follow-up mission to the Krsko nuclear power plant was to review the response to the recommendations made by the OSART (1984) and to investigate any problems encountered in their implementation. Most of the recommendations have been implemented or showed improvement and could be closed. The issues of annual personnel training programme for radiation protection, maintenance and fire fighting, installation of a post-accident sampling system and development of the manual of emergency scenarios, among others, have been addressed.

ZAIRE

ZAI/2/010 **RADIOIMMUNOASSAY KIT PRODUCTION**

COMPLETED: **91-06-01** TOTAL COST: **$132,521**

TO ESTABLISH LOCAL PRODUCTION OF RADIOIMMUNOASSAY KITS FOR DIAGNOSTIC APPLICATIONS.

This project, approved in 1983, enabled three local staff members to be trained through fellowships, and others through training courses and by the experts during their missions. Major equipment supplied included an automatic liquid scintillation counter and a centrifuge. Primary reagents for the assay of thyroid-related hormones (thyroxine and tri-iodotryronine) are now being produced locally and are used on a national scale. The objectives have thus been met and are expected to be further consolidated by implementation of the related new project ZAI/6/006.

ZAI/5/007 **FOOD PRESERVATION**

COMPLETED: **91-11-28** TOTAL COST: **$123,569**

TO EXTEND SHELF-LIFE OF DEHYDRATED VEGETABLES BY A COMBINED TREATMENT OF SOLAR DEHYDRATION AND IRRADIATION.

This project was first approved in 1981 as a follow-up to a related project. The Kinshasa Regional Nuclear Research Centre received expert services, equipment, consumables and fellowships to develop its R&D capabilities in food irradiation. Expert services for a total of nearly three months assisted in elaborating a food irradiation programme and establishing an adequate laboratory. The major items of equipment supplied include an atomic absorption spectrophotometer, a centrifuge and an incubator. Three staff members were trained for a total of nearly 17 months. As a result of this project, laboratory facilities for investigating microbial decontamination and

insect disinfestation have been firmly established. The trained staff members are engaged in R&D on disinfestation of dried fish and fishery products as well as on disinfestation of cereals and other grains. This acquired experience has enabled the Centre to participate actively in the FAO/IAEA Co-ordinated Research Programme on the Application of Irradiation Technique for Food Processing in Africa.

ZAI/9/003 RADIOACTIVITY MONITORING

COMPLETED: **91-11-28** TOTAL COST: **$193,965**

TO STRENGTHEN THE CAPABILITY FOR MONITORING RADIATION EXPOSURE OF PERSONS UNDER BOTH NORMAL AND EMERGENCY SITUATIONS AND FOR MONITORING ENVIRONMENTAL RADIATION.

The increased use of radiation at the Kinshasa Regional Nuclear Research Centre required improved facilities for radiation monitoring to protect workers at the Centre, the population of the region, and the environment in general. The Agency supplied some major items of equipment, including a gamma scintillation counter, contamination monitoring and sampling equipment, a meteorological station and various radioactive isotopes. Three expert missions for a total of two-and-a-half months assisted the counterparts from the planning stages up to installation. Assistance was also provided in the installation of the meteorological station. Three fellows were trained for a total of about 29 months. The project has led to a marked improvement in radiation monitoring facilities and the establishment of an effective radiation monitoring programme. These facilities are expected to be further upgraded and a monitoring programme consolidated under the new project, ZAI/9/005.

ZAMBIA

ZAM/4/004 NUCLEAR EQUIPMENT MAINTENANCE

COMPLETED: **91-11-13** TOTAL COST: **$93,455**

TO STRENGTHEN THE LOCAL CAPABILITY FOR THE MAINTENANCE, SERVICING AND REPAIR OF ELECTRONIC EQUIPMENT.

An Agency expert provided assistance to the Technical Services Unit of the National Council for Scientific Research, Lusaka, in planning efficient and effective methods of carrying out maintenance, repair and servicing of electronic equipment including the design of equipment and interfacing with microcomputers, and in providing on-the-job training. A number of electronic components were supplied by the Agency. As a result of this assistance the capability of the Technical Services Unit for repair and maintenance has been upgraded and a number of technicians trained. Some items of equipment have been repaired and, at certain levels, drop-out and power conditioning devices have been installed. Two simple designs of electronic devices were undertaken: the automatic water level controller and the neutron generator transfer system's automatic recycling electronic module for automatic data acquisition. The Unit is now capable of providing training and could host fellowships from other African countries as well as the Agency's regional training course on instrumentation.

ZAM/5/010 RADIOISOTOPES IN ANIMAL SCIENCE

COMPLETED: **91-06-01** TOTAL COST: **$219,416**

TO INCREASE THE PRODUCTIVITY OF DAIRY ANIMALS THROUGH IMPROVED NUTRITION AND DISEASE CONTROL.

This project at the Livestock and Pest Research Centre at Chilanga was initiated in 1982 to study the causes of infertility in indigenous breeds of cattle. Several expert missions were undertaken to provide training for local scientists on how to determine the nutritive value of pasture forages and locally available feedstuffs by means of in-vitro digestibility techniques. The experts also provided training in the enzyme-linked immunosorbent assay (ELISA) technology for studying contamination of foodstuffs by mycotoxins and moulds. In collaboration with the Faculty of Veterinary Medicine at the University, the experts gave training in the use of radioimmunoassay techniques for monitoring progesterone levels in dairy cattle and small ruminants. Training in the use of enzyme immunoassay techniques in disease diagnosis was also provided. Short-term fellowship training abroad was awarded to four counterpart scientists. Equipment for demonstration purposes and laboratory supplies were provided. As a result of this assistance the counterparts identified constraints on the reproductive efficiency of three indigenous breeds of cattle and made recommendations on management changes, such as early calf weaning, to improve cattle productivity.

ZAM/5/012 ISOTOPES IN AGRICULTURE (SOIL MOISTURE STUDIES)

COMPLETED: **91-12-31** TOTAL COST: **$153,401**

TO ACHIEVE BETTER SOIL AND WATER MANAGEMENT FOR RAIN-FED CROPS.

An expert was provided to train the staff of the Mount Makulu Agricultural Research Station and the University of Zambia School of Agriculture in the proper use of neutron moisture gauges and tensiometers for water use efficiency studies in agriculture. The expert also assisted in the initiation of field experiments and the interpretation of results. This on-the-job training was supplemented by the award of a fellowship for training abroad. Equipment provided included moisture probes, a scintillation counter and a detector. Soil and water losses were measured and the effect on the moisture regime observed. Studies were also carried out on the influence of conservation tillage practices on soil compaction, internal drainage and optimal water use for some crops. Useful data on water management and the efficient use of water were obtained, which, with the results of the complementary project ZAM/5/004, on fertilizer studies, would be used by the extension services to increase crop yields.

ZIMBABWE

ZIM/8/002 ASSESSMENT OF WATER RESOURCES

COMPLETED: **91-10-03** TOTAL COST: **$72,510**

TO INTEGRATE ISOTOPE STUDIES IN RELEVANT ONGOING PROGRAMMES FOR WATER DEVELOPMENT.

Under this project an expert was provided to the Hydrological Branch of the Ministry of Energy, Water Resources and Development to demonstrate the use of artificial tritium tracers for gauging river flow, to assist in planning field experiments, in the execution of river discharge measurements and in the preparation and counting of water samples. The necessary equipment for the project was provided and a liquid scintillation spectrometer already in the country was used for measuring water samples. Extensive training was given on all aspects of planning river discharge measurements with tritium tracers. A demonstration on the river Shavanhohwe was made and results obtained. The project succeeded in integrating the use of isotope techniques with conventional methods in ongoing programmes for water development.

IMPLEMENTATION SUMMARY I

ALL FUNDS*

Description	Adjusted Programme	Share of Total Programme	New Obligations	Implementation Rate	Earmarkings
	($)	(%)	($)	(%)	($)
Current year					
Area breakdown					
Africa	16,196,693	23.9%	9,225,440	57.0%	6,971,253
Asia & Pacific	16,797,121	24.8%	10,641,254	63.4%	6,155,867
Latin America	15,261,141	22.5%	10,888,820	71.3%	4,372,321
Middle East & Europe	15,081,722	22.2%	8,665,727	57.5%	6,415,995
Interregional	3,808,250	5.6%	3,189,240	83.7%	619,010
Global	660,952	1.0%	516,887	78.2%	144,065
Total	67,805,879	100.0%	43,127,368	63.6%	24,678,511
Component breakdown					
Experts	17,184,026	25.4%	9,664,957	56.2%	7,519,069
Equipment	29,650,385	43.7%	19,151,477	64.6%	10,498,908
Fellowships	10,936,283	16.1%	6,629,085	60.6%	4,307,198
Training Courses	7,509,317	11.1%	6,125,440	81.6%	1,383,877
Sub-contracts	1,822,849	2.7%	1,000,293	54.9%	822,556
Miscellaneous	703,019	1.0%	556,116	79.1%	146,903
Total	67,805,879	100.0%	43,127,368	63.6%	24,678,511
Fund breakdown					
TACF	51,965,550	76.7%	35,124,387	67.6%	16,841,163
UNDP	3,210,360	4.7%	1,513,194	47.1%	1,697,166
Extrabudgetary	11,262,970	16.6%	5,874,898	52.2%	5,388,072
Funds-in-Trust	1,366,999	2.0%	614,889	45.0%	752,110
Total	67,805,879	100.0%	43,127,368	63.6%	24,678,511
Current and future years					
Current	67,805,879	54.8%	43,127,368	63.6%	24,678,511
Future	55,973,274	45.2%	3,834,615	6.9%	52,138,659
GRAND TOTAL	123,779,153	100.0%	46,961,983		76,817,170

* As at 31 December 1991

IMPLEMENTATION SUMMARY II

TECHNICAL ASSISTANCE AND CO-OPERATION FUND*

Description	Adjusted Programme	Share of Total Programme	New Obligations	Imple-mentation Rate	Earmarkings
	($)	(%)	($)	(%)	($)
Current year					
Area breakdown					
Africa	13,541,732	26.0%	8,442,584	62.3%	5,099,148
Asia & Pacific	12,311,759	23.7%	7,754,378	63.0%	4,557,381
Latin America	10,956,621	21.1%	8,291,735	75.7%	2,664,886
Middle East & Europe	10,873,639	20.9%	7,067,935	65.0%	3,805,704
Interregional	3,620,847	7.0%	3,050,867	84.3%	569,980
Global	660,952	1.3%	516,888	78.2%	144,064
Total	51,965,550	100.0%	35,124,387	67.6%	16,841,163
Component breakdown					
Experts	12,580,041	24.2%	7,524,708	59.8%	5,055,333
Equipment	22,345,660	43.0%	15,438,226	69.1%	6,907,434
Fellowships	9,877,905	19.0%	6,233,187	63.1%	3,644,718
Training Courses	5,606,343	10.8%	4,776,139	85.2%	830,204
Sub-contracts	883,329	1.7%	620,173	70.2%	263,156
Miscellaneous	672,272	1.3%	531,954	79.1%	140,318
Total	51,965,550	100.0%	35,124,387	67.6%	16,841,163
Currency breakdown					
Convertible	46,376,889	89.2%	32,669,469	70.4%	13,707,420
Non-Convertible	5,588,661	10.8%	2,454,918	43.9%	3,133,743
Total	51,965,550	100.0%	35,124,387	67.6%	16,841,163
Current and future years					
Current	51,965,550	48.1%	35,124,387	67.6%	16,841,163
Future	55,973,274	51.9%	3,834,615	6.9%	52,138,659
GRAND TOTAL	107,938,824	100.0%	38,959,002		68,979,822

* As at 31 December 1991

IMPLEMENTATION SUMMARY IIIA

ALL FUNDS BY DEPARTMENT AND DIVISION*

Description	Adjusted Programme ($)	Share of Total Programme (%)	New Obligations ($)	Implementation Rate (%)	Earmarkings ($)
Current year					
DEPARTMENT OF RESEARCH AND ISOTOPES					
Joint FAO/IAEA Division	11,424,535	16.9%	7,788,830	68.2%	3,635,705
Division of Life Sciences	7,709,509	11.4%	3,990,339	51.8%	3,719,170
Division of Physical and Chemical Sciences	20,555,917	30.3%	12,411,845	60.4%	8,144,072
The Agency's Laboratories	4,238,751	6.2%	3,272,538	77.2%	966,213
Laboratory of Marine Radioactivity, Monaco	264,062	0.4%	120,383	45.6%	143,679
Total	44,192,774	65.2%	27,583,935	62.4%	16,608,839
DEPARTMENT OF NUCLEAR ENERGY AND SAFETY					
Division of Nuclear Safety	10,545,161	15.5%	6,699,136	63.5%	3,846,025
Division of Nuclear Power	3,859,531	5.7%	2,366,964	61.3%	1,492,567
Division of Scientific and Technical Information	346,600	0.5%	179,415	51.8%	167,185
Division of Nuclear Fuel Cycle and Waste Management	3,502,246	5.2%	2,399,693	68.5%	1,102,553
Total	18,253,538	26.9%	11,645,208	63.8%	6,608,330
DEPARTMENT OF ADMINISTRATION					
Legal Division	75,094	0.1%	74,562	99.3%	532
DEPARTMENT OF SAFEGUARDS					
Division of Operations A	18,939*	0.0%	18,053	95.3%	886
DEPARTMENT OF TECHNICAL CO-OPERATION					
Evaluation Section	90,958	0.1%	90,659	99.7%	299
Programme Co-ordination Section	437,773	0.7%	238,051	54.4%	199,722
Division of Technical Co-operation Programmes	4,075,850	6.0%	2,960,012	72.6%	1,115,838
Total	4,604,581	6.8%	3,288,722	71.4%	1,315,859
GLOBAL (Not distributed by Department)	660,953	1.0%	516,888	78.2%	144,065
GRAND TOTAL	67,805,879	100.0%	43,127,368	63.6%	24,678,511

* as at 31 December 1991

IMPLEMENTATION SUMMARY IIIB

IMPLEMENTATION AGAINST FUTURE YEARS ALL FUNDS BY DEPARTMENT AND DIVISION*

Description	Adjusted Programme ($)	Share of Total Programme (%)	New Obligations ($)	Implementation Rate (%)	Earmarkings ($)
Future years					
DEPARTMENT OF RESEARCH AND ISOTOPES					
Joint FAO/IAEA Division	7,687,950	13.7%	401,827	5.2%	7,286,123
Division of Life Sciences	7,213,120	12.9%	625,500	8.7%	6,587,620
Division of Physical and Chemical Sciences	19,964,542	35.7%	1,765,192	8.8%	18,199,350
The Agency's Laboratories	2,987,222	5.3%	126,074	4.2%	2,861,148
Laboratory of Marine Radioactivity, Monaco	158,350	0.3%	28,755	18.2%	129,595
Total	38,011,184	67.9%	2,947,348	7.8%	35,063,836
DEPARTMENT OF NUCLEAR ENERGY AND SAFETY					
Division of Nuclear Safety	7,155,029	12.8%	380,799	5.3%	6,774,230
Division of Nuclear Power	1,858,656	3.3%	23,683	1.3%	1,834,973
Division of Scientific and Technical Information	150,400	0.3%	0	0.0%	150,400
Division of Nuclear Fuel Cycle and Waste Management	3,261,805	5.8%	267,070	8.2%	2,994,735
Total	12,425,890	22.2%	671,552	5.4%	11,754,338
DEPARTMENT OF TECHNICAL CO-OPERATION					
Programme Co-ordination Section	223,200	0.4%	0	0.0%	223,200
Division of Technical Co-operation Programmes	5,313,000	9.5%	215,715	4.1%	5,097,285
Total	5,536,200	9.9%	215,715	3.9%	5,320,485
GRAND TOTAL	55,973,274	100.0%	3,834,615	6.9%	52,138,659

* As at 31 December 1991

Explanatory Notes to Figures

Figure 1. Resources available for Agency technical co-operation programmes: 1985-1991

This figure shows all resources made available to the Agency for technical co-operation activities from all funds for the programme years 1985-91. Amounts given for UNDP resources correspond to total claims against UNDP resources for projects implemented during each calendar year. These amounts are also used in the Agency's Accounts, reflecting UNDP's requirement to report expenditures as the sum of cash disbursements plus unliquidated obligations. UNDP funds for 1985-91 include resources made available by the UNDP-administered United Nations Fund for Science and Technology for Development for projects for which IAEA acts as associated agency. Amounts shown as extrabudgetary funds refer to resources made available for activities planned for execution in the year shown. It should be noted that the amounts shown in Figure 1 do not include resources made available for future years.

Figure 2. Disbursements by Agency programme area: 1991

This figure shows, by component and by Agency programme area, the distribution of all assistance provided in 1991, irrespective of the source of funds. It should be noted that fellowships under the manpower training projects have been individually assigned to an Agency programme area and their costs are accounted for accordingly.

Figure 3. Disbursements by programme component: 1982-1991

The total assistance provided during the ten year period 1982-1991 ($375,720,500) is broken down by year and type of input (training, experts and equipment), irrespective of the source of funds.

Figure 4. Technical co-operation personnel services by region: 1991

A graphic presentation is given of (i) the origin of technical co-operation field personnel (ii) their destination and (iii) the time spent in the field, grouped by geographic region.

Figure 5. Distribution of equipment disbursements by region: 1991

Total disbursements for equipment, grouped by origin and recipient regions, are shown in this figure; individual recipient countries are shown in Table 7. The list at the bottom of the page excludes countries in which the total purchase volume was less than $50,000.

Figure 6. Summary data on training programmes: 1991

This graphic presentation shows where trainees studied, where they came from and how much training was received by their home regions. Information on the training provided to nationals of individual recipient countries is given in Table 6B.

Figure 7. Technical Assistance and Co-operation Fund disbursements by type of currency and region: 1991

This figure, which refers only to the Technical Assistance and Co-operation Fund, gives total disbursements for 1990 broken down by region and for convertible and non-convertible currencies.

Figure 8. Distribution of technical co-operation disbursements by Agency programme area and region: 1991

The table in the middle gives in thousands of US$ disbursements by Agency Programme (AAPC) for each of the geographical areas involved. The bar charts at the top illustrate the different emphasis to the various Agency Programmes (AAPC) in each region. (Please note that the scales are different for each region). At the bottom, the overall expenditures by Agency Programme are shown in a summary bar chart.

Figure 9. Distribution of technical co-operation disbursements by source and region: 1991

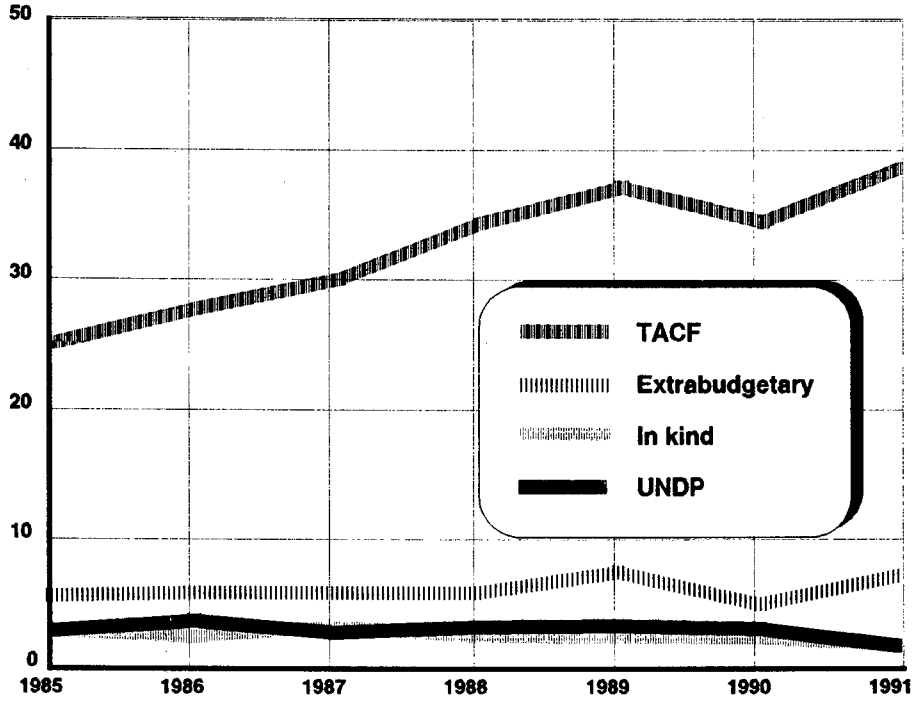
In this graphic presentation, disbursements from the Technical Assistance and Co-operation Fund, extrabudgetary funds, assistance in kind and from UNDP funds are shown for each region, as are total disbursements from all funds by region.

Figure 10. Utilization of the Technical Assistance and Co-operation Fund

The bar chart shows, over a ten-year period, the total resources available to the Technical Assistance and Co-operation Fund year by year - each year including the unobligated and unspent funds of prior years - as well as the disbursements and obligations incurred against these resources as at 31 December of each year. Obligations incurred against future years for approved multi-year projects are shown separately, reflecting the status at the end of 1991. The graph below it shows, in per cent, the unobligated balance, unliquidated obligations and disbursements for the same ten-year period.

FIGURE 1

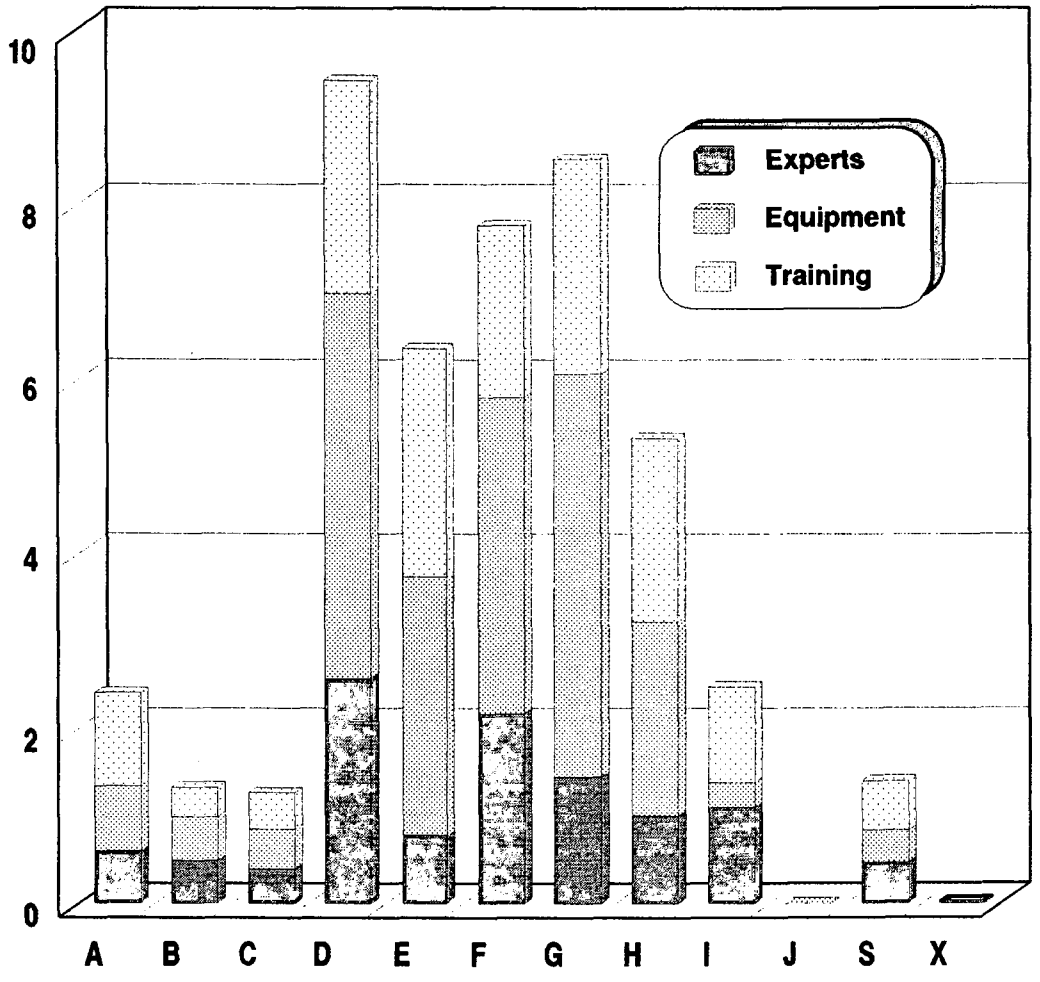
RESOURCES AVAILABLE FOR AGENCY TECHNICAL CO-OPERATION PROGRAMMES (in millions of dollars)



	1985	1986	1987	1988	1989	1990	1991
TACF	25.197	27.860	30.153	34.510	37.312	34.660	38.882
Extra-budgetary funds	5.484	5.702	5.700	5.710	7.375	4.820	7.018
Assistance in kind	2.765	2.282	3.066	2.322	2.295	2.214	1.702
UNDP	2.654	3.480	2.568	3.051	3.106	2.856	1.513
TOTAL	36.100	39.324	41.487	45.593	50.088	44.550	49.115

FIGURE 2

DISBURSEMENTS BY AAPC:1991
(in millions of dollars)



A = Nuclear Power
B = Nuclear Fuel Cycle
C = Radioactive Waste Management
D = Food and Agriculture
E = Human Health
F = Industry and Earth Sciences
G = Physical and Chemical Sciences
H = Radiation Protection
I = Safety of Nuclear Installations
J = Safeguards
S = Direction and Support
X = Comparative Assessment

FIGURE 3

DISBURSEMENTS BY COMPONENT: 1982 - 1991
(IN MILLIONS OF DOLLARS)

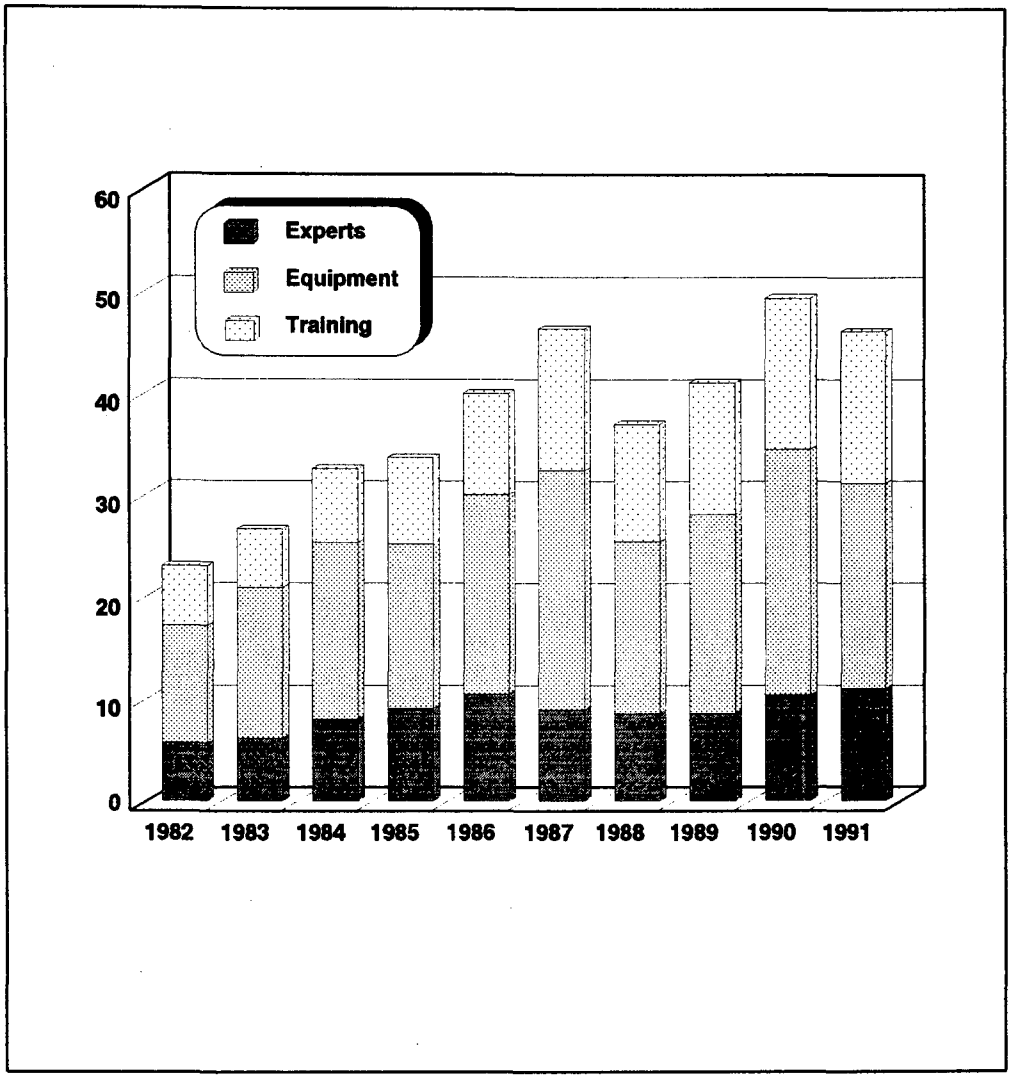


FIGURE 4

TECHNICAL CO-OPERATION PERSONNEL SERVICES BY REGION: 1991

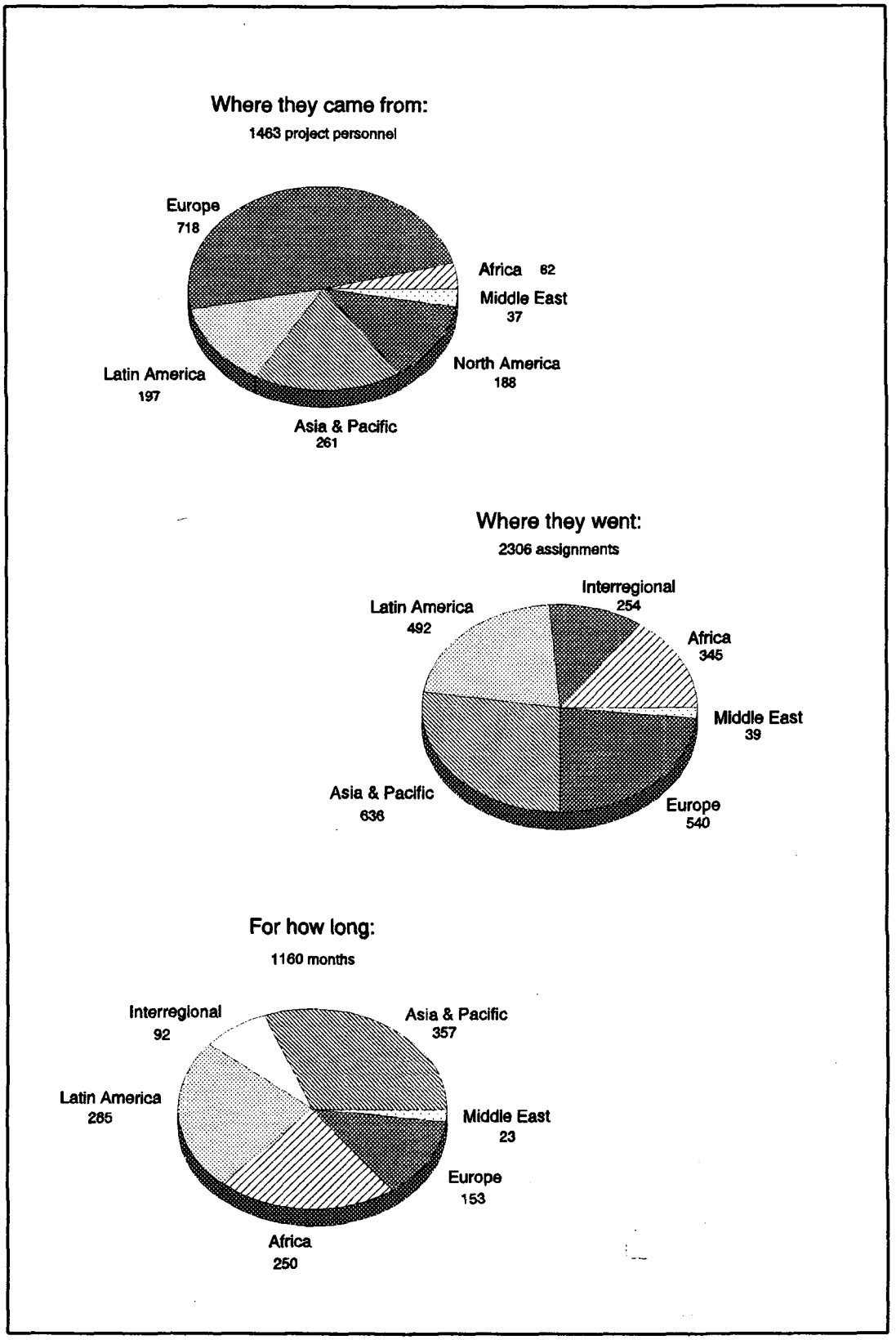
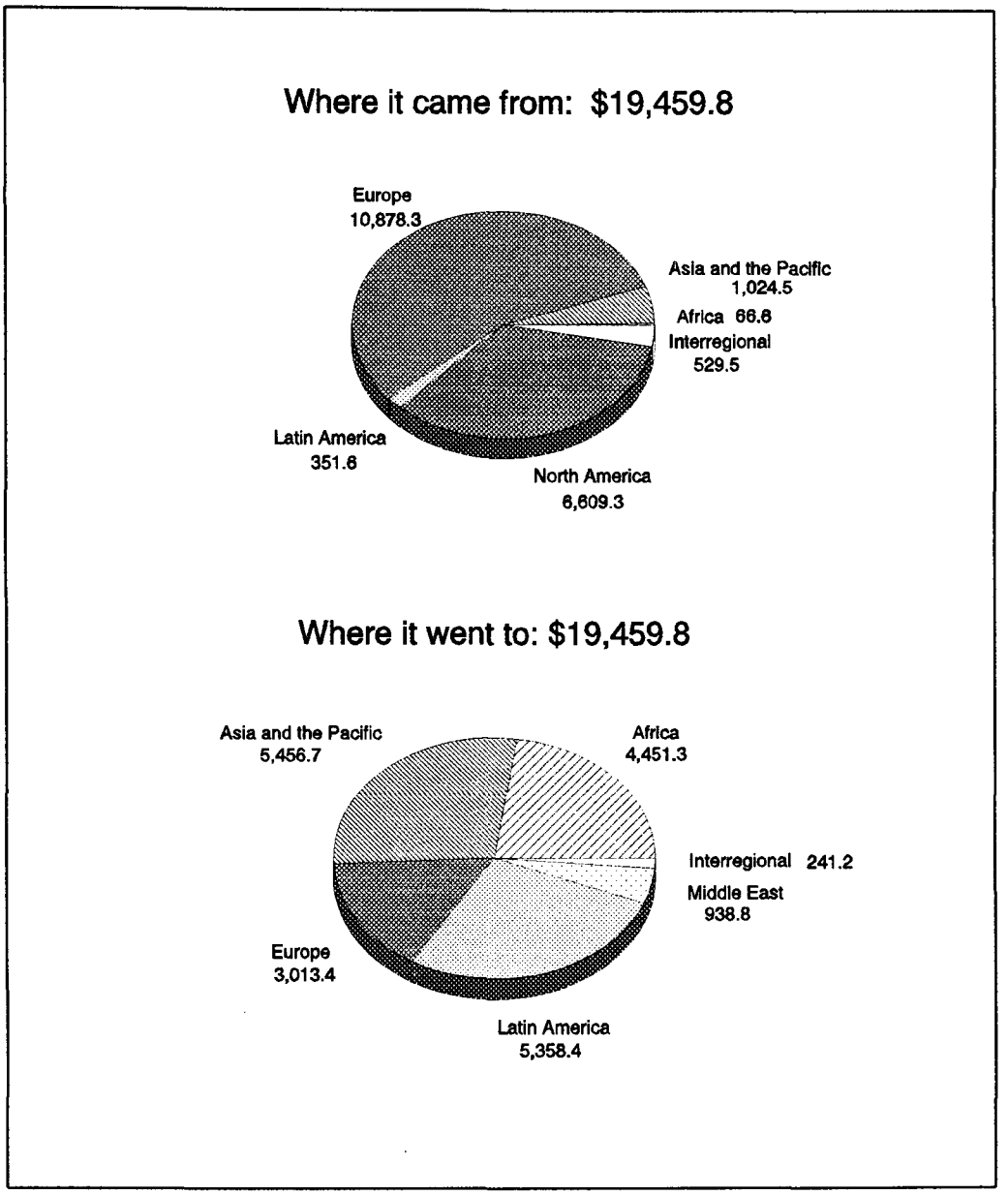


FIGURE 5

DISTRIBUTION OF EQUIPMENT DISBURSEMENTS BY REGION: 1991 (in thousands of dollars)



Where equipment was purchased:

Australia	136.7	India	93.8
Austria	791.4	Italy	446.7
Belgium	69.5	Japan	318.7
Brazil	147.5	Netherlands	322.4
Bulgaria	53.8	Norway	69.0
Canada	224.1	Poland	187.4
Chile	85.4	Sweden	189.3
China	229.6	Switzerland	88.1
Czech and Slovak F.R.	161.4	Taiwan, China	61.8
Denmark	101.8	Thailand	51.7
Finland	116.9	UK (Hong Kong)	113.1
France	977.0	United Kingdom	2,454.5
Germany	2,501.2	USA	6,385.2
Hungary	254.9	USSR	1,920.1
IAEA	135.6	Others	771.2

FIGURE 6

SUMMARY DATA ON TRAINING PROGRAMMES: 1991

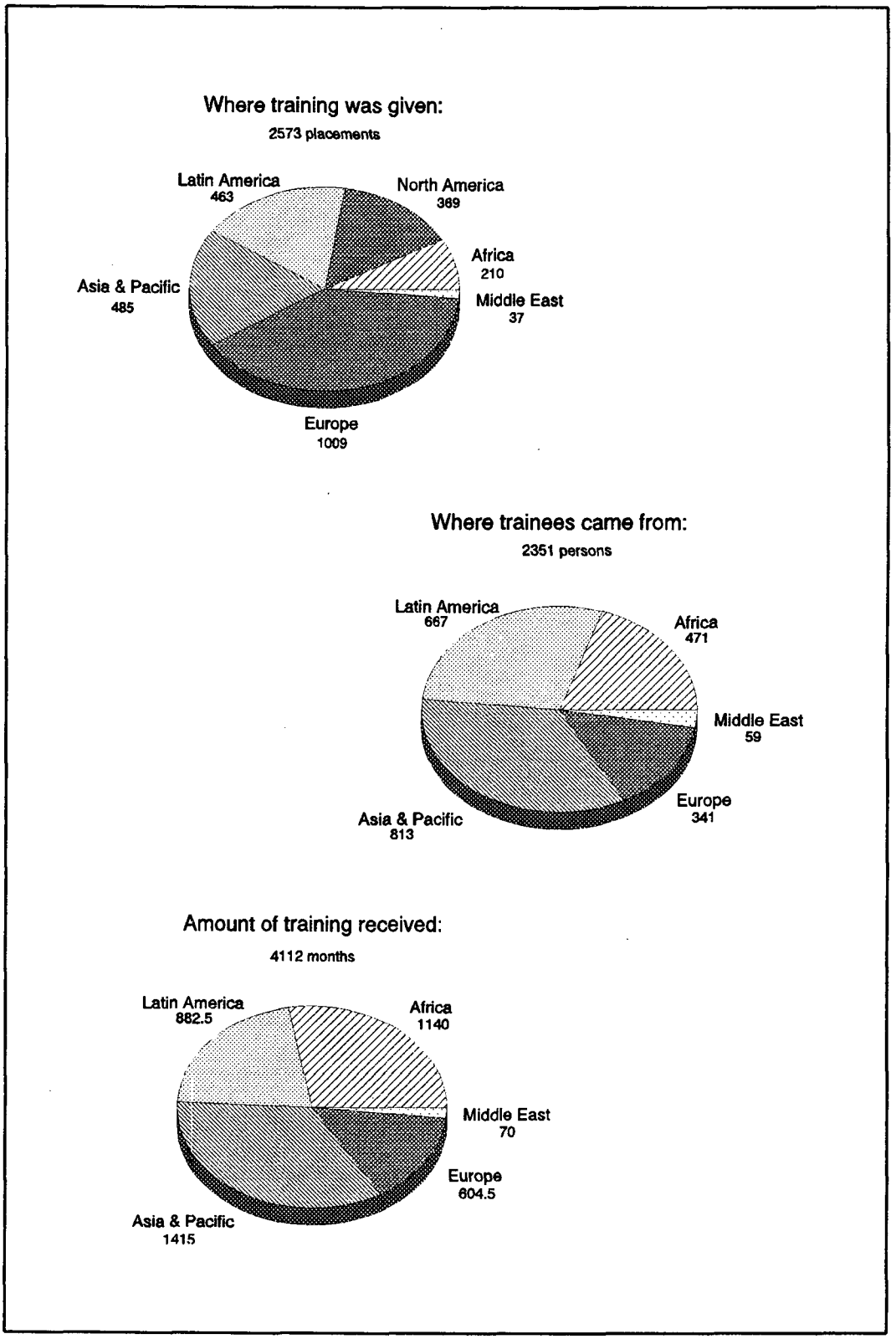
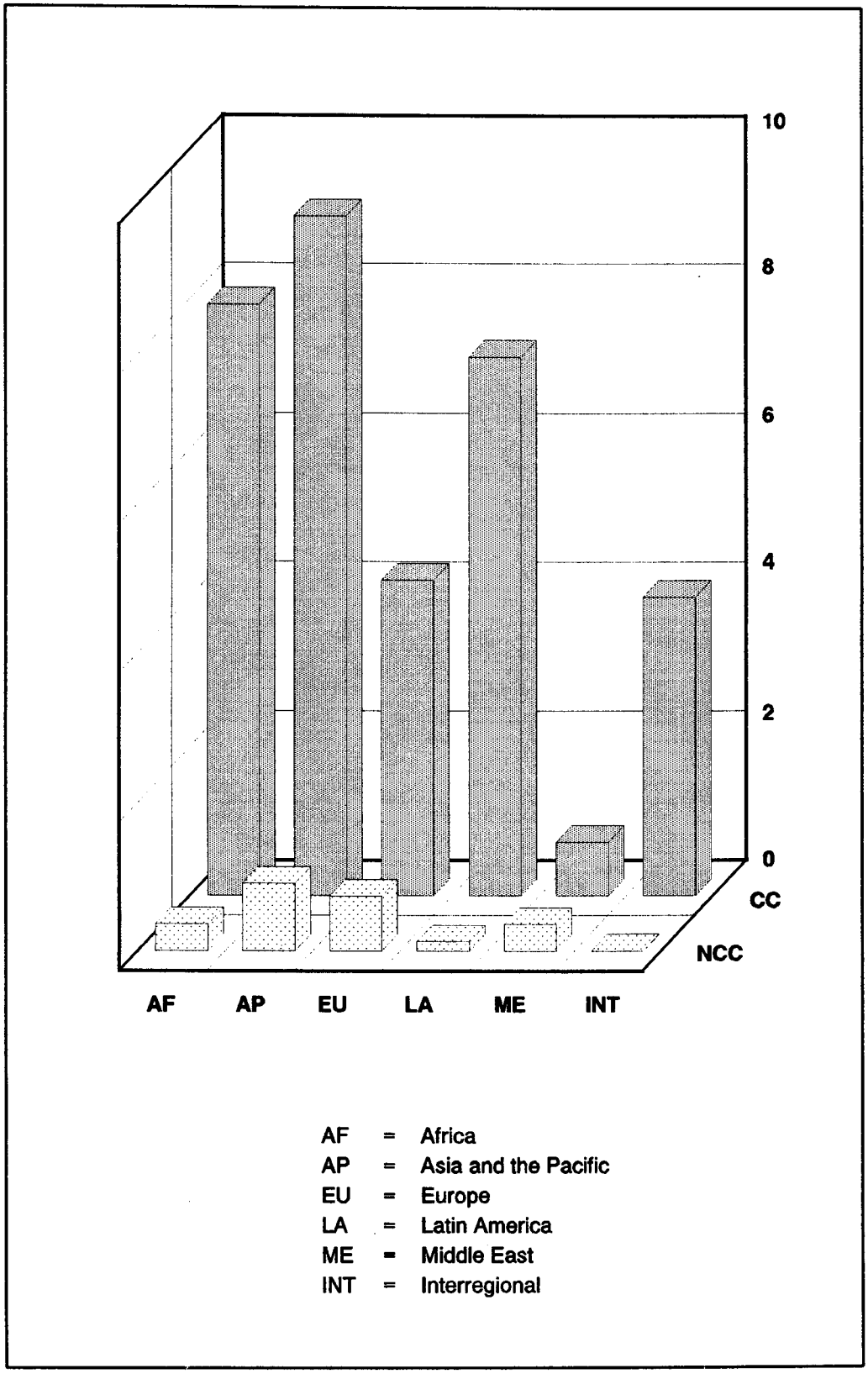


FIGURE 7

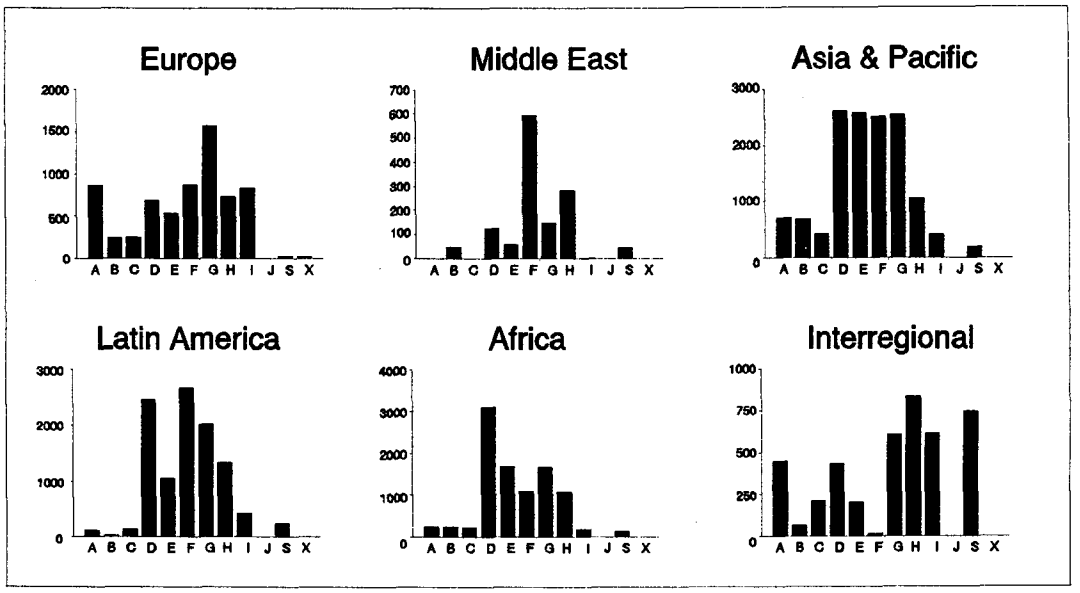
TECHNICAL ASSISTANCE AND CO-OPERATION FUND DISBURSEMENTS BY TYPE OF CURRENCY AND REGION: 1991 (in millions of dollars)



AF = Africa
AP = Asia and the Pacific
EU = Europe
LA = Latin America
ME = Middle East
INT = Interregional

FIGURE 8

TECHNICAL ASSISTANCE AND CO-OPERATION DISBURSEMENTS BY AAPC AND REGION: 1991



AAPC	Inter-regional	Africa	Latin America	Asia & Pacific	Europe	Middle East	TOTAL
A. Nuclear Power	451.6	251.9	116.2	715.6	870.2	0.0	2,405.5
B. Nuclear Fuel Cycle	63.5	251.8	30.6	687.8	242.8	50.2	1,326.7
C. Radioactive Waste Management	213.4	231.0	144.2	423.3	253.9	0.0	1,265.8
D. Food and Agriculture	436.7	3,108.4	2,454.0	2,604.1	684.3	126.1	9,413.6
E. Human Health	207.6	1,688.7	1,056.7	2,574.4	530.8	58.4	6,116.6
F. Industry and Earth Sciences	17.0	1,096.9	2,673.1	2,509.8	873.6	593.1	7,763.5
G. Physical and Chemical Sciences	609.4	1,671.3	2,023.6	2,536.2	1,570.4	147.3	8,558.2
H. Radiation Protection	833.6	1,088.3	1,334.5	1,059.1	734.3	283.4	5,333.2
I. Safety of Nuclear Installations	619.1	182.9	420.8	411.4	837.3	4.7	2,476.2
J. Safeguards	0.0	0.0	0.0	0.3	0.0	0.0	0.3
S. Direction and Support	746.9	137.3	238.1	198.6	28.7	47.0	1,396.6
X. Comparative Assessment	0.0	0.0	0.0	0.0	19.5	0.0	19.5
TOTAL	4,198.8	9,708.5	10,491.8	13,720.6	6,645.8	1,310.2	46,075.7

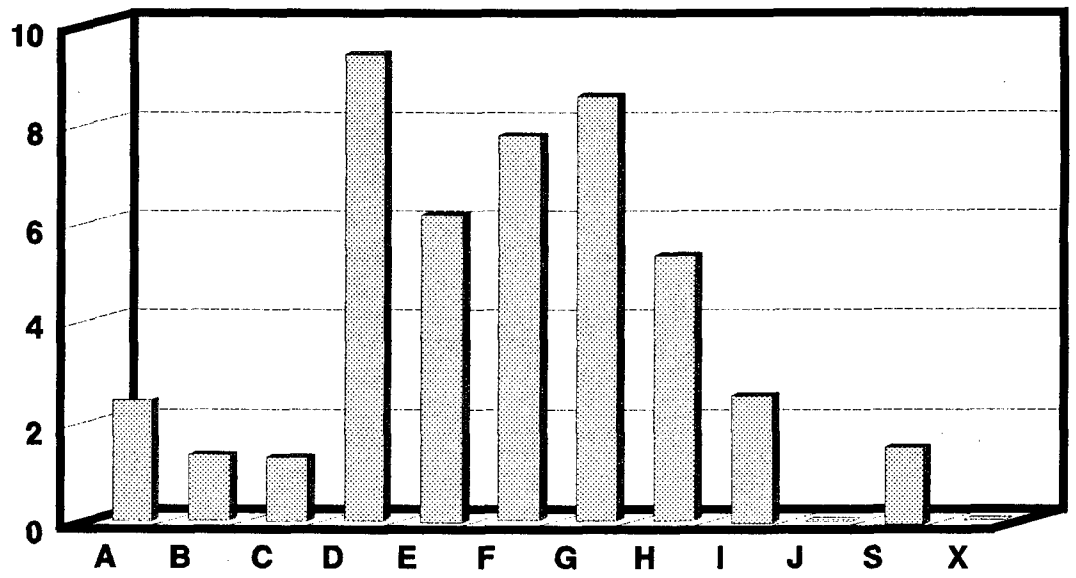


FIGURE 9
DISTRIBUTION OF TECHNICAL CO-OPERATION DISBURSEMENTS BY SOURCE AND REGION: 1991
(in thousands of dollars)

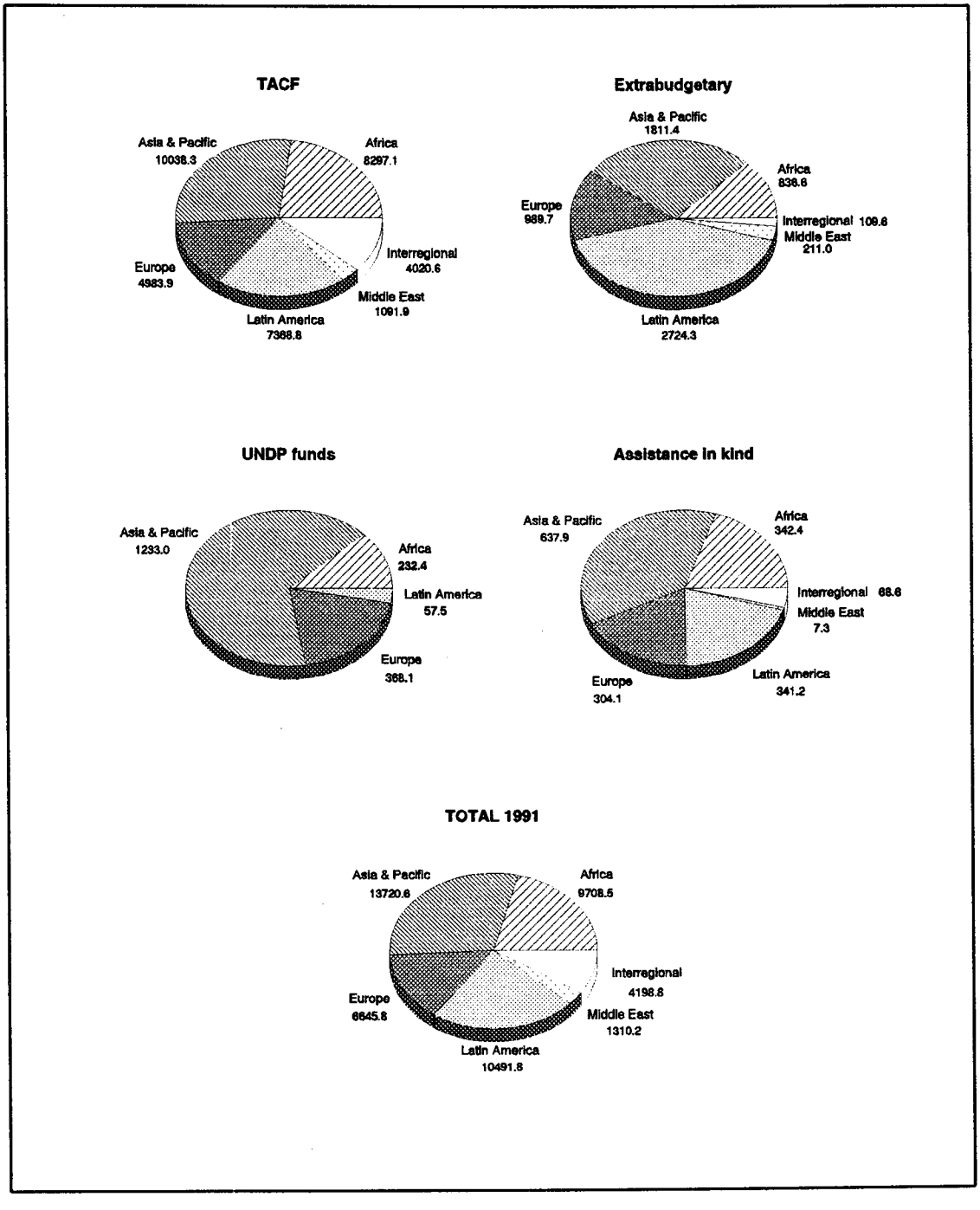
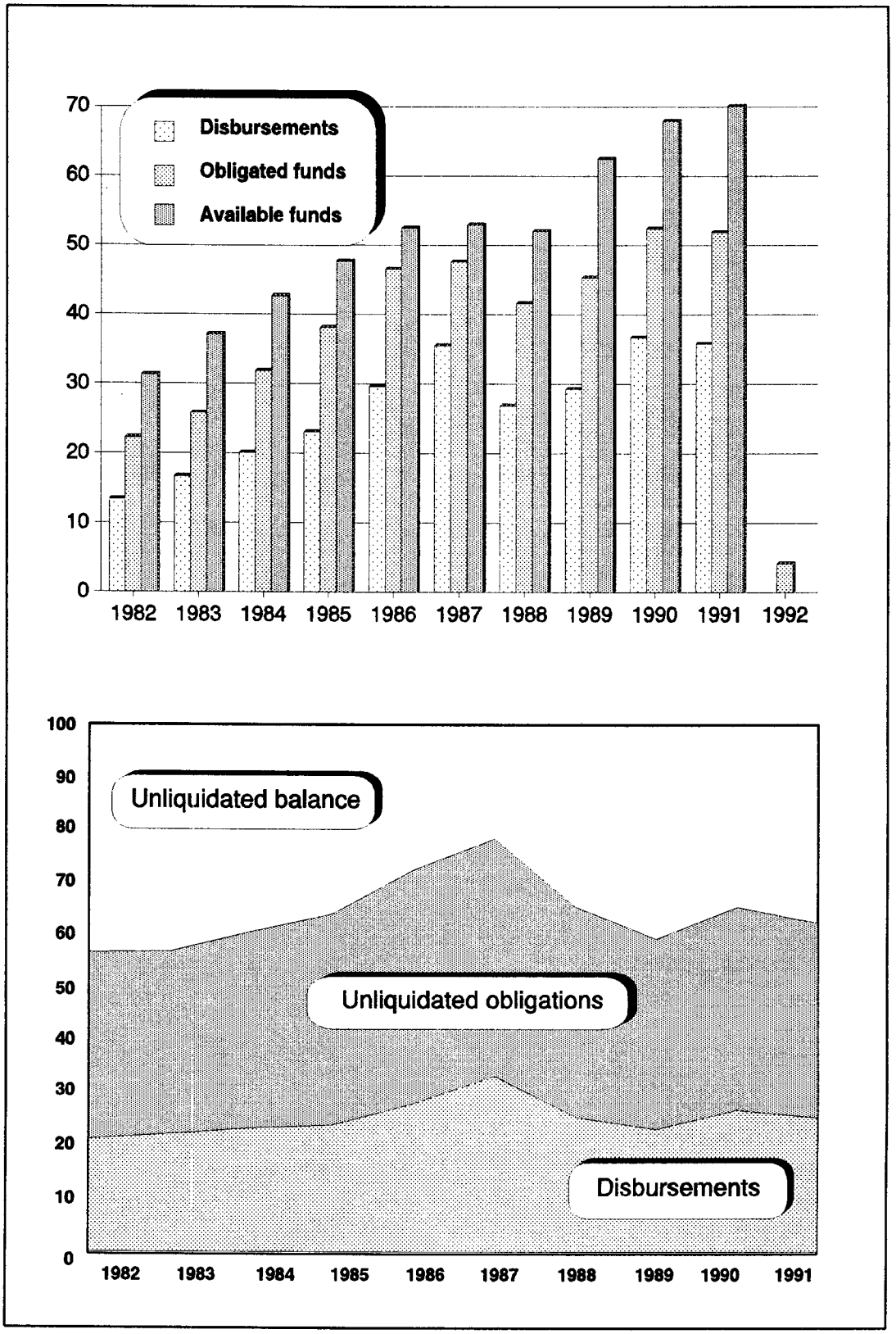


FIGURE 10

UTILIZATION OF THE TECHNICAL ASSISTANCE AND CO-OPERATION FUND (status at year end)



Explanatory Notes to Tables

Table 1. Available resources: 1982-1991

This table is directly related to Figure 1, but shows resources over a ten-year period. The Technical Assistance and Co-operation Fund is broken down by its various components; other resources (extrabudgetary funds, assistance in kind and UNDP) are shown separately, together with their sub-totals. For an explanation of the miscellaneous income loss for 1991, please see text paragraph II.E.1.

Table 2. Technical Assistance and Co-operation Fund: 1982-1991

The ten-year development of the target, of the amounts pledged and of the funds actually made available are shown (see Annex IV for contributions made by Member States to the Technical Assistance and Co-operation Fund for 1991). It should be noted that, in this table, voluntary contributions are shown not by the year in which they become available but for the programme year for which they are pledged. The graphic presentation below it shows, for a ten-year period the percentage of the target actually pledged. It also shows total income as a percentage of the target. Total income comprises the pledges, the assessed programme costs received, interest income and gains/losses on exchange.

Table 3A. Project personnel by place of origin: 1991

This table shows the number of individuals, both international and national, who undertook technical co-operation assignments during 1991. They came from 86 countries. Information of the number of assignments is also provided. It should be noted that IAEA staff, as well as staff of other international organizations, are listed under their nationalities. The number of such staff involved are given in the footnote.

Table 3B. Trainees in the field by place of study: 1991

A breakdown is given for trainees (fellows, training course participants and visiting scientists) based on the place of study. There were 75 places of study involved.

Table 4. Distribution of technical co-operation disbursements by type: 1987-1991

This financial table shows technical assistance disbursements from all funds during the last five years, broken down by programme component. It is the only table that shows (in column 10) the balance for assistance in kind. This balance represents the estimated value of months of training beyond the end of 1991 for fellows who had already started their studies in 1991. "Miscellaneous" refers to disbursements in all components for telex charges, health insurance, copying fees and for other minor items or services. In 1991, it also included a charge for radiation protection services.

Table 5. Extrabudgetary funds for technical co-operation activities by donor as at 31 December 1991

This table shows the status of all extrabudgetary funds, including the monies received, their utilization and the balance remaining for further implementation for each donor fund. The amounts footnoted in the table under c, d, and e are not recorded as income in the Agency's Accounts as these are receivables.

Table 6A. Technical Co-operation personnel services: 1991

A list is given of 79 recipient countries showing the number of assignments undertaken and months provided to each country. Persons not serving on country projects are shown under intercountry projects and training courses.

Table 6B. Recipients of training abroad: 1991

The list shows the 88 recipient countries, number of trainees and the total months of training received in 1991.

Table 7. Financial Summary: 1991

This major table shows, by type of assistance and by source, the total technical assistance furnished to 83 countries as well as to intercountry projects and training courses. Fellowship disbursements from regional manpower development projects have been distributed to the individual recipient countries. The figures used represent disbursements incurred during the current year. In the case of UNDP, they also include disbursements against prior-year obligations.

Table 8. Financial Summary: 1958-1991

A summary is given of all assistance provided since the beginning of the Agency's technical co-operation activities, in 1958.

Table 9. Women's participation in Technical Co-operation activities

This table shows the involvement of women in the Agency's technical co-operation programme by human resource category. Numbers and percentages are given for the base year 1981 and for 1990 and 1991.

TABLE 1

AVAILABLE RESOURCES: 1982-1991
(in thousands of dollars)

Year	Technical Assistance and Co-operation Fund				Other resources				Grand total (1+5)
	Voluntary contributions		Miscellaneous income	Subtotal	Extrabudgetary funds	Assistance in kind	UNDP	Subtotal	
	Convertible currency	Non-convertible currency							
	(1a)	(1b)	(1c)	(1)	(2)	(3)	(4)	(5)	(6)
1982	12,112	2,789	1,102	16,003	4,413	2,493	4,631	11,537	27,540
1983	14,169	3,447	1,625	19,241	8,101	2,172	3,706	13,979	33,220
1984	17,213	3,524	1,495	22,232	5,964	2,066	2,541	10,571	32,803
1985	19,282	3,976	1,939	25,197	5,484	2,765	2,654	10,903	36,100
1986	21,348	5,431	1,081	27,860	5,702	2,282	3,480	11,464	39,324
1987	24,571	5,178	404	30,153	5,700	3,066	2,568	11,334	41,487
1988	26,889	5,854	1,767	34,510	5,710	2,322	3,051	11,083	45,593
1989	29,223	6,458	1,631	37,312	7,375	2,295	3,106	12,776	50,088
1990	32,251	6,598	(4,189)	34,660	4,820	2,214	2,856	9,890	44,550
1991	33,688	4,756	438	38,882	7,018	1,702	1,513	10,233	49,115
1982-1991	230,746	48,011	7,293	286,050	60,287	23,377	30,106	113,770	399,820

TABLE 2

TECHNICAL ASSISTANCE AND CO-OPERATION FUND: 1982-1991

Programme Year	Target for voluntary contributions to the Technical Assistance & Co-operation Fund	Amount Pledged	Per cent of target pledged	Income available for technical co-operation programmes	Income as per cent of target
1982	16,000,000	14,901,346	93.1	16,003,198	100.0
1983	19,000,000	17,621,272	92.7	19,246,803	101.3
1984	22,500,000	20,735,931	92.2	22,231,347	98.8
1985	26,000,000	23,314,101	89.7	25,252,982	97.1
1986	30,000,000	26,732,785	89.1	27,813,735	92.7
1987	34,000,000	29,772,162	87.6	30,175,831	88.8
1988	38,000,000	32,710,534	86.1	34,478,116	90.7
1989	42,000,000	35,732,734	85.1	37,360,724	89.0
1990	45,500,000	38,811,140	85.3	34,621,391	76.1
1991	49,000,000	38,423,983	78.4	38,862,448	79.3

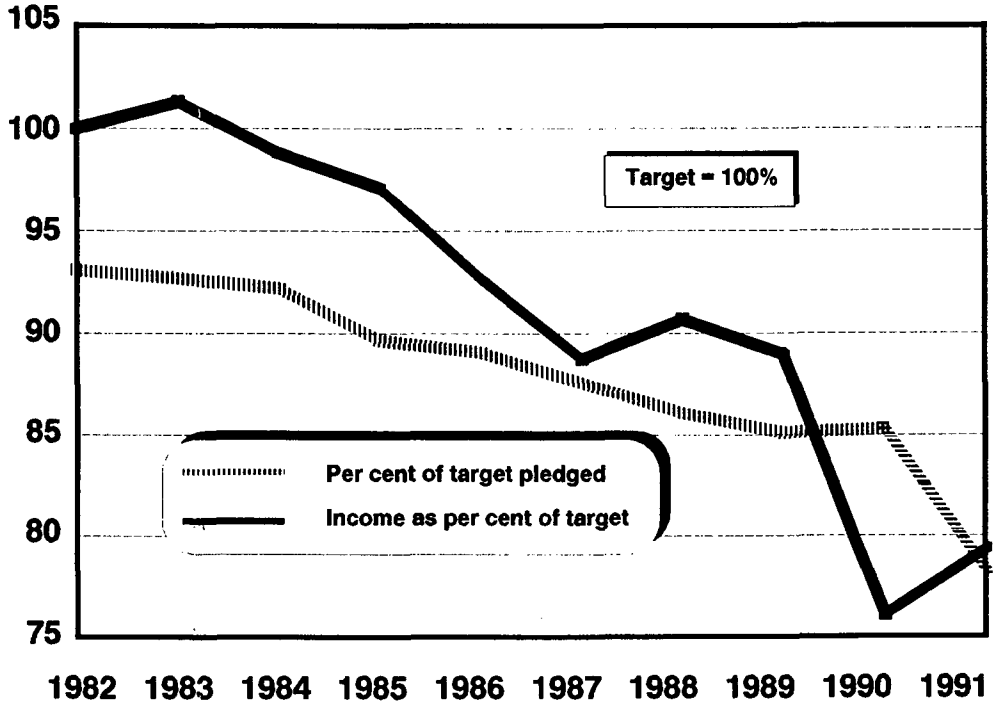


TABLE 3A

PROJECT PERSONNEL BY PLACE OF ORIGIN: 1991

Place of Origin	Total Individuals [a]	Assignments				
		International experts [b]	National experts	Lecturers [c]	Other project personnel	Total
Afghanistan	4	0	4	0	0	4
Albania	3	0	3	0	0	3
Algeria	3	0	2	1	0	3
Argentina	48	59	8	22	3	92
Australia	35	38	0	17	0	55
Austria	41	62	0	10	5	77
Bangladesh	11	5	8	2	0	15
Belgium	22	25	0	8	0	33
Bolivia	5	7	6	2	0	15
Brazil	43	33	11	17	0	61
Bulgaria	29	4	38	2	0	44
Canada	42	45	0	18	0	63
Chile	18	14	5	5	0	24
China	19	12	8	6	0	26
Colombia	9	3	5	1	0	9
Costa Rica	6	1	5	0	0	6
Cuba	6	4	4	1	0	9
Cyprus	2	0	1	1	0	2
Czech & Slovak Fed. Rep.	35	16	26	5	0	47
Denmark	10	18	0	0	0	18
Ecuador	4	2	2	2	0	6
Egypt	11	7	5	1	0	13
El Salvador	1	0	1	1	0	2
Finland	6	6	0	1	0	7
France	61	60	0	17	1	78
Germany	100	126	0	40	0	166
Ghana	8	4	3	4	0	11
Greece	3	3	1	0	0	4
Guatemala	6	2	5	0	0	7
Hungary	46	34	34	5	0	73

Place of Origin	Total Individuals [a]	Assignments				
		International experts [b]	National experts	Lecturers [c]	Other project personnel	Total
India	49	70	6	16	0	92
Indonesia	15	6	12	0	0	18
Iran, Islamic Rep.	11	4	12	0	0	16
Ireland	4	3	0	1	0	4
Israel	7	8	0	5	0	13
Italy	17	31	0	3	0	34
Japan	30	31	0	7	0	38
Jordan	4	1	4	0	0	5
Kenya	4	1	3	0	0	4
Korea, Rep. of	10	6	3	3	0	12
Kuwait	2	0	2	0	0	2
Lao P.D.R.	1	1	0	0	0	1
Lebanon	1	1	0	0	0	1
Libyan Arab J.	1	0	1	0	0	1
Madagascar	1	0	1	0	0	1
Malaysia	15	2	11	5	0	18
Mali	3	2	1	0	0	3
Mauritius	1	2	0	0	0	2
Mexico	20	21	6	7	1	35
Mongolia	2	0	2	0	0	2
Morocco	10	3	9	0	0	12
Myanmar	1	0	1	0	0	1
Netherlands	18	21	0	9	0	30
New Zealand	2	3	0	0	0	3
Niger	2	1	1	0	0	2
Nigeria	5	3	1	3	0	7
Pakistan	15	8	10	2	0	20
Paraguay	3	1	2	0	0	3
Peru	14	19	8	3	0	30
Philippines	9	3	6	1	0	10
Poland	46	49	29	2	0	80
Portugal	4	0	2	3	0	5
Romania	24	3	26	1	0	30

Place of Origin	Total Individuals [a]	Assignments				
		International experts [b]	National experts	Lecturers [c]	Other project personnel	Total
Saudi Arabia	6	0	7	0	0	7
Senegal	1	0	1	0	0	1
Singapore	1	0	1	0	0	1
South Africa	1	0	0	0	1	1
Spain	19	30	0	7	0	37
Sri Lanka	8	22	3	3	0	28
Sudan	1	0	0	1	0	1
Sweden	23	46	0	10	0	56
Switzerland	2	2	0	1	0	3
Syrian Arab Rep.	14	2	15	1	0	18
Thailand	13	11	5	1	0	17
Tunisia	6	4	5	0	0	9
Turkey	16	23	13	1	0	37
United Arab Emirates	3	0	3	0	0	3
UK	95	104	0	27	1	132
United Rep. Tanzania	2	4	1	0	0	5
USA	146	186	0	41	1	228
USSR	58	54	0	34	0	88
Uruguay	5	6	3	3	0	12
Venezuela	9	7	2	9	0	18
Viet Nam	10	1	11	0	0	12
Yugoslavia	34	60	9	13	0	82
Zaire	2	2	0	0	0	2
TOTAL	1,463[a]	1,458[b]	423	412[c]	13	2,306

[a] Includes 189 IAEA staff members and 6 other international organization members. [b] Includes 429 assignments of IAEA staff members and 2 assignments of other international organization members as international experts. [c] Includes 123 assignments of IAEA staff members and 4 assignments of other international organization members as lecturers.

TABLE 3B

TRAINEES IN THE FIELD BY PLACE OF STUDY: 1991

Place of Study	Fellows	Training course participants	Visiting scientists	Total[a]
Algeria	0	6	0	6
Argentina	9	59	4	72
Australia	22	12	3	37
Austria	19	0	8	27
Belgium	15	0	4	19
Bangladesh	1	0	0	1
Bolivia	0	18	0	18
Brazil	24	58	5	87
Bulgaria	1	0	0	1
Burkina Faso	1	0	0	1
Cameroon	0	12	0	12
Canada	41	29	21	91
Chile	1	29	15	45
China	3	32	2	37
Colombia	1	9	0	10
Cote d'Ivoire	1	0	0	1
Cuba	0	11	0	11
Czech & Slovak F.R.	8	30	2	40
Denmark	5	0	9	14
Dominican Republic	0	15	0	15
Ecuador	2	38	0	40
Egypt	11	46	2	59
Finland	7	0	6	13
France	46	48	26	120
Germany	74	73	37	184
Ghana	0	31	0	31
Greece	6	0	0	6
Guatemala	0	15	0	15
Guyana	0	17	0	17
Hungary	30	0	5	35
India	27	40	2	69
Indonesia	4	69	1	74
Iran, Islamic Rep.	0	0	1	1
Ireland	1	0	1	2
Israel	7	0	0	7

Place of Study	Fellows	Training course participants	Visiting scientists	Total[a]
Italy	15	0	12	27
Japan	7	75	7	89
Kenya	2	41	0	43
Korea, Republic of	0	15	8	23
Madagascar	0	18	0	18
Malaysia	5	50	3	58
Mali	0	3	0	3
Mexico	9	65	3	77
Monaco	1	0	0	1
Morocco	1	4	0	5
Netherlands	8	0	5	13
Nigeria	0	14	0	14
Norway	1	0	3	4
Pakistan	4	0	3	7
Panama	1	0	0	1
Peru	0	25	0	25
Philippines	1	0	3	4
Poland	17	2	2	21
Portugal	0	0	1	1
Saudi Arabia	0	8	0	8
Senegal	1	6	0	7
South Africa	0	0	2	2
Singapore	1	9	0	10
Spain	14	26	6	46
Sweden	13	0	8	21
Switzerland	3	0	5	8
Syrian A.R.	2	20	0	22
Thailand	7	60	7	74
Trinidad and Tobago	0	16	0	16
Turkey	0	28	0	28
USSR	10	19	1	30
UK	71	22	22	115
U.R. Tanzania	0	8	0	8
USA	89	156	33	278
Uruguay	3	7	2	12
Venezuela	0	0	2	2
Viet Nam	1	0	0	1
Yugoslavia	3	0	0	3
IAEA	104	79	36	219
European Nuclear Res. Center	10	0	1	11
TOTAL	771	1,473	329	2,573

[a] The difference between the number of trainees (2,351) and the number of places of study (2,573) is due to the fact that a number of fellows, training course participants and visiting scientists went to more than one country/place.

TABLE 4

DISTRIBUTION OF TECHNICAL CO-OPERATION DISBURSEMENTS BY TYPE: 1987 - 1991

Year	Source	Experts		Equipment		Fellowships		Scientific visits		Training courses		Sub-contracts		Miscellaneous		TOTAL		Unliquid-ated obliga-tions	In kind balance	TOTAL
		$	%	$	%	$	%	$	%	$	%	$	%	$	%	$	%	$	$	$
1987	UNDP funds	983.8	29.5	1.423.7	42.7	319.4	9.6	127.1	3.8	292.3	8.8	182.0	5.5	3.5	0.1	3,331.8	100.0	0.0	0.0	3,331.8
	Agency funds	6,746.7	19.0	18,518.5	52.2	5.904.3	16.7	369.6	1.0	3,539.0	10.0	212.0	0.6	170.1	0.5	35,460.2	100.0	0.0	0.0	35,460.2
	Extrabudgetary funds	954.8	21.3	3,043.4	67.8	89.9	2.0	8.5	0.2	288.7	6.4	101.9	2.3	0.0	0.0	4,487.2	100.0	0.0	0.0	4,487.2
	Assistance in kind	171.5	5.6	0.0	0.0	2.514.6	82.0	0.0	0.0	376.8	12.3	2.9	0.1	0.0	0.0	3,065.8	100.0	0.0	0.0	3,065.8
	Total	8,856.8	19.1	22 985.6	49.6	8.828.2	19.0	505.2	1.1	4,496.8	9.7	498.8	1.1	173.6	0.4	46,345.0	100.0	0.0	0.0	46,345.0
1988	UNDP funds	855.7	34.7	664.3	26.9	327.4	13.3	128.9	5.2	324.8	13.2	123.0	5.0	42.3	1.7	2,466.4	100.0	0.0	0.0	2,466.4
	Agency funds	6,077.3	22.7	11,948.8	44.6	4,049.2	15.1	405.2	1.5	3,663.9	13.6	262.7	1.0	403.2	1.5	26,810.3	100.0	0.0	0.0	26,810.3
	Extrabudgetary funds	1,077.3	20.0	3,391.8	62.9	(38.4)	(0.7)	9.8	0.2	554.8	10.3	391.8	7.3	0.0	0.0	5,387.1	100.0	0.0	0.0	5,387.1
	Assistance in kind	290.0	12.5	55.7	2.4	1.542.5	66.4	0.0	0.0	434.3	18.7	0.0	0.0	0.0	0.0	2,322.5	100.0	0.0	0.0	2,322.5
	Total	8,300.3	22.4	16,060.6	43.4	5.880.7	15.9	543.9	1.5	4,977.8	13.5	777.5	2.1	445.5	1.2	36,986.3	100.0	0.0	0.0	36,986.3
1989	UNDP funds	828.6	30.0	823.3	29.8	657.5	23.8	105.8	3.8	307.6	11.1	16.3	0.6	24.7	0.9	2.763.8	100.0	0.0	0.0	2.763.8
	Agency funds	5 994.8	20.5	14.064.0	48.1	3.946.2	13.5	771.4	2.6	3.712.5	12.7	292.1	1.0	483.4	1.6	29 264.4	100.0	0.0	0.0	29.264.4
	Extrabudgetary funds	1.220.9	18.1	3,818.2	56.6	220.1	3.3	38.0	0.6	1 079.1	16.0	363.9	5.4	0.0	0.0	6,740.2	100.0	0.0	0.0	6.740.2
	Assistance in kind	313.9	13.7	18.0	0.8	1 436.8	62.6	13.8	0.6	512.1	22.3	0.0	0.0	0.0	0.0	2.294.6	100.0	0.0	0.0	2.294.6
	Total	8 358.2	20.4	18.723.5	45.6	6 260.6	15.2	929.0	2.3	5.611.3	13.7	672.3	1.6	508.1	1.2	41.063.0	100.0	0.0	0.0	41.063.0
1990	UNDP funds	835.5	25.7	1,103.8	34.0	534.1	16.4	163.1	5.0	460.9	14.2	138.8	4.3	13.9	0.4	3,250.1	100.0	0.0	0.0	3,250.1
	Agency funds	7,211.9	19.6	18,000.9	49.0	5.111.5	13.9	872.2	2.4	4,867.3	13.3	109.8	0.3	531.3	1.4	36.704.9	100.0	0.0	0.0	36,704.9
	Extrabudgetary funds	1.414.2	19.7	4 430.6	61.7	181.9	2.5	19.7	0.3	674.0	9.4	462.5	6.4	0.0	0.0	7,182.9	100.0	0.0	0.0	7.182.9
	Assistance in kind	318.0	14.4	125.0	5.6	1.302.9	58.9	31.1	1.4	436.8	19.7	0.0	0.0	0.0	1.0	2.213.8	100.0	0.0	0.0	2.213.8
	Total	9.779.6	19.8	23.660.3	47.9	7.130.4	14.4	1.086.1	2.2	6.439.0	13.0	711.1	1.4	545.2	1.1	49.351.7	100.0	0.0	0.0	49.351.7
1991	UNDP funds	675.8	35.7	479.3	25.4	151.9	8.0	13.1	0.7	361.8	19.1	189.5	10.0	19.6	1.1	1.891.0	100.0	1.100.7	0.0	2.991.7
	Agency funds	7.905.0	22.1	15.236.0	42.5	5.413.0	15.1	777.8	2.2	5.426.8	15.2	528.4	1.5	513.6	1.4	35.800.6	100.0	20.305.5	0.0	56.106.1
	Extrabudgetary funds	1.461.5	21.9	3.503.1	52.4	198.1	3.0	25.8	0.4	928.9	13.9	565.2	8.4	0.0	0.0	6.682.6	100.0	3.452.2	0.0	10.134.8
	Assistance in kind	310.5	18.2	0.0	0.0	1.101.0	64.7	14.8	0.9	275.2	16.2	0.0	0.0	0.0	0.0	1.701.5	100.0	0.0	188.9	1.890.4
	Total	10.352.8	22.5	19.218.4	41.7	6.864.0	14.9	831.5	1.8	6.992.7	15.2	1.283.1	2.8	533.2	1.1	46.075.7	100.0	24.858.4	188.9	71.123.0
1987-1991	UNDP funds	4.179.4	30.5	4.494.4	32.8	1.990.3	14.5	538.0	3.9	1.747.4	12.8	649.6	4.7	104.0	0.8	13.703.1	100.0	1.100.7	0.0	14.803.8
	Agency funds	33.935.7	20.7	77.768.2	47.4	24.424.2	14.9	3.196.2	1.9	21.209.5	12.9	1.405.0	0.9	2.101.6	1.3	164.040.4	100.0	20.305.5	0.0	184.345.9
	Extrabudgetary funds	6.128.7	20.1	18.187.1	59.7	651.6	2.1	101.8	0.3	3.525.5	11.6	1.885.3	6.2	0.0	0.0	30.480.0	100.0	3.452.2	0.0	33.932.2
	Assistance in kind	1.403.9	12.1	198.7	1.7	7.897.8	68.1	59.7	0.5	2.035.2	17.6	2.9	0.0	0.0	0.0	11.598.2	100.0	0.0	188.9	11.787.1
	Total	45.647.7	20.7	100.648.4	45.8	34.963.9	15.9	3.895.7	1.8	28.517.6	13.0	3.942.8	1.8	2.205.6	1.0	219.821.7	100.0	24.858.4	188.9	244.869.0

TABLE 5

EXTRABUDGETARY FUNDS FOR TECHNICAL CO-OPERATION ACTIVITIES BY DONOR (as at 31 December 1991)

Donor	Funds available 1 January 1991	New funds in 1991	Total funds available	Disbursements in 1991	Unliquidated obligations at year-end	Unobligated balance
Part A: Funds for activities where donor is not recipient						
Australia	631,448	104,210	735,658	288,551	83,875	363,232
Belgium	234,577	111,111	345,688	20,712	33,030	291,946
Canada	1,510	0	1,510	0	0	1,510
Chile	1,635	8,000	9,635	9,635	0	0
Colombia	0	10,000	10,000	2,820	6,000	1,180
CEC	91,698	0	91,698	63,460	0	28,238
Finland	161,603	0	161,603	105,797	45,000	10,806
France	492,778	558,296	1,051,074	272,658	391,130	387,286
Germany	1,464,008	1,016,274	2,480,282	1,180,183	695,521	604,578
Italy	1,002,459	25,148	1,027,607	830,702	104,608	92,297
Japan	305,713	485,084[a]	790,797	435,290	117,258	238,249
Korea, Rep. of	133,936	118,000	251,936	14,124	0	237,812
Kuwait	2,416	0	2,416	6	0	2,410
Norway	505	0	505	0	0	505
Saudi Arabia	4,229	0	4,229	0	0	4,229
Spain	144,313	233,740	378,053	165,813	155,122	57,118
Sweden	447,048	489,017	936,065	547,752	158,251	230,062
USSR	599,003	239,719[b]	838,722	471,489	232,629	134,604
UK	1,794,534	913,066[c]	2,707,600	698,824	545,257	1,463,519
USA	2,332,743	1,629,121[d]	3,961,864	1,136,528	609,664	2,215,672
Sub-total	9,846,156	5,940,786	15,786,942	6,244,344	3,177,345	6,365,253
Part B: Funds for activities where donor is recipient						
Chile	1,844	61,000	62,844	0	63,232	-388
Colombia	514	50,000	50,514	28,841	19,375	2,298
Ecuador	2,301	0	2,301	0	2,300	1
Ghana	15,715	200,000	215,715	6,490	0	209,225
Hungary	8,991	-1,100	7,891	7,891	0	0
Iceland	0	13,724	13,724	11,978	0	1,746
Iran, Islamic Rep.	8,822	84,936	93,758	56,780	23,594	13,384
Ireland	10,000	0	10,000	10,000	0	0
Libyan Arab J.	16,073	13,047	29,120	18,728	0	10,392
Malaysia	505	0	505	0	0	505
Mexico	115	0	115	115	0	0
Nigeria	0	9,624	9,624	9,475	0	149
Pakistan	66,909	24,965	91,874	62,572	500	28,802
Poland	13,005	-5,848	7,157	7,157	0	0
Portugal	19,763	0	19,763	17,392	0	2,371
Syrian Arab Rep.	144,845	309,468[e]	454,313	34,200	0	420,113
Thailand	3	0	3	3	0	0
U.A. Emirates	206,209	100,000	306,209	159,123	161,557	-14,471
Yugoslavia	75,374	0	75,374	7,494	4,250	63,630
Sub-total	590,988	859,816	1,450,804	438,239	274,808	737,757
TOTAL	10,437,144	6,800,602	17,237,746	6,682,583	3,452,153	7,103,010

[a] Additional funds provided under non-TC programme for the RCA project in Asia. [b] Includes 39,611 loss on exchange for funds received in earlier years. [c] Includes receivable of 909,550. [d] Includes receivable of 180,000. [e] Includes 300,000 letter of credit.

TABLE 6A

TECHNICAL CO-OPERATION PERSONNEL SERVICES: 1991

Recipient	Number of assign-ments	Number of months
Afghanistan	2	1.5
Albania	2	1.5
Algeria	16	10.0
Argentina	13	5.5
Bangladesh	23	15.5
Bolivia	13	6.0
Brazil	33	26.0
Bulgaria	43	13.0
Cameroon	4	2.5
Chile	13	7.5
China	45	26.0
Colombia	11	5.0
Costa Rica	8	6.5
Cote d'Ivoire	4	2.0
Cuba	12	9.0
Cyprus	8	3.0
Czech & Slovak F.R.	14	3.0
Dem. P.R. Korea	8	9.0
Dominican Republic	4	2.0
Ecuador	19	10.5
Egypt	30	15.5
El Salvador	9	5.5
Ethiopia	5	3.5
Gabon	1	0.5
Ghana	12	9.5
Greece	5	2.0
Guatemala	8	5.0
Haiti	3	5.0
Hungary	7	2.5
Indonesia	58	36.5
Iran, Islamic Rep.	36	16.0
Ireland	1	0.5
Jamaica	5	4.0
Jordan	20	11.0
Kenya	4	3.5
Korea, Rep. of	33	13.0
Libyan Arab J.	9	29.0
Madagascar	4	4.0
Malaysia	33	19.0
Mali	6	5.0
Mauritius	2	1.0
Mexico	51	20.0
Mongolia	20	15.0
Morocco	27	9.0
Myanmar	10	5.0
Nicaragua	6	4.0
Niger	2	2.0
Nigeria	14	15.0
Pakistan	26	14.0
Panama	8	3.5
Paraguay	4	3.0
Peru	15	10.0
Philippines	19	11.0
Poland	7	2.5
Portugal	10	5.0
Romania	59	20.0
Saudi Arabia	6	4.0
Senegal	3	2.0
Sierra Leone	4	2.5
Singapore	4	2.5
Spain	1	0.5
Sri Lanka	23	13.0
Sudan	2	1.0
Syrian Arab Rep.	12	6.0
Thailand	35	20.0
Tunisia	12	3.0
Turkey	38	14.0
Uganda	7	4.0
Ukraine	6	3.0
United Arab Emirates	1	1.0
UK (Hong Kong)	2	1.0
U.R. Tanzania	12	12.0
Uruguay	8	3.0
Venezuela	14	5.5
Viet Nam	24	13.5
Yugoslavia	16	4.5
Zaire	6	5.0
Zambia	11	8.0
Zimbabwe	5	13.0
Sub-total	1,116	637.5
Intercountry Projects	778	421.0
Training Courses	412	101.5
Sub-total	1,190	522.5
TOTAL	2,306	1,160.0

TABLE 6B

RECIPIENTS OF TRAINING ABROAD: 1991

RECIPIENT	Fellows		Visiting scientists		Training course participants		Total	
	(1)	(2)	(1)	(2)	(1)	(2)	(1)	(2)
Afghanistan	0	0.0	0	0.0	5	4.0	5	4.0
Albania	6	19.5	1	1.0	7	5.5	14	26.0
Algeria	11	28.5	0	0.0	20	35.0	31	63.5
Argentina	8	22.0	13	5.0	44	28.5	65	55.5
Bangladesh	25	96.0	3	2.0	32	19.5	60	117.5
Barbados	0	0.0	0	0.0	6	1.5	6	1.5
Belarus	0	0.0	1	0.5	1	1.5	2	2.0
Benin	0	0.0	0	0.0	1	1.5	1	1.5
Bolivia	0	0.0	0	0.0	17	16.0	17	16.0
Brazil	18	56.0	11	5.0	50	45.5	79	106.5
Bulgaria	23	92.5	15	9.0	28	20.5	66	122.0
Burundi	0	0.0	0	0.0	1	1.0	1	1.0
Cameroon	4	14.0	0	0.0	10	10.0	14	24.0
Chile	9	19.0	3	3.0	37	20.0	49	42.0
China	39	139.0	16	13.5	46	30.0	101	182.5
Colombia	14	48.5	3	2.5	26	12.5	43	63.5
Costa Rica	2	3.5	2	1.0	19	8.0	23	12.5
Cote d'Ivoire	5	10.0	0	0.0	3	2.0	8	12.0
Cuba	21	71.5	5	4.5	29	34.5	55	110.5
Cyprus	3	4.5	1	0.5	3	2.0	7	7.0
Czech & Slovak F.R.	14	63.0	3	1.0	24	19.5	41	83.5
Dem. P.R. Korea	4	9.5	0	0.0	6	3.5	10	13.0
Dominican Rep.	4	13.5	1	0.5	7	3.5	12	17.5
Ecuador	14	29.0	2	1.0	23	28.5	39	58.5
Egypt	25	132.0	8	3.5	25	22.0	58	157.5
El Salvador	1	1.0	0	0.0	8	13.0	9	14.0
Ethiopia	7	64.0	0	0.0	8	6.5	15	70.5
Gabon	0	0.0	0	0.0	2	1.0	2	1.0
Ghana	11	49.0	1	0.5	17	11.0	29	60.5
Greece	5	15.5	1	1.0	5	3.0	11	19.5
Guatemala	9	48.0	2	0.5	15	24.0	26	72.5
Guyana	0	0.0	0	0.0	5	1.0	5	1.0
Hungary	12	45.0	8	3.5	26	19.0	46	67.5
India	1	1.0	0	0.0	31	18.0	32	19.0
Indonesia	28	98.0	10	4.5	48	34.0	86	136.5
Iran, I.R.	10	37.0	3	2.0	23	18.0	36	57.0
Jamaica	2	8.5	0	0.0	11	3.5	13	12.0

RECIPIENT	Fellows		Visiting scientists		Training course participants		Total	
	(1)	(2)	(1)	(2)	(1)	(2)	(1)	(2)
Jordan	6	17.0	4	3.0	16	11.0	26	31.0
Kenya	6	19.0	0	0.0	15	12.0	21	31.0
Korea, Repbulic of	21	107.0	5	3.0	33	19.0	59	129.0
Kuwait	0	0.0	0	0.0	1	0.5	1	0.5
Libyan Arab J.	15	101.0	0	0.0	7	5.5	22	106.5
Madagascar	1	6.0	0	0.0	4	2.0	5	8.0
Malaysia	15	49.0	13	7.5	37	17.0	65	73.5
Mali	5	9.0	0	0.0	8	3.0	13	12.0
Mauritius	0	0.0	1	1.0	4	1.0	5	2.0
Mexico	18	62.5	5	1.0	56	52.0	79	115.5
Mongolia	12	40.5	0	0.0	5	7.5	17	48.0
Morocco	17	59.5	1	2.0	12	7.5	30	69.0
Myanmar	7	41.0	0	0.0	10	7.5	17	48.5
Namibia	0	0.0	0	0.0	1	0.5	1	0.5
Nepal	0	0.0	0	0.0	3	3.0	3	3.0
Nicaragua	2	4.5	0	0.0	3	9.0	5	13.5
Niger	2	10.0	0	0.0	4	3.0	6	13.0
Nigeria	34	182.0	2	1.0	18	10.5	54	193.5
Pakistan	26	108.0	4	2.0	37	26.0	67	136.0
Panama	4	11.5	0	0.0	8	5.0	12	16.5
Paraguay	3	9.5	0	0.0	10	3.0	13	12.5
Peru	13	40.0	5	2.0	31	34.5	49	76.5
Philippines	12	38.0	3	2.5	28	23.0	43	63.5
Poland	15	66.0	3	2.0	12	14.0	30	82.0
Portugal	5	18.5	3	1.5	3	2.0	11	22.0
Romania	13	44.0	15	11.0	25	24.5	53	79.5
Saudi Arabia	1	1.0	1	0.5	7	5.5	9	7.0
Senegal	5	14.0	1	1.0	9	6.5	15	21.5
Sierra Leone	1	11.5	1	0.5	4	3.0	6	15.0
Singapore	1	3.0	0	0.0	7	2.0	8	5.0
Spain	0	0.0	0	0.0	2	3.0	2	3.0
Sri Lanka	11	58.0	1	1.0	29	16.0	41	75.0
Sudan	14	80.0	0	0.0	16	16.0	30	96.0
Syrian A.R.	5	13.5	2	1.0	11	10.0	18	24.5
Thailand	25	106.5	1	0.5	45	25.0	71	132.0
Trinidad and Tobago	0	0.0	0	0.0	4	1.0	4	1.0
Tunisia	2	4.0	7	4.0	14	8.5	23	16.5
Turkey	10	30.0	1	0.5	20	18.0	31	48.5
Uganda	4	19.0	0	0.0	11	6.0	15	25.0
Ukraine	0	0.0	0	0.0	2	1.0	2	1.0

RECIPIENT	Fellows		Visiting scientists		Training course participants		Total	
	(1)	(2)	(1)	(2)	(1)	(2)	(1)	(2)
U.A. Emirates	1	4.0	0	0.0	3	2.0	4	6.0
U.K. (Hong Kong)	2	5.0	0	0.0	0	0.0	2	5.0
U.R. Tanzania	11	50.0	1	1.0	13	7.5	25	58.5
Uruguay	3	8.0	4	2.0	18	7.0	25	17.0
Venezuela	7	15.5	1	1.0	31	30.0	39	46.5
Viet Nam	37	134.0	3	1.0	50	32.0	90	167.0
Yemen	0	0.0	1	0.5	0	0.0	1	0.5
Yugoslavia	6	25.5	0	0.0	19	15.5	25	41.0
Zaire	4	28.5	0	0.0	10	9.5	14	38.0
Zambia	9	32.0	1	0.5	9	6.0	19	38.5
Zimbabwe	1	1.0	0	0.0	7	3.5	8	4.5
TOTAL	747	2,926.0	203	120.0	1,401	1,066.0	2,351	4,112.0

(1) Number of trainees. (2) Number of months of training received.

TABLE 7

FINANCIAL SUMMARY: 1991
(in thousands of dollars)

Recipient	Assistance provided, by type						Assistance provided, by source						Unliquid. oblig.	TOTAL
	Experts	Equipment	Fellowships	Group trng.	Subcontracts	Total	UNDP	TACF CC	TACF NCC	Extrabud.	In kind	Total		
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)
AFGHANISTAN	15.0	0.2	0.0	0.0	0.0	15.2	0.0	15.2	0.0	0.0	0.0	15.2	25.8	41.0
ALBANIA	14.8	46.7	36.6	0.0	0.0	98.1	19.3	60.1	18.7	0.0	0.0	98.1	21.9	120.0
ALGERIA	79.5	400.1	48.2	0.0	0.0	527.8	0.0	457.6	70.2	0.0	0.0	527.8	208.4	736.2
ARGENTINA	69.6	71.2	86.4	0.0	0.0	227.2	23.7	201.4	0.0	0.0	2.1	227.2	153.0	380.2
BANGLADESH	140.3	371.6	252.8	0.0	0.0	764.7	0.0	525.3	33.1	146.5	59.8	764.7	503.1	1,267.8
BELARUS	0.0	0.0	3.0	0.0	0.0	3.0	0.0	3.0	0.0	0.0	0.0	3.0	0.0	3.0
BOLIVIA	46.1	173.2	4.8	0.0	0.0	224.1	0.0	233.2	3.6	(12.7)	0.0	224.1	218.8	442.9
BRAZIL	322.6	445.8	182.8	0.0	0.0	951.2	14.5	337.6	0.0	584.2	14.9	951.2	228.9	1,180.1
BULGARIA	124.4	113.7	265.5	0.0	431.1	934.7	0.0	847.7	45.4	0.0	41.6	934.7	572.0	1,506.7
CAMEROON	30.9	187.9	46.5	0.0	0.0	265.3	0.0	265.3	0.0	0.0	0.0	265.3	90.0	355.3
CHILE	112.7	301.7	72.7	0.0	0.0	487.1	0.0	462.8	15.1	0.0	9.2	487.1	519.6	1,006.7
CHINA	256.9	323.9	391.3	2.9	0.0	975.0	104.0	785.7	28.8	23.0	33.5	975.0	795.5	1,770.5
COLOMBIA	59.2	302.2	93.2	0.0	0.0	454.6	0.0	423.2	2.6	28.8	0.0	454.6	322.7	777.3
COSTA RICA	58.4	184.3	10.1	0.0	0.0	252.8	0.0	181.5	0.0	71.3	0.0	252.8	40.6	293.4
COTE D'IVOIRE	25.2	48.1	26.8	0.0	0.0	100.1	0.0	83.6	0.0	16.5	0.0	100.1	76.2	176.3
CUBA	82.3	370.5	137.9	0.0	0.0	590.7	10.1	540.5	40.1	0.0	0.0	590.7	688.1	1,278.8
CYPRUS	23.3	142.0	15.3	0.0	0.0	180.6	0.0	118.8	0.0	60.4	1.4	180.6	120.3	300.9
CZECH & SLOVAK F.R.	23.3	17.6	135.1	0.0	0.0	176.0	0.0	125.0	0.0	21.1	29.9	176.0	142.3	318.3
DEM. P.R. KOREA	86.4	560.2	25.3	0.0	0.0	671.9	0.0	625.0	46.9	0.0	0.0	671.9	339.2	1,011.1
DOMINICAN REP.	20.5	139.2	42.5	0.0	0.0	202.2	0.0	202.2	0.0	0.0	0.0	202.2	88.0	290.2
ECUADOR	86.9	383.9	76.4	0.0	0.0	547.2	0.0	367.5	31.5	133.8	14.4	547.2	543.4	1,090.6
EGYPT	141.4	465.6	299.0	0.0	53.8	959.8	209.8	511.7	85.6	117.1	35.6	959.8	2,370.7	3,330.5
EL SALVADOR	45.8	165.0	4.6	0.0	0.0	215.4	0.0	150.6	5.1	59.7	0.0	215.4	57.9	273.3
ETHIOPIA	30.0	170.4	110.2	0.0	0.0	310.6	0.0	249.5	0.0	39.9	21.2	310.6	130.5	441.1
GABON	10.1	0.0	0.0	0.0	0.0	10.1	0.0	10.1	0.0	0.0	0.0	10.1	1.4	11.5
GHANA	93.4	206.6	125.4	0.0	0.0	425.4	0.0	341.2	6.0	78.2	0.0	425.4	153.8	579.2
GREECE	20.9	138.1	48.9	0.0	0.0	207.9	0.0	99.6	0.8	94.5	13.0	207.9	723.9	931.8
GUATEMALA	49.7	205.7	105.1	0.0	70.8	431.3	0.0	326.5	0.0	104.8	0.0	431.3	399.5	830.8
HAITI	29.5	48.4	0.0	0.0	0.0	77.9	0.0	77.9	0.0	0.0	0.0	77.9	30.9	108.8
HUNGARY	11.5	69.9	95.2	0.0	0.0	176.6	2.6	79.7	50.0	9.9	34.4	176.6	413.5	590.1
ICELAND	0.0	27.4	0.0	0.0	0.0	27.4	0.0	15.4	0.0	12.0	0.0	27.4	0.0	27.4
INDIA	0.0	0.0	3.5	0.0	0.0	3.5	0.0	0.9	0.0	0.0	2.6	3.5	0.0	3.5
INDONESIA	485.3	529.9	290.0	0.0	0.0	1,305.2	96.1	734.3	120.8	284.7	69.3	1,305.2	363.7	1,668.9
IRAN, I.R.	250.2	358.6	85.9	0.0	0.0	694.7	0.0	504.7	125.8	56.8	7.4	694.7	351.4	1,046.1
IRAQ	1.1	1.1	1.9	0.0	0.0	4.1	0.0	4.1	0.0	0.0	0.0	4.1	0.7	4.8
IRELAND	3.7	16.1	0.0	0.0	0.0	19.8	0.0	9.8	0.0	10.0	0.0	19.8	0.0	19.8
JAMAICA	30.2	54.1	10.1	0.0	0.0	94.4	0.0	94.4	0.0	0.0	0.0	94.4	125.6	220.0
JORDAN	128.0	221.9	50.4	0.0	0.0	400.3	0.0	345.3	30.0	17.7	7.3	400.3	151.5	551.8
KENYA	34.8	95.1	78.0	0.0	0.0	207.9	22.6	161.4	0.0	1.6	22.3	207.9	154.0	361.9
KOREA, REP. OF	227.5	11.6	317.2	0.0	0.0	556.3	0.0	405.9	0.0	60.9	89.5	556.3	232.7	789.0
LIBYAN A.J.	220.6	130.5	197.7	0.0	0.0	548.8	0.0	314.7	43.6	190.5	0.0	548.8	220.2	769.0
MADAGASCAR	28.8	99.2	7.9	0.0	0.0	135.9	0.0	135.5	0.4	0.0	0.0	135.9	3.0	138.9
MALAYSIA	238.0	370.3	197.1	0.0	0.0	805.4	0.0	744.3	0.0	47.4	13.7	805.4	133.8	939.2

Recipient	Assistance provided, by type						Assistance provided, by source						Unliquid. oblig.	TOTAL
	Experts	Equipment	Fellowships	Group trng.	Subcontracts	Total	UNDP	TACF CC	TACF NCC	Extrabud.	In kind	Total		
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)
MALI	56.9	189.5	38.5	0.0	0.0	284.9	0.0	264.6	0.0	0.0	20.3	284.9	55.9	340.8
MAURITIUS	14.9	63.6	10.1	0.0	0.0	88.6	0.0	88.6	0.0	0.0	0.0	88.6	9.5	98.1
MEXICO	235.7	313.0	188.5	0.0	0.0	737.2	0.0	427.6	11.4	206.0	92.2	737.2	1,047.0	1,784.2
MONGOLIA	148.1	410.1	63.3	0.0	0.0	621.5	0.0	450.0	171.5	0.0	0.0	621.5	324.2	945.7
MOROCCO	101.6	242.6	120.1	0.0	0.0	464.3	0.0	355.8	12.1	57.4	39.0	464.3	337.5	801.8
MYANMAR	40.3	131.0	51.9	0.0	0.0	223.2	0.0	223.2	0.0	0.0	0.0	223.2	58.0	281.2
NICARAGUA	48.8	171.4	21.8	0.0	0.0	242.0	0.0	224.6	17.4	0.0	0.0	242.0	106.0	348.0
NIGER	13.9	90.0	21.9	0.0	0.0	125.8	0.0	103.1	13.4	0.0	9.3	125.8	102.9	228.7
NIGERIA	124.5	327.8	408.9	0.0	62.2	923.4	0.0	595.3	14.2	212.9	101.0	923.4	595.3	1,518.7
PAKISTAN	144.8	536.6	251.9	0.0	0.0	933.3	0.0	710.1	158.7	62.6	1.9	933.3	311.1	1,244.4
PANAMA	39.4	214.9	20.7	0.0	0.0	275.0	0.0	275.0	0.0	0.0	0.0	275.0	43.4	318.4
PARAGUAY	22.5	56.9	27.6	0.0	0.0	107.0	0.0	87.1	0.0	0.0	19.9	107.0	19.5	126.5
PERU	123.7	406.3	100.1	0.0	0.0	630.1	0.4	580.2	1.6	30.7	17.2	630.1	438.5	1,068.6
PHILIPPINES	110.0	426.7	122.2	0.0	0.0	658.9	0.0	607.7	0.0	21.5	29.7	658.9	245.3	904.2
POLAND	21.3	601.5	169.3	0.0	0.0	792.1	0.0	457.3	121.7	185.9	27.2	792.1	686.9	1,479.0
PORTUGAL	56.9	248.0	53.9	0.0	0.0	358.8	0.0	296.7	0.0	50.5	11.6	358.8	665.7	1,024.5
ROMANIA	232.7	464.5	178.6	0.0	0.0	875.8	180.3	550.6	74.0	45.1	25.8	875.8	249.5	1,125.3
SAUDI ARABIA	44.5	0.4	10.0	0.0	0.0	54.9	0.0	54.9	0.0	0.0	0.0	54.9	5.9	60.8
SENEGAL	24.6	97.1	31.5	0.0	0.0	153.2	0.0	149.2	4.0	0.0	0.0	153.2	28.5	181.7
SIERRA LEONE	25.5	122.0	41.0	0.0	0.0	188.5	0.0	188.5	0.0	0.0	0.0	188.5	48.1	236.6
SINGAPORE	29.5	40.2	8.2	0.0	0.0	77.9	0.0	77.9	0.0	0.0	0.0	77.9	36.2	114.1
SPAIN	3.4	27.8	0.0	0.0	0.0	31.2	0.0	31.2	0.0	0.0	0.0	31.2	0.0	31.2
SRI LANKA	145.0	321.6	141.3	0.0	0.0	607.9	0.0	500.5	35.9	27.8	43.7	607.9	99.3	707.2
SUDAN	11.9	251.0	198.3	0.0	0.0	461.2	0.0	461.2	0.0	0.0	0.0	461.2	106.9	568.1
SYRIAN A.R.	43.8	505.0	52.9	0.0	14.0	615.7	0.0	244.5	337.0	34.2	0.0	615.7	358.4	974.1
THAILAND	214.4	303.0	285.6	5.2	0.0	808.2	64.7	504.6	3.5	144.7	90.7	808.2	304.5	1,112.7
TUNISIA	32.3	152.0	27.8	0.0	0.0	212.1	0.0	145.0	0.0	62.8	4.3	212.1	201.6	413.7
TURKEY	149.8	242.0	81.0	0.0	112.2	585.0	165.9	388.4	24.0	0.0	6.7	585.0	671.4	1,256.4
UGANDA	42.3	126.7	36.1	0.0	0.0	205.1	0.0	205.1	0.0	0.0	0.0	205.1	33.7	238.8
UK (HONG KONG)	7.0	30.5	16.0	0.0	0.0	53.5	0.0	53.5	0.0	0.0	0.0	53.5	50.4	103.9
UKRAINE	20.2	3.1	0.0	0.0	0.0	23.3	0.0	15.9	0.0	0.0	7.4	23.3	31.2	54.5
URUGUAY	27.7	118.6	24.3	0.0	0.0	170.6	0.0	166.3	0.0	4.3	0.0	170.6	139.6	310.2
U.A. EMIRATES	12.6	210.4	12.2	0.0	0.0	235.2	0.0	76.1	0.0	159.1	0.0	235.2	178.7	413.9
U.R. TANZANIA	96.3	179.5	119.8	0.0	0.0	395.6	0.0	377.5	(1.5)	1.4	18.2	395.6	79.5	475.1
VENEZUELA	62.8	189.5	30.6	2.0	0.0	284.9	7.6	254.4	0.0	11.0	11.9	284.9	246.1	531.0
VIET NAM	142.9	430.2	287.5	0.0	0.0	860.6	0.0	652.0	165.6	0.0	43.0	860.6	390.2	1,250.8
YUGOSLAVIA	52.4	662.0	60.0	0.0	0.0	774.4	0.0	203.6	203.5	334.5	32.8	774.4	296.1	1,070.5
ZAIRE	73.8	154.8	75.7	0.0	0.0	304.3	0.0	254.5	5.1	1.8	42.9	304.3	28.3	332.6
ZAMBIA	104.7	182.1	59.5	0.0	0.0	346.3	0.0	322.3	20.5	0.0	3.5	346.3	87.2	433.5
ZIMBABWE	106.6	41.1	8.0	0.0	0.0	155.7	0.0	152.2	3.5	0.0	0.0	155.7	73.2	228.9
Sub-Total	6,768.8	17,254.5	7,437.9	10.1	744.1	32,215.4	921.6	23,956.5	2,201.2	3,912.8	1,223.3	32,215.4	20,507.7	52,723.1
INTERREGIONAL	667.2	19.4	0.0	2,961.0	37.6	3,685.2	0.0	3,501.4	5.6	109.6	68.6	3,685.2	1,520.2	5,205.4
REGIONAL AFRICA	689.2	428.0	4.8	744.9	40.9	1,907.8	0.0	1,738.4	88.1	56.5	24.8	1,907.8	674.2	2,582.0
REG. ARAB STATE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	5.6	5.6
REG. ASIA & PACIFIC	935.5	300.5	89.0	1,622.2	136.5	3,083.7	968.2	999.7	27.2	935.5	153.1	3,083.7	843.0	3,926.7
REGIONAL EUROPE	455.4	193.0	33.8	528.2	170.7	1,381.1	0.0	936.0	207.0	165.8	72.3	1,381.1	418.5	1,799.6
REG. LATIN AMERICA	836.7	1,042.6	130.0	1,126.3	153.3	3,288.9	1.2	1,624.8	1.1	1,502.4	159.4	3,288.9	886.0	4,174.9
Sub-Total	3,584.0	1,983.5	257.6	6,982.6	539.0	13,346.7	969.4	8,800.3	329.0	2,769.8	478.2	13,346.7	4,347.5	17,694.2
MISCELLANEOUS	115.0	221.8	90.1	79.0	7.7	513.6	0.0	513.6	0.0	0.0	0.0	513.6	3.2	516.8
GRAND TOTAL	10,467.8	19,459.8	7,785.6	7,071.7	1,290.8	46,075.7	1,891.0	33,270.4	2,530.2	6,682.6	1,701.5	46,075.7	24,858.4	70,934.1

TABLE 8

FINANCIAL SUMMARY: 1958-1991
(in thousands of dollars)

Recipient	Assistance provided, by type						Assistance provided, by source				
	Experts	Equip-ment	Fellow-ships	Group training	Sub-con-tracts	Total	UNDP	Agency	Extra bud.[a]	In kind	Total
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)
AFGHANISTAN	400.3	441.7	137.2	0.0	0.0	979.2	92.9	804.5	0.0	81.8	979.2
ALBANIA	251.2	1,873.9	331.3	38.5	0.0	2,494.9	252.4	2,192.5	0.0	50.0	2,494.9
ALGERIA	647.1	2,401.1	552.7	0.0	0.0	3,600.9	21.7	3,428.1	0.0	151.1	3,600.9
ARGENTINA	3,523.0	2,637.7	1,428.3	0.0	0.0	7,589.0	5,134.3	1,892.3	17.5	544.9	7,589.0
BANGLADESH	1,323.0	5,709.4	3,276.3	0.0	0.0	10,308.7	63.8	7,118.6	1,545.3	1,581.0	10,308.7
BELARUS	0.0	48.8	3.0	0.0	0.0	51.8	0.0	51.8	0.0	0.0	51.8
BOLIVIA	692.5	2,364.7	461.5	5.7	0.0	3,524.4	159.5	2,653.3	534.0	177.6	3,524.4
BRAZIL	6,622.8	7,561.3	2,837.0	0.0	0.0	17,021.1	5,674.9	7,433.5	3,062.7	850.0	17,021.1
BULGARIA	396.2	4,412.3	3,037.7	0.0	431.1	8,277.3	543.9	6,687.3	312.6	733.5	8,277.3
CAMEROON	509.6	611.9	156.9	0.0	0.0	1,278.4	297.3	873.8	88.3	19.0	1,278.4
CAPE VERDE	3.5	0.1	0.0	0.0	0.0	3.6	3.6	0.0	0.0	0.0	3.6
CHILE	3,054.6	4,043.2	1,832.3	0.0	0.0	8,930.1	3,615.1	4,777.5	23.0	514.5	8,930.1
CHINA	1,878.9	2,483.2	3,190.3	2.9	8.1	7,563.4	2,428.0	4,338.0	463.9	333.5	7,563.4
COLOMBIA	1,594.3	3,933.5	1,265.3	0.0	0.0	6,793.1	1,693.6	3,723.1	632.5	743.9	6,793.1
COSTA RICA	1,018.7	1,460.3	339.5	0.0	7.0	2,825.5	618.1	1,709.2	305.6	192.6	2,825.5
COTE D'IVOIRE	547.0	981.9	223.2	0.0	0.0	1,752.1	73.4	1,528.7	119.8	30.2	1,752.1
CUBA	820.1	6,640.6	709.4	0.0	0.0	8,170.1	2,250.3	5,722.6	39.2	158.0	8,170.1
CYPRUS	181.9	951.1	223.1	0.0	0.0	1,356.1	24.1	1,029.8	135.1	167.1	1,356.1
CZECH & SLOVAK FEDERAL REP.	71.2	167.5	1,364.2	0.0	0.0	1,602.9	6.2	1,126.2	34.0	436.5	1,602.9
DEM. P.R. KOREA	318.9	4,563.7	866.5	0.0	0.0	5,749.1	0.0	5,218.1	52.6	478.4	5,749.1
DOMINICAN REP.	241.6	953.1	245.4	0.0	0.0	1,440.1	0.0	1,404.0	3.9	32.2	1,440.1
ECUADOR	1,620.5	4,550.7	898.4	0.0	16.9	7,086.5	547.5	4,907.0	1,159.1	472.9	7,086.5
EGYPT	3,962.5	12,255.8	4,688.6	99.6	1,215.8	22,222.3	2,071.0	9,591.3	7,885.7	2,674.3	22,222.3
EL SALVADOR	324.3	1,049.1	216.1	0.0	0.0	1,589.5	14.1	1,161.8	235.8	177.8	1,589.5
ETHIOPIA	634.1	1,202.1	648.5	0.0	0.0	2,484.7	437.5	1,848.2	45.3	153.7	2,484.7
GABON	89.6	89.2	29.3	0.0	0.0	208.1	0.0	195.5	0.0	12.6	208.1
GHANA	931.4	2,872.9	2,762.6	0.0	0.0	6,566.9	354.5	4,094.7	641.9	1,475.8	6,566.9
GREECE	2,009.9	2,328.9	1,374.4	0.0	0.0	5,713.2	1,561.9	2,860.2	606.6	684.5	5,713.2
GUATEMALA	458.7	1,905.5	443.7	0.0	224.9	3,032.8	56.2	2,258.4	600.6	117.6	3,032.8
HAITI	66.4	151.9	14.8	0.0	0.9	234.0	0.9	233.1	0.0	0.0	234.0
HONDURAS	0.0	0.0	0.7	0.0	0.0	0.7	0.0	0.7	0.0	0.0	0.7
HUNGARY	140.0	8,097.5	2,041.8	0.0	0.0	10,279.3	720.3	8,256.5	926.4	376.1	10,279.3
ICELAND	76.6	764.4	152.3	0.0	0.0	993.3	0.0	845.7	20.5	127.1	993.3
INDIA	1,015.8	3,801.6	2,709.9	0.0	0.0	7,527.3	2,920.3	1,293.2	2,149.0	1,164.8	7,527.3
INDONESIA	4,482.6	5,024.8	2,836.2	7.2	33.0	12,383.8	2,480.0	6,947.0	1,809.3	1,147.5	12,383.8
IRAN, I.R.	1,613.1	3,227.3	1,541.1	0.0	211.7	6,593.2	2,122.8	3,671.4	408.1	390.9	6,593.2
IRAQ	882.1	1,315.6	1,024.5	0.0	18.3	3,240.5	242.5	2,540.2	25.0	432.8	3,240.5
IRELAND	6.7	42.7	19.4	0.0	0.0	68.8	0.0	57.3	10.0	1.5	68.8
ISRAEL	257.8	819.8	438.7	0.0	0.0	1,516.3	170.9	900.6	18.0	426.8	1,516.3
JAMAICA	295.0	737.7	71.5	0.0	55.0	1,159.2	15.3	964.8	108.3	70.8	1,159.2
JORDAN	793.4	1,313.7	372.6	0.0	0.0	2,479.7	89.3	2,160.2	118.3	111.9	2,479.7
KENYA	996.9	1,641.6	1,228.9	0.0	0.0	3,867.4	97.2	2,507.3	735.3	527.6	3,867.4
KOREA, REP. OF	4,123.6	2,165.1	4,555.6	0.0	0.0	10,844.3	1,206.8	5,721.1	1,509.6	2,406.8	10,844.3
LEBANON	248.5	298.4	129.7	0.0	0.0	676.6	139.3	482.7	31.4	23.2	676.6

Recipient	Assistance provided, by type						Assistance provided, by source				
	Experts	Equip-ment	Fellow-ships	Group training	Sub-con-tracts	Total	UNDP	Agency	Extra bud.[a]	In kind	Total
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)
LIBERIA	117.3	29.0	0.0	0.0	0.0	146.3	60.2	29.8	0.0	56.3	146.3
LIBYAN A.J.	678.3	812.3	1,207.9	0.0	0.0	2,698.5	7.3	2,274.4	324.4	92.4	2,698.5
MADAGASCAR	1,393.5	1,827.8	324.1	0.0	0.0	3,545.4	1,436.6	1,797.3	244.2	67.3	3,545.4
MALAWI	5.1	0.0	0.0	0.0	0.0	5.1	5.1	0.0	0.0	0.0	5.1
MALAYSIA	2,076.3	4,024.2	1,584.1	0.0	0.0	7,684.6	1.6	5,918.4	1,158.4	606.2	7,684.6
MALI	875.4	1,442.9	416.9	0.0	0.0	2,735.2	13.4	2,469.3	143.4	109.1	2,735.2
MAURITIUS	124.0	325.6	70.3	0.0	0.0	519.9	0.0	516.1	3.8	0.0	519.9
MEXICO	3,336.8	1,966.3	1,810.3	0.0	564.8	7,678.2	419.3	4,857.9	1,406.5	994.5	7,678.2
MONGOLIA	621.1	1,903.5	252.0	0.0	0.0	2,776.6	0.0	2,741.2	10.6	24.8	2,776.6
MOROCCO	2,057.0	2,063.5	646.2	0.0	18.0	4,784.7	909.6	3,063.7	505.8	305.6	4,784.7
MYANMAR	897.2	1,772.4	301.4	0.0	0.0	2,971.0	537.0	2,330.4	0.0	103.6	2,971.0
NICARAGUA	172.0	823.0	138.6	0.0	0.0	1,133.6	0.0	1,133.6	0.0	0.0	1,133.6
NIGER	410.1	897.3	182.3	0.0	0.0	1,489.7	0.0	1,418.1	0.0	71.6	1,489.7
NIGERIA	3,237.9	3,728.6	2,180.3	0.0	183.8	9,330.6	980.9	3,513.0	3,764.0	1,072.7	9,330.6
PAKISTAN	2,149.5	4,484.6	4,208.6	0.0	5.2	10,847.9	1,842.0	7,346.0	236.8	1,423.1	10,847.9
PANAMA	461.5	1,446.6	297.0	0.0	0.0	2,205.1	4.1	1,865.6	194.3	141.1	2,205.1
PARAGUAY	344.8	1,341.7	354.4	0.0	0.0	2,040.9	0.0	1,771.0	145.3	124.6	2,040.9
PERU	3,866.4	7,097.7	1,605.7	2.7	58.6	12,631.1	3,907.6	5,022.5	2,859.5	841.5	12,631.1
PHILIPPINES	2,630.2	4,511.2	4,042.8	0.0	90.8	11,275.0	1,964.4	5,681.0	1,323.0	2,306.6	11,275.0
POLAND	272.8	6,093.9	3,467.7	0.0	0.0	9,834.4	202.9	7,793.5	1,050.4	787.6	9,834.4
PORTUGAL	495.0	3,788.0	478.6	0.0	0.0	4,761.6	0.0	3,568.7	1,003.1	189.8	4,761.6
ROMANIA	1,405.5	5,637.4	1,165.5	0.0	134.5	8,342.9	3,126.8	4,835.6	97.3	283.2	8,342.9
SAUDI ARABIA	125.0	12.3	35.4	0.0	0.0	172.7	0.0	165.7	0.0	7.0	172.7
SENEGAL	522.7	1,405.8	296.2	0.0	0.0	2,224.7	345.8	1,651.9	154.7	72.3	2,224.7
SIERRA LEONE	483.2	398.6	256.6	0.0	0.0	1,138.4	174.5	835.2	12.4	116.3	1,138.4
SINGAPORE	484.5	1,241.4	172.9	0.0	0.0	1,898.8	0.0	1,729.0	103.3	66.5	1,898.8
SPAIN	386.0	93.4	105.0	0.0	0.0	584.4	0.0	505.3	56.0	23.1	584.4
SRI LANKA	1,225.9	3,573.8	1,995.0	0.0	0.0	6,794.7	307.9	5,106.1	727.2	653.5	6,794.7
SUDAN	912.3	2,515.5	2,307.2	0.0	13.4	5,748.4	296.7	4,168.9	580.2	702.6	5,748.4
SYRIAN A.R.	911.9	2,627.0	774.4	0.0	222.9	4,536.2	693.2	3,150.6	582.1	110.3	4,536.2
THAILAND	3,263.9	5,573.8	5,735.6	19.0	3.8	14,596.1	2,006.9	7,202.4	2,529.2	2,857.6	14,596.1
TUNISIA	821.4	1,741.1	446.5	0.0	0.0	3,009.0	141.2	2,272.4	419.0	176.4	3,009.0
TURKEY	2,448.2	3,376.9	3,592.3	0.0	134.4	9,551.8	2,040.3	5,408.9	130.8	1,971.8	9,551.8
UGANDA	432.8	710.4	459.7	0.0	0.0	1,602.9	131.0	1,416.7	0.0	55.2	1,602.9
UK (HONG KONG)	131.8	164.2	58.3	0.0	0.0	354.3	0.0	345.3	0.0	9.0	354.3
UKRAINE	20.2	53.1	0.0	0.0	0.0	73.3	0.0	65.9	0.0	7.4	73.3
URUGUAY	910.0	2,752.6	598.3	0.0	0.0	4,260.9	193.1	2,838.7	906.3	322.8	4,260.9
USSR	0.0	50.0	0.0	0.0	0.0	50.0	0.0	50.0	0.0	0.0	50.0
U.A. EMIRATES	81.2	714.5	28.1	0.0	0.0	823.8	0.0	328.0	495.8	0.0	823.8
U.R. TANZANIA	775.1	1,693.0	1,014.6	0.0	0.0	3,482.7	9.6	3,177.7	88.4	207.0	3,482.7
VENEZUELA	1,448.2	1,786.6	553.5	20.6	0.0	3,808.9	391.2	3,029.5	191.0	197.2	3,808.9
VIET NAM	688.1	5,164.9	2,458.8	0.0	0.0	8,311.8	31.4	7,327.1	139.5	813.8	8,311.8
YUGOSLAVIA	1,511.9	7,053.3	2,800.0	0.0	37.3	11,402.5	3,061.7	5,645.9	1,758.8	936.1	11,402.5
ZAIRE	817.9	2,106.6	986.3	0.0	0.0	3,910.8	578.8	2,683.8	206.5	441.7	3,910.8
ZAMBIA	1,609.4	3,015.8	875.0	0.0	0.0	5,500.2	152.5	4,891.1	180.9	275.7	5,500.2
ZIMBABWE	190.4	313.8	109.0	0.0	0.0	613.2	0.0	589.5	0.0	23.7	613.2
OTHER COUNTRIES[b]	593.8	266.2	1,468.3	0.0	0.0	2,328.3	565.5	902.4	8.5	851.9	2,328.3
SUB-TOTAL	97,549.4	214,319.4	102,542.1	196.2	3,690.2	418,297.3	64,741.5	262,646.9	50,155.6	40,753.3	418,297.3

Recipient	Assistance provided, by type						Assistance provided, by source				
	Experts	Equip-ment	Fellow-ships	Group training	Sub-con-tracts	Total	UNDP	Agency	Extra bud.[a]	In kind	Total
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)
INTERREGIONAL	13,111.5	5,205.6	17,041.9	13,461.4	519.7	49,340.1	1,790.5	40,380.7	4,262.6	2,906.3	49,340.1
REGIONAL AFRICA	3,033.3	2,156.1	353.7	2,212.4	80.9	7,836.4	332.8	7,157.7	250.3	95.6	7,836.4
REG. ARAB STATE	26.9	7.3	33.8	7.0	0.0	75.0	75.0	0.0	0.0	0.0	75.0
REG. ASIA & PACIFIC	7,415.9	4,462.0	2,650.7	6,337.7	354.8	21,221.1	8,831.5	6,264.4	4,287.0	1,838.2	21,221.1
REG. EUROPE	1,266.7	953.4	104.2	1,013.3	1,479.0	4,816.6	59.5	4,277.7	323.1	156.3	4,816.6
REG. LATIN AMERICA	6,540.0	5,970.0	1,516.5	5,289.6	902.6	20,218.7	2,992.5	9,962.9	5,073.3	2,190.0	20,218.7
REG. MIDDLE EAST	5.8	1.2	5.3	0.0	0.0	12.3	12.3	0.0	0.0	0.0	12.3
SUB-TOTAL	31,400.1	18,755.6	21,706.1	28,321.4	3,337.0	103,520.2	14,094.1	68,043.4	14,196.3	7,186.4	103,520.2
MISCELLANEOUS	766.2	1,341.6	509.8	287.2	30.5	2,935.3	23.2	2,912.1	0.0	0.0	2,935.3
GRAND TOTAL	129,715.7	234,416.6	124,758.0	28,804.8	7,057.7	524,752.8	78,858.8	333,602.4	64,351.9	47,939.7	524,752.8

[a] The assistance provided from extrabudgetary funds prior to 1977 is included under assistance "in kind".

[b] Includes the following countries which have not received technical assistance during the last ten or more years: Austria, Chad, Democratic Kampuchea, Denmark, Finland, France, Germany, Italy, Japan, Kuwait, Monaco, the Netherlands, New Zealand, Niue, Norway, St. Christopher, Somalia, South Africa, Sweden, Switzerland, and the United States of America.

TABLE 9

WOMEN'S PARTICIPATION IN TECHNICAL CO-OPERATION

	1981			1990			1991		
	Total	of which women	% of women	Total	of which women	% of women	Total	of which women	% of women
Fellows	570	97	17.0	814	182	22.4	747	177	23.7
Visiting scientists	65	7	10.8	243	45	18.5	203	42	20.7
Training course participants	519	64	12.3	1358	261	19.2	1401	271	19.3
Project counterparts	511	46	9.0	1121	140	12.5	1333	187	14.0
International experts	319	7	2.2	1032	47	4.6	879	48	5.5
National experts	12	0	0.0	88	10	11.4	349	46	13.2
Lecturers	119	2	1.7	286	20	6.7	342	23	6.7
Other project personnel	11	9	81.8	16	12	75.0	10	8	80.0
TC Professional staff[a]	34	5	14.7	55	15	27.3	55	14	25.5
TC General services staff[a]	54	48	88.8	85	80	94.1	88	81	92.1

[a] Excluding the staff of Printing Section and Publishing Section

Explanatory Notes to Annexes

Annex I. Disbursements of extrabudgetary and in-kind contributions: 1991

Related to Table 5, this Annex shows, by donor and by type, the technical assistance disbursements made during 1991 utilizing extrabudgetary resources and, separately, contributions in kind. In many cases, the Agency must depend on donor countries for information about the value of in-kind inputs that have been provided.

Annex II. Training courses: 1991

The courses organized by the Agency in 1991 are listed together with the numbers of participants and the amounts obligated. This is the only table in which local participants and participants not financed from training course resources are shown. National courses are not included in this summary.

Annex III. Published reports: 1991

Technical co-operation project reports published in 1991 are listed by country.

Annex IV. Voluntary contributions pledged and paid to the Technical Assistance and Co-operation Fund for 1991

Data on voluntary contributions by Member States to the Technical Assistance and Co-operation Fund are given in this table. Figures reflect the status as at 31 December 1991.

Annex V. Cost free fellowships offered and awarded: 1991

Information is made available in this table on the number of cost-free fellowships offered by Member States and the number of awards.

Annex VI. Approved and on-going UNDP projects as at 31 December 1991

This table includes two projects for which IAEA acts only as an associated agency.

Annex VII. Footnote-a/ projects made operational or extended during 1991

These projects are shown with the source of the funds that made upgrading to operational status or extension possible.

Annex VIII. Approvals against the Reserve Fund in 1991

Information is provided on Reserve Fund approvals for new and existing projects.

Annex IX. Net programme changes by recipient: 1991

In accordance with the Revised Guiding Principles information on changes to approved projects is provided. As 876 were involved, the list only shows the net changes that took place in each country. The amounts given in the existing approval column refer to those projects which were affected by programme changes. Detailed data by project are available on request.

Annex X. Projects rephased during 1991

As a result of dynamic programming, which was approved as part of the Board's 1983 policy review, it is possible for the Secretariat to reallocate project funds originally intended for use in the current future years. This mechanism, known as "rephasing", may be invoked in cases where project requirements differ from those originally foreseen, so as to keep project plans realistic. The Annex shows only net changes per country to projects rephased in 1991.

Annex XI. Extrabudgetary contributions for activities relating to technical co-operation which are not included in the technical co-operation programme: 1991

At the request of some Member States information is provided in this annex concerning activities which have technical co-operation aspects but which are initiated and implemented without the involvement of the Department of Technical Co-operation. They are therefore not included in technical co-operation databases from which all other tables and figures in this report are produced.

ANNEX I

DISBURSEMENTS OF EXTRABUDGETARY AND IN-KIND CONTRIBUTIONS: 1991

A. Assistance for activities where donor is not recipient (in thousands of dollars)

Donor	Extrabudgetary						In-kind				Total
	Experts	Equip-ment	Fellow-ships	Group training	Sub-con-tracts	Sub-total	Experts	Fellow-ships	Group training	Sub-total	
Countries											
ARGENTINA	0.0	0.0	0.0	0.0	0.0	0.0	21.6	0.0	42.7	64.3	64.3
AUSTRALIA	27.8	17.0	43.1	141.5	59.2	288.6	14.5	0.0	5.2	19.7	308.3
AUSTRIA	0.0	0.0	0.0	0.0	0.0	0.0	7.2	7.3	0.0	14.5	14.5
BELGIUM	1.3	19.4	0.0	0.0	0.0	20.7	8.1	24.3	0.0	32.4	53.1
BOLIVIA	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	3.8	3.8	3.8
BRAZIL	0.0	0.0	0.0	0.0	0.0	0.0	6.7	0.0	11.0	17.7	17.7
CANADA	0.0	0.0	0.0	0.0	0.0	0.0	4.2	0.0	0.9	5.1	5.1
CHILE	9.2	0.0	0.0	0.4	0.0	9.6	15.2	0.0	9.0	24.2	33.8
CHINA	0.0	0.0	0.0	0.0	0.0	0.0	4.8	0.0	42.1	46.9	46.9
COLOMBIA	0.0	0.0	0.0	2.8	0.0	2.8	2.4	0.0	1.9	4.3	7.1
CUBA	0.0	0.0	0.0	0.0	0.0	0.0	1.5	0.0	0.0	1.5	1.5
CZECH & SLOVAK FEDERAL REP.	0.0	0.0	0.0	0.0	0.0	0.0	4.5	0.1	0.8	5.4	5.4
DENMARK	0.0	0.0	0.0	0.0	0.0	0.0	0.0	4.1	0.0	4.1	4.1
ECUADOR	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	3.4	3.4	3.4
FINLAND	34.6	23.5	2.7	0.0	45.0	105.8	1.6	1.4	0.0	3.0	108.8
FRANCE	77.1	177.2	0.0	18.4	0.0	272.7	16.8	37.3	4.2	58.3	331.0
GERMANY	361.2	661.7	0.0	93.5	63.8	1,180.2	34.6	222.5	10.7	267.8	1,448.0
HUNGARY	0.0	0.0	0.0	0.0	0.0	0.0	5.7	27.3	2.3	35.3	35.3
INDIA	0.0	0.0	0.0	0.0	0.0	0.0	6.8	48.5	21.5	76.8	76.8
ISRAEL	0.0	0.0	0.0	0.0	0.0	0.0	0.0	34.4	1.0	35.4	35.4
ITALY	107.1	348.2	5.5	271.6	98.3	830.7	0.0	28.1	4.3	32.4	863.1
JAPAN	122.3	0.0	8.5	304.5	0.0	435.3	6.0	0.0	0.9	6.9	442.2
KOREA, REP.	0.0	0.0	14.1	0.0	0.0	14.1	1.0	0.0	43.5	44.5	58.6
MEXICO	0.0	0.0	0.0	0.0	0.0	0.0	1.2	0.0	1.0	2.2	2.2
NETHERLANDS	0.0	0.0	0.0	0.0	0.0	0.0	3.8	0.0	8.3	12.1	12.1
NIGER	0.0	0.0	0.0	0.0	0.0	0.0	3.0	0.0	0.0	3.0	3.0
PERU	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.0	1.0	1.0
POLAND	0.0	0.0	0.0	0.0	0.0	0.0	4.4	0.0	1.9	6.3	6.3
PORTUGAL	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	3.8	3.8	3.8
SPAIN	0.0	0.0	0.0	0.0	165.8	165.8	4.4	22.1	0.5	27.0	192.8
SWEDEN	335.6	195.4	16.8	0.0	0.0	547.8	5.8	1.3	1.0	8.1	555.9
USSR	0.0	471.5	0.0	0.0	0.0	471.5	38.9	0.0	4.0	42.9	514.4
UNITED KINGDOM	127.9	424.7	84.0	0.0	62.2	698.8	13.5	101.6	1.7	116.8	815.6
USA	257.3	713.0	0.0	95.3	70.9	1,136.5	66.5	555.5	14.7	636.7	1,773.2
URUGUAY	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2.8	2.8	2.8
VENEZUELA	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	4.4	4.4	4.4
YUGOSLAVIA	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2.0	2.0	2.0
SUB-TOTAL	1,461.4	3,051.6	174.7	928.0	565.2	6,180.9	304.7	1,115.8	256.3	1,676.8	7,857.7
International Organizations											
FAO	0.0	0.0	0.0	0.0	0.0	0.0	1.0	0.0	0.0	1.0	1.0
CEC	0.0	32.1	30.5	0.9	0.0	63.5	0.0	0.0	4.1	4.1	67.6
OECD-NEA	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	4.2	4.2	4.2
PAHO	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	10.6	10.6	10.6
UNTCD	0.0	0.0	0.0	0.0	0.0	0.0	4.8	0.0	0.0	4.8	4.8
SUB-TOTAL	0.0	32.1	30.5	0.9	0.0	63.5	5.8	0.0	18.9	24.7	88.2
GRAND TOTAL	1,461.4	3,083.7	205.2	928.9	565.2	6,244.4	310.5	1,115.8	275.2	1,701.5	7,945.9

B. Assistance for activities where donor is recipient (in thousands of dollars)

Donor	Project Title	Project	Equipment	Fellow-ships	Total
COLOMBIA	UPGRADING OF RESEARCH REACTOR INSTRUMENTATION	COL/4/009	28.8	0.0	28.8
GHANA	TRAINING IN NUCLEAR INSTRUMENTATION	GHA/4/008	6.5	0.0	6.5
HUNGARY	PROCUREMENT ASSISTANCE FOR HUNGARY	HUN/4/008	7.9	0.0	7.9
ICELAND	RADIATION PROTECTION	ICE/9/002	12.0	0.0	12.0
IRAN, I.R.	PROCUREMENT ASSISTANCE	IRA/0/005	4.0	0.0	4.0
	RADIOISOTOPE PRODUCTION	IRA/2/004	52.8	0.0	52.8
IRELAND	DOSIMETRY LABORATORY	IRE/1/002	10.0	0.0	10.0
LIBYAN A.J.	ERADICATION OF MEDITERRANEAN FRUIT FLY	LIB/5/003	0.0	18.7	18.7
MEXICO	ECOLOGICAL MODELLING	MEX/9/028	0.1	0.0	0.1
NIGERIA	RADIATION PROTECTION	NIR/9/003	9.5	0.0	9.5
PAKISTAN	KANUPP ELECTRONIC SYSTEMS DEVELOPMENT	PAK/4/023	38.6	0.0	38.6
	CONTROL AND INSTRUMENTATION	PAK/4/027	23.9	0.0	23.9
POLAND	PROCUREMENT ASSISTANCE	POL/4/007	7.2	0.0	7.2
PORTUGAL	RESEARCH REACTOR MODERNIZATION	POR/4/012	17.4	0.0	17.4
SYRIAN A.R.	PROCUREMENT ASSISTANCE	SYR/0/005	34.2	0.0	34.2
U.A. EMIRATES	RADIOACTIVE ENVIRONMENTAL AND FOOD CONTAMINATION	UAE/9/003	159.1	0.0	159.1
YUGOSLAVIA	PROCUREMENT ASSISTANCE	YUG/9/023	7.5	0.0	7.5
TOTAL			419.5	18.7	438.2

ANNEX II

TRAINING COURSES: 1991

Project title and code	Place(s) and dates	Source of Funds	Participation [a]			Amount(s) expended [b] ($)
			(1)	(2)	(3)	
INTERREGIONAL TRAINING COURSE ON INTEGRATED ENERGY AND ELECTRICITY PLANNING FOR NUCLEAR POWER DEVELOPMENT WITH EMPHASIS ON ENPEP, INT/0/052/001	ARGONNE, IL, USA 9 SEPTEMBER - 1 NOVEMBER	AGENCY	32	0	0	221,735 (CC)
ADVANCED INTERREGIONAL TRAINING COURSE ON NUCLEAR ELECTRONICS, INT/4/105/001	SALAZAR, MEXICO 14 JANUARY - 12 APRIL	AGENCY USA	17	0	3	231,684 (CC) 28,000 (CC)
INTERREGIONAL TRAINING COURSE ON QUALITY ASSURANCE IN NUCLEAR POWER PLANT OPERATION, INT/4/106/001	MADRID, SPAIN 14 OCTOBER - 15 NOVEMBER	AGENCY	16	0	0	99,829 (CC)
INTERREGIONAL TRAINING COURSE ON CONTROL AND INSTRUMENTATION OF NUCLEAR POWER PLANTS, INT/4/107/001	KARLSRUHE, GERMANY 16 SEPTEMBER - 18 OCTOBER	AGENCY	27	2	0	129,891 (CC) 1,008(NCC)
INTERREGIONAL TRAINING COURSE ON INTERFACING IN NUCLEAR EXPERIMENTS, INT/4/108/001	ANTANANARIVO, MADAGASCAR 14 OCTOBER - 13 DECEMBER	AGENCY	18	0	1	212,215 (CC)
INTERREGIONAL TRAINING COURSE ON INDUCTION AND USE OF MUTATIONS IN PLANT BREEDING, INT/5/121/001	SEIBERSDORF, AUSTRIA 3 APRIL - 16 MAY	AGENCY	17	0	0	160,743 (CC) 94(NCC)
INTERREGIONAL TRAINING COURSE ON USE OF ISOTOPES AND RADIATION TECHNIQUES IN STUDIES ON SOIL/PLANT RELATIONSHIPS WITH EMPHASIS ON PLANT NUTRITION, INT/5/122/001	SEIBERSDORF, AUSTRIA 21 MAY - 28 JUNE	AGENCY	18	1	0	122,771 (CC)
INTERREGIONAL TRAINING COURSE ON IMMUNOASSAY AND RELATED TECHNIQUES IN THE STUDY OF LIVESTOCK PRODUCTION IN THE TROPICS, INT/5/123/001	SEIBERSDORF, AUSTRIA 2 SEPTEMBER - 4 OCTOBER	AGENCY	20	0	0	134,386 (CC)
INTERREGIONAL TRAINING COURSE ON NUCLEAR MEDICINE, INT/6/040/001	BERLIN, GERMANY 16 SEPTEMBER - 11 OCTOBER	AGENCY	23	1	0	114,034 (CC) 273(NCC)
INTERREGIONAL TRAINING COURSE ON APPLICATIONS OF NUCLEAR ANALYTICAL TECHNIQUES TO AIR POLLUTION, INT/8/003/001	ARGONNE, IL, USA 21 JANUARY - 22 FEBRUARY	AGENCY	20	0	0	102,110 (CC) 1,073(NCC)
INTERREGIONAL TRAINING COURSE ON SAFETY IN NUCLEAR POWER PLANT OPERATION: PREVENTION AND MANAGEMENT OF ACCIDENTS, INT/9/113/001	ARGONNE, IL, USA 18 MARCH - 19 APRIL	AGENCY	31	0	0	175,762 (CC)
INTERREGIONAL TRAINING COURSE ON PLANNING, PREPAREDNESS AND RESPONSE TO RADIOLOGICAL EMERGENCIES, INT/9/114/001	ARGONNE, IL, USA 29 APRIL - 24 MAY	AGENCY	27	2	0	137,502 (CC)
INTERREGIONAL TRAINING COURSE ON PHYSICAL PROTECTION OF NUCLEAR FACILITIES AND MATERIALS, INT/9/115/001	ALBUQUERQUE, NM, USA 27 OCTOBER - 14 NOVEMBER	USA	18	12	0	117,679 (CC)
INTERREGIONAL TRAINING COURSE ON RADIATION PROTECTION AND NUCLEAR SAFETY, INT/9/116/001	BUENOS AIRES, ARGENTINA 1 APRIL - 30 NOVEMBER	AGENCY	19	0	0	248,308 (CC)
INTERREGIONAL TRAINING COURSE ON SAFE TRANSPORT OF RADIOACTIVE MATERIALS, INT/9/117/001	OLDBURY-ON-SEVERN, UK 16 SEPTEMBER - 4 OCTOBER	AGENCY	22	2	0	133,096 (CC) 399(NCC)
INTERREGIONAL TRAINING COURSE ON EVALUATION AND FEEDBACK OF SAFETY-RELATED EXPERIENCE IN NUCLEAR POWER PLANT OPERATION, INT/9/118/001	ARGONNE, IL, USA FREDERICTON, NEW BRUNSWICK, CANADA 3 JUNE - 28 JUNE	AGENCY	29	1	0	147,794 (CC)
INTERREGIONAL TRAINING COURSE ON RADIATION PATHOLOGY, INT/9/119/001	GIF-SUR-YVETTE, FRANCE 8 APRIL - 19 APRIL	AGENCY	26	0	0	100,556 (CC)
INTERREGIONAL TRAINING COURSE ON DECONTAMINATION OF RESEARCH REACTORS AND SMALL NUCLEAR FACILITIES, INT/9/120/001	GIF-SUR-YVETTE, FRANCE 18 JUNE - 5 JULY	AGENCY	22	1	0	101,805 (CC)
INTERREGIONAL TRAINING COURSE ON TARGET AND SAMPLE PREPARATION AND ASSAY IN NUCLEAR ANALYTICAL TECHNIQUES AND NUCLEAR DATA MEASUREMENTS, INT/9/121/001	LENINGRAD, USSR 3 JUNE - 22 JUNE	AGENCY	19	0	0	58,364 (CC) 93,153(NCC)
REGIONAL TRAINING COURSE ON NUCLEAR LAW AND SAFETY REGULATIONS, RAF/0/004/001	NAIROBI, KENYA 4 MARCH - 15 MARCH	AGENCY	18	0	2	74,762 (CC)

Project title and code	Place(s) and dates	Source of Funds	Participation [a]			Amount(s) expended [b] ($)
			(1)	(2)	(3)	
REGIONAL TRAINING COURSE ON DESIGN, MANAGEMENT AND EVALUATION TECHNIQUES OF IAEA TECHNICAL CO-OPERATION PROJECTS, RAF/0/006/001	LEGON-ACCRA, GHANA 22 APRIL - 3 MAY	AGENCY	18	0	4	83,789 (CC)
REGIONAL TRAINING COURSE ON APPLICATION OF NUCLEAR ANALYTICAL TECHNIQUES IN MINERAL EXPLORATION AND EXPLOITATION,RAF/2/003/001	LEGON-ACCRA, GHANA 7 OCTOBER - 25 OCTOBER	AGENCY	13	0	3	68,747 (CC)
REGIONAL TRAINING COURSE ON PROTECTION OF NUCLEAR INSTRUMENTS, RAF/4/004/001	CAIRO, EGYPT 19 OCTOBER - 13 NOVEMBER	AGENCY	8	0	4	25,195 (CC)
REGIONAL WORKSHOP ON THE ESTABLISHMENT AND USE OF A MONOCLONAL-ANTIBODY BASED COMPETITIVE ELISA-SYSTEM FOR THE SERO-MONITORING OF RINDERPEST, RAF/5/006/001	GAROUA, CAMEROON 23 SEPTEMBER - 27 SEPTEMBER	AGENCY	12	0	0	12,899 (CC)
REGIONAL WORKSHOP ON THE USE OF COMPUTERS IN MEDFLY STUDIES, RAF/5/013/005	MEKNES, MOROCCO 30 SEPTEMBER - 11 OCTOBER	AGENCY	4	0	3	17,673 (CC)
REGIONAL TRAINING COURSE ON ISOTOPE AND NUCLEAR TECHNIQUES IN STUDIES ON SOIL/PLANT RELATIONS WITH EMPHASIS ON AGROFORESTRY AND ON PLANT NUTRITION, RAF/5/020/001	IBADAN, NIGERIA 29 JULY - 30 AUGUST	AGENCY	14	0	5	108,085 (CC)
REGIONAL TRAINING COURSE ON FOOD IRRADIATION TECHNOLOGY, RAF/5/021/001	CAIRO, EGYPT 10 NOVEMBER - 6 DECEMBER	AGENCY	16	0	2	51,884 (CC)
REGIONAL TRAINING COURSE ON DOSIMETRY IN RADIOTHERAPY, INCLUDING TREATMENT PLANNING, RAF/6/005/001	CAIRO, EGYPT 23 NOVEMBER - 13 DECEMBER	AGENCY	16	0	59	47,913 (CC)
REGIONAL CO-ORDINATORS' MEETING ON RADIOIMMUNOASSAY OF THYROID-RELATED HORMONES, RAF/6/006/001	ARUSHA, U.R. TANZANIA 3 JUNE - 7 JUNE	AGENCY	8	0	1	18,733 (CC)
REGIONAL WORKSHOP ON CO-OPERATION IN RADIOIMMUNOASSAY, RAF/6/007/001	NAIROBI, KENYA 27 MAY - 31 MAY	FRANCE	6	0	0	14,641 (CC)
REGIONAL WORKSHOP ON ISOTOPE HYDROLOGY AND SEDIMENTOLOGY, RAF/8/012/004	BAMAKO, MALI 15 JULY - 15 SEPTEMBER	AGENCY	3	0	2	8,268 (CC)
REGIONAL WORKSHOP ON THE STUDY OF NON-SATURATED ZONES, RAF/8/012/005	DAKAR, SENEGAL 11 NOVEMBER - 20 NOVEMBER	AGENCY	6	0	2	10,480 (CC)
REGIONAL TRAINING COURSE ON NON-DESTRUCTIVE TESTING, RADIOGRAPHY (LEVEL 2),RAF/8/014/001	ALGIERS, ALGERIA 3 JUNE - 23 JUNE	AGENCY	6	0	10	69,456 (CC) 38(NCC)
REGIONAL TRAINING COURSE ON IRRADIATION PROCESSING IN STERILIZATION OF MEDICAL SUPPLIES INCLUDING PHARMACEUTICALS AND BIOLOGICAL PRODUCTS, RAF/8/016/001	CAIRO, EGYPT 2 NOVEMBER - 27 NOVEMBER	AGENCY	6	0	2	23,560 (CC)
REGIONAL WORKSHOP ON TROUBLE SHOOTING AND MAINTENANCE OF HARSHAW TLD EQUIPMENT, RAF/9/005/005	VIENNA, AUSTRIA 18 MARCH - 22 MARCH	AGENCY	9	0	0	20,212 (CC)
REGIONAL WORKSHOP ON TROUBLE SHOOTING AND MAINTENANCE OF VINTEN TLD EQUIPMENT, RAF/9/005/006	VIENNA, AUSTRIA 8 APRIL - 12 APRIL	AGENCY	6	0	0	16,577 (CC)
REGIONAL WORKSHOP ON EMERGENCY PLANNING, PREPAREDNESS AND INTERNATIONAL CO-OPERATION, RAF/9/005/007	VIENNA, AUSTRIA 27 MAY - 31 MAY	AGENCY	10	0	0	31,007 (CC)
REGIONAL TRAINING COURSE ON MANAGEMENT OF SPENT SEALED RADIATION SOURCES, RAF/9/006/001	NAIROBI, KENYA 15 APRIL - 26 APRIL	AGENCY	17	0	4	67,504 (CC)
REGIONAL TRAINING COURSE ON NUCLEAR POWER PRE-PROJECT ACTIVITIES AND MANPOWER DEVELOPMENT, RAS/0/015/006	TAEJEON, CHUNG-NAM, KOREA, REP. OF 7 OCTOBER - 25 OCTOBER	AGENCY KOREA, R.	15	0	2	12,172 (CC) 42,500(GIK)
REGIONAL TRAINING COURSE ON ENVIRONMENTAL MONITORING RELATED TO THE ASSESSMENT OF THE SAFETY AND NUCLEAR FACILITIES, RAS/0/015/007	TAIYUAN, SX, CHINA 14 OCTOBER - 25 OCTOBER	AGENCY CHINA	6	0	2	2,668 (CC) 14,162(GIK)
REGIONAL TRAINING COURSE ON SAFETY ASPECTS IN INDUSTRIAL APPLICATIONS OF RADIATION SOURCES, RAS/0/015/008	BOMBAY, INDIA 2 DECEMBER - 13 DECEMBER	AGENCY INDIA	8	3	5	946 (CC) 10,870(GIK)
REGIONAL TRAINING COURSE ON EXPLORATION DRILLING AND ORE RESERVE ESTIMATION IN URANIUM EXPLORATION, RAS/3/006/001	HYDERABAD, INDIA 21 JANUARY - 15 FEBRUARY	AGENCY	11	0	4	87,105 (CC)

Project title and code	Place(s) and dates	Source of Funds	Participation [a]			Amount(s) expended [b] ($)
			(1)	(2)	(3)	
REGIONAL TRAINING COURSE ON COMPUTER APPLICATION ON RESEARCH REACTOR CONTROL AND CALCULATION, RAS/4/011/003	SERPONG, JAKARTA, INDONESIA 29 NOVEMBER - 19 DECEMBER	AGENCY	9	0	1	37,742 (CC)
REGIONAL TRAINING COURSE ON POWER SUPPLIES IN NUCLEAR INSTRUMENTS, RAS/4/012/001	SINGAPORE, SINGAPORE 4 MARCH - 22 MARCH	GERMANY	9	0	0	20,929 (CC)
REGIONAL WORKSHOP ON EVALUATION AND TESTING OF COMMERCIAL MCA CARDS, RAS/4/012/002	CHIANG MAI, THAILAND 9 SEPTEMBER - 27 SEPTEMBER	GERMANY	5	1	2	12,019 (CC)
REGIONAL TRAINING COURSE ON USE OF PERSONAL COMPUTERS IN RESEARCH REACTOR OPERATIONS, RAS/4/013/001	BANDUNG, INDONESIA 7 NOVEMBER - 27 NOVEMBER	AGENCY	7	2	2	50,787 (CC)
REGIONAL WORKSHOP ON PUBLIC INFORMATION OF FOOD IRRADIATION, RAS/5/020/003	BANGKOK, THAILAND 27 MAY - 31 MAY	UNDP	13	1	1	35,105 (CC)
TRIPARTITE REVIEW MEETING ON ASIA REGIONAL CO-OPERATIVE PROJECT ON FOOD IRRADIATION (RPFI-PHASE III), RAS/5/020/004	JAKARTA, INDONESIA 19 JULY - 19 JULY	UNDP	17	0	0	[c]
RESEARCH CO-ORDINATION MEETING ON ASIA REGIONAL CO-OPERATIVE PROJECT ON FOOD IRRADIATION (RPFI-PHASE III,) RAS/5/020/005	JAKARTA, INDONESIA 15 JULY - 18 JULY	UNDP	17	0	0	34,099 (CC)
REGIONAL WORKSHOP ON RHIZOBIUM TECHNOLOGY, RAS/5/021/003	BANGKOK, THAILAND 3 JUNE - 14 JUNE	UNDP	11	0	1	33,372 (CC)
REGIONAL RESEARCH CO-ORDINATION MEETING ON THE USE OF ISOTOPES IN STUDIES TO IMPROVE YIELD AND NITROGEN FIXATION OF GRAIN LEGUMES IN THE TROPICS AND SUB-TROPICS OF ASIA, RAS/5/021/004	CHIANG MAI, THAILAND 27 MAY - 31 MAY	UNDP	6	0	1	20,133 (CC)
REGIONAL TRAINING COURSE ON THE STERILE INSECT TECHNIQUE AND F-1 STERILITY FOR INSECT CONTROL, RAS/5/023/001	SERDANG, SELANGOR, MALAYSIA OKINAWA, JAPAN 4 NOVEMBER - 30 NOVEMBER	AGENCY	18	2	2	113,027 (CC)
REGIONAL TRAINING COURSE ON DIAGNOSIS OF VIRAL HEPATITIS INFECTION BY RADIOIMMUNOASSAY, RAS/6/011/004	SHANGHAI, CHINA 18 MARCH - 29 MARCH	AGENCY	15	0	2	46,152 (CC) 3,875(NCC)
REGIONAL TRAINING COURSE ON SAMPLING, SAMPLE PREPARATION AND DATA EVALUATION IN MULTI-ELEMENT AND RADIONUCLIDE ANALYSIS BY NUCLEAR AND INSTRUMENTAL METHODS, RAS/7/005/001	BOMBAY, INDIA 18 NOVEMBER - 7 DECEMBER	AGENCY	13	0	2	58,968 (CC)
REGIONAL WORKSHOP ON INDUSTRIAL STERILIZATION - REGULATORY ASPECTS, RAS/8/061/104	BANGKOK, THAILAND 22 APRIL - 26 APRIL	UNDP	17	1	0	26,058 (CC)
REGIONAL TRAINING COURSE ON NON-DESTRUCTIVE TESTING OF MAGNETIC PARTICLE AND LIQUID PENETRANT (LEVEL III), RAS/8/061/105	BANDUNG, INDONESIA 9 SEPTEMBER - 27 SEPTEMBER	UNDP	12	2	4	45,003 (CC)
REGIONAL TRAINING COURSE ON TRACER APPLICATION IN INDUSTRY, RAS/8/061/106	JAKARTA, INDONESIA 11 NOVEMBER - 29 NOVEMBER	UNDP	11	0	2	63,785 (CC)
REGIONAL TRAINING COURSE ON MODEL (NDT) QUALIFYING EXAMINATION FOR RADIOGRAPHY (LEVEL III), RAS/8/061/107	KUALA LUMPUR, MALAYSIA 21 OCTOBER - 25 OCTOBER	UNDP	14	3	2	22,365 (CC)
REGIONAL WORKSHOP ON WELD DEFECT SIZING USING NDT, RAS/8/062/026	TOKYO, JAPAN 30 SEPTEMBER - 4 OCTOBER	JAPAN	12	0	0	53,830 (CC)
REGIONAL TRAINING COURSE ON RADIATION CHEMISTRY, RAS/8/062/027	TAKASAKI, GUNMA, JAPAN 13 MAY - 24 MAY	JAPAN	15	0	0	50,286 (CC)
REGIONAL TRAINING COURSE ON RADIATION VULCANIZATION OF NATURAL RUBBER LATEX, RAS/8/062/028	JAKARTA, INDONESIA 26 JUNE - 10 JULY	AGENCY JAPAN	15	1	3	5,224 (CC) 28,793 (CC)
REGIONAL TRAINING COURSE ON SAFETY OPERATING INDUSTRIAL RADIATION PROCESSING FACILITIES, RAS/8/062/029	TAKASAKI, GUNMA, JAPAN 9 SEPTEMBER - 13 SEPTEMBER	JAPAN	10	0	0	29,529 (CC)
REGIONAL TRAINING COURSE ON ELECTRON BEAM IRRADIATION TECHNOLOGY, RAS/8/062/030	SHANGHAI, CHINA 26 AUGUST - 6 SEPTEMBER	JAPAN CHINA	11	0	4	66 (CC) 26,972(GIK)
REGIONAL WORKSHOP ON NON-DESTRUCTIVE EXAMINATION OF NON-METALLIC MATERIALS, RAS/8/062/031	BANGKOK, THAILAND 11 NOVEMBER - 15 NOVEMBER	JAPAN	10	0	3	24,065 (CC)

Project title and code	Place(s) and dates	Source of Funds	Participation [a]			Amount(s) expended [b] ($)
			(1)	(2)	(3)	
REGIONAL WORKSHOP ON NUCLEONIC CONTROL SYSTEMS IN THE STEEL INDUSTRY, RAS/8/062/032	TOKYO, JAPAN 28 AUGUST - 5 SEPTEMBER	JAPAN	8	0	0	67,107 (CC)
REGIONAL WORKSHOP ON RADIATION STERILIZATION OF PHARMACEUTICALS AND DRUGS, RAS/8/062/033	BOMBAY, INDIA 25 NOVEMBER - 29 NOVEMBER	INDIA	8	5	2	7,890(GIK)
REGIONAL TRAINING COURSE ON RADIATION CURING OF SURFACE COATINGS,RAS/8/064/003	LUCAS HEIGHTS, AUSTRALIA 18 FEBRUARY - 1 MARCH	AUSTRALIA	12	0	0	81,691 (CC)
REGIONAL TRAINING COURSE ON THE BASIC TECHNIQUE OF RADIATION PROTECTION, RAS/9/006/006	TOKAI, JAPAN 14 OCTOBER - 25 OCTOBER	JAPAN	12	0	0	48,106 (CC)
REGIONAL TRAINING COURSE ON NATIONAL INFRASTRUCTURE FOR RADIOACTIVE WASTE MANAGEMENT, RAS/9/009/001	SERPONG, JAKARTA, INDONESIA 21 OCTOBER - 1 NOVEMBER	AGENCY	15	2	3	59,392 (CC)
REGIONAL TRAINING COURSE ON SAFETY AND REGULATION OF RADIATION SOURCES, RAS/9/011/001	KUALA LUMPUR, MALAYSIA 7 OCTOBER - 8 NOVEMBER	AGENCY	18	0	3	101,856 (CC)
REGIONAL WORKSHOP ON IN-SERVICE INSPECTION - PROGRAMME AND DESIGN PROCEDURES, RER/4/003/001	MADRID, SPAIN 8 APRIL - 19 APRIL	AGENCY	5	0	0	17,591 (CC) 1,203(NCC)
SECOND REGIONAL WORKSHOP ON IN-SERVICE INSPECTION - PROGRAMME AND DESIGN PROCEDURES, RER/4/003/002	MADRID, SPAIN 17 JUNE - 21 JUNE	AGENCY	6	0	0	8,228 (CC) 1,207(NCC)
THIRD REGIONAL WORKSHOP ON IN-SERVICE INSPECTION - PROGRAMME AND DESIGN PROCEDURES, RER/4/003/003	MADRID, SPAIN 14 OCTOBER - 18 OCTOBER	AGENCY	5	0	0	5,965 (CC) 1,705(NCC)
REGIONAL WORKSHOP ON THE USE OF ELECTRON ACCELERATORS FOR FOOD IRRADIATION, RER/5/003/004	WARSAW, POLAND 10 JUNE - 22 JUNE	AGENCY	2	0	2	6,780 (CC)
REGIONAL WORKSHOP ON THE USE OF NUCLEAR AND RELATED TECHNIQUES IN PLANT NUTRIENT AND WATER BALANCE STUDIES IN LEGUME-CEREAL CROP ROTATION SYSTEMS, RER/5/004/001	DAMASCUS, SYRIAN A.R. 8 SEPTEMBER - 18 SEPTEMBER	AGENCY	12	0	0	15,428 (CC)
REGIONAL WORKSHOP ON GENERATOR AND CYCLOTRON-PRODUCED RADIOPHARMACEUTICALS, RER/6/002/007	RIYADH, SAUDI ARABIA 12 OCTOBER - 30 OCTOBER	AGENCY	8	0	0	33,955 (CC)
REGIONAL TRAINING COURSE ON DOSIMETRY IN RADIOTHERAPY, RER/6/003/001	PRAGUE, CZECH AND SLOVAK FED. REP. 14 JANUARY - 1 FEBRUARY	AGENCY	17	10	2	36,035 (CC) 19,074(NCC)
REGIONAL WORKSHOP ON ISOTOPE HYDROLOGY, RER/8/002/004	ANKARA, TURKEY 14 OCTOBER - 25 OCTOBER	AGENCY	11	0	0	28,528 (CC)
REGIONAL WORKSHOP ON ADVANCED RADIOCHEMICAL TECHNIQUES FOR THE MONITORING OF FOOD AND ENVIRONMENTAL SAMPLES, RER/9/003/008	DAMASCUS, SYRIAN A.R. 17 NOVEMBER - 12 DECEMBER	AGENCY	8	2	0	36,875 (CC)
ADVANCED REGIONAL TRAINING COURSE ON DETERMINATION OF RADIONUCLIDES IN FOOD AND ENVIRONMENTAL SAMPLES, RER/9/008/001	KARLSRUHE, GERMANY 3 JUNE - 28 JUNE	AGENCY	23	1	0	105,126 (CC) 245(NCC)
REGIONAL TRAINING COURSE ON MANAGEMENT OF RADIOACTIVE WASTES FROM HOSPITALS AND OTHER NUCLEAR APPLICATION ACTIVITIES, RER/9/009/001	ISTANBUL, TURKEY 23 SEPTEMBER - 11 OCTOBER	AGENCY	17	0	5	78,146 (CC) 186(NCC)
REGIONAL TRAINING COURSE ON SAFETY IN NUCLEAR POWER PLANT OPERATION WITH PWR/WWER REACTORS AND THE ROLE OF HUMAN FACTORS, RER/9/012/001	TRNAVA, CZECH AND SLOVAK FED. REP. 9 SEPTEMBER - 4 OCTOBER	AGENCY	13	0	5	38,051 (CC) 52,320(NCC)
REGIONAL THIRD WORKSHOP ON NUCLEAR INFORMATION, RLA/0/009/006	QUITO, ECUADOR 4 MARCH - 8 MARCH	AGENCY	11	0	0	20,591 (CC)
REGIONAL TRAINING COURSE FOR LIBRARIANS AND INFORMATION SPECIALISTS IN INIS PROCEDURES, RLA/0/009/007	LIMA, PERU 1 JULY - 19 JULY	AGENCY	11	0	4	29,345 (CC)
REGIONAL WORKSHOP ON ANALYTICAL APPLICATIONS OF NEUTRON GENERATORS AND ISOTOPIC NEUTRON SOURCES, RLA/2/003/011	LA PAZ, BOLIVIA 20 MAY - 31 MAY	AGENCY	7	0	2	22,676 (CC)
SECOND REGIONAL TRAINING COURSE ON NUCLEAR ANALYTICAL TECHNIQUES IN THE AGROINDUSTRY AND FOOD ANALYSIS, RLA/2/003/012	RIO DE JANEIRO, BRAZIL 7 OCTOBER - 1 NOVEMBER	AGENCY	11	0	3	44,567 (CC)

Project title and code	Place(s) and dates	Source of Funds	Participation [a]			Amount(s) expended [b] ($)
			(1)	(2)	(3)	
REGIONAL WORKSHOP ON THE PREPARATION OF NATIONAL TRAINING COURSES IN NUCLEAR MEDICAL EQUIPMENT MAINTENANCE. RLA/4/008/001	BOGOTA, COLOMBIA 16 SEPTEMBER - 11 OCTOBER	AGENCY COLOMBIA	3	0	3	14,705 (CC) 6,000 (CC)
REGIONAL TRAINING COURSE ON REPAIR OF MULTICHANNEL ANALYZERS, RLA/4/008/004	RIO DE JANEIRO, BRAZIL 30 SEPTEMBER - 25 OCTOBER	AGENCY GERMANY	11	0	3	29,161 (CC) 20,000 (CC)
REGIONAL ADVANCED TRAINING COURSE ON THE USE OF PERSONAL COMPUTERS FOR FIELD DATA ANALYSIS, RLA/5/021/007	COLONIA, URUGUAY 11 NOVEMBER - 22 NOVEMBER	AGENCY USA	7	0	5	29,181 (CC) 10,627 (CC)
REGIONAL TRAINING COURSE ON RADIOIMMUNOASSAY AND RELATED TECHNIQUES IN LIVESTOCK REPRODUCTION AND NUTRITION RESEARCH IN LATIN AMERICA, RLA/5/027/001	MEXICO CITY, MEXICO 11 NOVEMBER - 29 NOVEMBER	AGENCY	21	0	7	91,855 (CC)
REGIONAL WORKSHOP ON THE UTILIZATION OF IMMUNOASSAY FOR THE DIAGNOSIS AND EPIDEMIOLOGY OF ANIMAL DISEASES. RLA/5/028/001	RIO DE JANEIRO, BRAZIL 11 NOVEMBER - 14 NOVEMBER	AGENCY	19	4	3	15,642 (CC)
REGIONAL TRAINING COURSE ON OPTIMIZATION OF RADIOIMMUNOASSAY METHODOLOGY FOR NEONATAL HYPOTHYROID SCREENING, RLA/6/016/001	LA PAZ, BOLIVIA 4 MARCH - 15 MARCH	AGENCY	11	1	4	29,822 (CC)
REGIONAL TRAINING COURSE ON NEW APPROACHES IN RADIATION STERILIZATION OF MEDICAL SUPPLIES. RLA/7/004/001	BUENOS AIRES, ARGENTINA 22 JULY - 2 AUGUST	AGENCY	10	1	5	49,387 (CC)
REGIONAL TRAINING COURSE ON UT CHARACTERIZATION AND DIMENSIONING OF WELDING DEFECTS, RLA/8/013/102	PORT-OF-SPAIN, TRINIDAD AND TOBAGO 11 MARCH - 15 MARCH	ITALY	16	0	0	28,542 (CC)
REGIONAL TRAINING COURSE ON PREPARATION OF TEST PROCEDURES, RLA/8/013/106	GEORGETOWN, GUYANA 25 MARCH - 29 MARCH	ITALY	17	0	0	32,327 (CC)
REGIONAL WORKSHOP ON CRITERIA FOR CONCEPTION AND MANAGEMENT OF TEST PIECES FOR QUALIFICATION AND CERTIFICATION OF NDT PERSONNEL, RLA/8/013/109	SANTIAGO, CHILE 8 APRIL - 12 APRIL	ITALY	16	0	0	26,139 (CC)
REGIONAL WORKSHOP ON NDT IN CIVIL WORKS, RLA/8/013/110	GUATEMALA CITY, GUATEMALA 15 APRIL - 19 APRIL	ITALY	15	0	0	22,684 (CC)
REGIONAL WORKSHOP ON INSPECTION OF LPG CYLINDERS, RLA/8/013/111	SANTO DOMINGO, DOMINICAN REP. 15 APRIL - 24 APRIL	ITALY	15	0	0	38,204 (CC)
REGIONAL II TECHNICAL COORDINATION MEETING ON THE STUDY OF RESOURCES AND CONTAMINATION OF UNDERGROUNDWATER. RLA/8/014/006	HAVANA, CUBA 18 NOVEMBER - 22 NOVEMBER	GERMANY	11	0	1	23,019 (CC)
REGIONAL TRAINING COURSE ON USE OF TRACERS TO STUDY CONTAMINANT DISPERSION IN SURFACE WATERS, RLA/8/015/001	BUENOS AIRES, ARGENTINA 6 MAY - 31 MAY	AGENCY	15	0	3	89,996 (CC)
REGIONAL WORKSHOP ON INDUSTRIAL QUALITY IN PRODUCTION AND MAINTENANCE. RLA/8/017/001	SAO PAULO, BRAZIL 19 AUGUST - 27 AUGUST	GERMANY	17	0	1	36,838 (CC)
REGIONAL WORKSHOP ON ISO CRITERIA FOR A SURVEY ON QUALITY CONTROL IN THE REGION, RLA/8/017/002	QUITO, ECUADOR 21 OCTOBER - 25 OCTOBER	GERMANY	15	0	0	25,493 (CC)
REGIONAL TRAINING COURSE ON SAFETY AND REGULATION OF RADIATION SOURCES, RLA/9/010/001	SALAZAR, MEXICO 2 SEPTEMBER - 4 OCTOBER	AGENCY USA	14	1	5	92,423 (CC) 29,496 (CC)
REGIONAL TRAINING COURSE ON RADIOLOGICAL EMERGENCIES. RLA/9/011/001	LIMA, PERU 12 AUGUST - 23 AUGUST	AGENCY PAHO	14	5	4	25,312 (CC) 7,092(GIK)
REGIONAL TRAINING COURSE ON SAFE OPERATION OF INDUSTRIAL RADIATION FACILITIES, RLA/9/011/002	MEXICO CITY, MEXICO 10 JUNE - 21 JUNE	AGENCY	13	0	6	32,021 (CC)
REGIONAL WORKSHOP ON COORDINATED RESEARCH WORK ON DISPOSAL OF MEDICAL AND INDUSTRIAL RADIATION SOURCES, RLA/9/011/003	BOGOTA, COLOMBIA 29 JULY - 2 AUGUST	COLOMBIA	6	0	1	2,820 (CC)

Project title and code	Place(s) and dates	Source of Funds	Participation [a]			Amount(s) expended [b] ($)
			(1)	(2)	(3)	
REGIONAL TRAINING COURSE ON THERMOLUMINESCENCE APPLIED TO DOSIMETRY, RLA/9/011/004	QUITO, ECUADOR 4 NOVEMBER - 15 NOVEMBER	AGENCY FRANCE	12	0	8	12,312 (CC) 20,219 (CC)
REGIONAL SYMPOSIUM ON RADIATION PROTECTION AND NUCLEAR SAFETY, RLA/9/011/005	BUENOS AIRES, ARGENTINA 21 OCTOBER - 25 OCTOBER	AGENCY	15	0	0	31,065 (CC)
REGIONAL TRAINING COURSE ON REGULATORY ASPECTS AND SAFETY DOCUMENTATION OF RESEARCH REACTORS, RLA/9/012/001	SANTIAGO, CHILE 19 AUGUST - 6 SEPTEMBER	AGENCY	13	0	10	45,588 (CC)

[a] The figures under (1) denote the number of award-holders whose cost of participation was met out of project funds; those under (2) denote the number of participants who attended at the expense of their government, or of another organization on programme; those under (3) denote the number of local participants. No stipends or international travel costs were paid out of project funds in respect of participants shown under (2) and (3).

[b] The amounts expended (i.e. disbursements plus unliquidated obligations) do not include expenditures by host governments for local lecturers or facilities. They also do not give the final cost of the training course, since accounts may be settled in the following year. Substantial in-kind donations are listed with the abbreviation GIK.

[c] In connection with RAS/5/020/005

ANNEX III

PUBLISHED REPORTS: 1991

Recipient	Subject of report	Project code	Author(s)	Reference no.
INDONESIA	ISOLATION OF ARBOVIRUSES, THEIR IDENTIFICATION AND THE IDENTIFICATION OF THEIR CULICOIDES VECTORS IN INDONESIA	INS/5/021	MELLOR, PHILIP S.	IAEA/UNDP-INS/88/013-11
	CONTROLLED RELEASE OF PESTICIDE FORMULATIONS	INS/5/021	VOLLNER, L.	IAEA/UNDP-INS/88/013-12
	APPLICATION OF MOLASSES-UREA BLOCKS TO RUMINANT PRODUCTION IN INDONESIA	INS/5/021	LENG, R.A.	IAEA/UNDP-INS/88/013-13
	RICE-AZOLLA-FISH CULTURE-USE OF NUCLEAR TECHNIQUES	INS/5/021	WATANABE, I.	IAEA/UNDP-INS/88/013-14
	METHODS FOR INCREASING RUMINANT PRODUCTION FROM AVAILABLE FEED RESOURCES IN INDONESIA-NUTRITION-REPRODUCTION INTERACTION	INS/5/021	ENTWISTLE, K.W.	IAEA/UNDP-INS/88/013-15
INTERREGIONAL	COUNTRY PROGRAMME REVIEW: ETHIOPIA	INT/0/053	RIDWAN, MOHAMMAD CUARON-SANTISTEBAN, A. YURTSEVER, YUECEL MICKE, ALEXANDER WILLSTAETTER GREIG, P.	IAEA-TC-PM-001
NAMIBIA	COUNTRY PROGRAMMING MISSION		LA CHANCE, L. FLAKUS, F. JEGGO, M. NAIR, G.	IAEA-TC-PM-002
ROMANIA	PRE-OSART MISSION TO CERNAVODA	ROM/9/005	BARRON, THOMAS MACHO, ANDRES ROY, IVAN DULAR, JANEZ HIDE, KEITH MOORE,BRIAN OLIVIER, GILBERT WAITE, RICHARD	IAEA-TA-2456
THAILAND	BIOLOGICAL NITROGEN FIXATION	THA/5/031	BOWEN, G.D.	IAEA/UNDP-THA/85/004-17
	FERTILIZER EXPERIMENTS - DATA ANALYSIS AND INTERPRETATION OF RESULTS	THA/5/031	LARRY A. NELSON	IAEA/UNDP-THA/85/004-18
	MUTATION BREEDING OF FOOD LEGUMES	THA/5/031	ORAM, R.N.	IAEA/UNDP-THA/85/004-19
	IMPROVING THE REPRODUCTIVE PERFORMENCE OF LARGE AND SMALL RUMINANTS IN THAILAND	THA/5/031	JOHN E. VERCOE	IAEA/UNDP-THA/85/004-20
	APPLICATION ON MONOCLONAL ANTIBODIES FOR PROGESTERONE MEASUREMENT	THA/5/031	BUTCHER, G.	IAEA/UNDP-THA/85/004-21
	IMPROVING FOOD AND AGRICULTURAL PRODUCTION WITH NUCLEAR AND RELATED TECHNOLOGY	THA/5/031	VANDERDEELEN, J.	IAEA/UNDP-THA/85/004-22
TURKEY	DEVELOPMENT OF NON-DESTRUCTIVE TESTING	TUR/8/010	ALAT, ALI ZATOLOKIN, BORIS	IAEA/UNDP-TUR/87/016-TR
UKRAINE	INSARR MISSION TO WWR-M RESEARCH REACTOR (ADVISORY SERVICES)	UKR/4/002	ALCALA-RUIZ, F. BYSZEWSKI, W. DI MEGLIO, A.F. MUECK, K.	IAEA-TA-2457

ANNEX IV

VOLUNTARY CONTRIBUTIONS PLEDGED AND PAID TO THE TECHNICAL ASSISTANCE AND CO-OPERATION FUND FOR 1991
(as at 31 December 1991)

Member State	Base rate %	Share of $49.0 million target for voluntary contributions for 1991 using base rate[a/]	Pledged	Paid
Afghanistan	0.01	4,900	0	0
Albania	0.01	4,900	4,900	0
Algeria	0.15	73,500	0	0
Argentina	0.65	318,500	200,000	200,000
Australia	1.55	759,500	791,667	791,667
Austria	0.73	357,700	357,700	357,700
Bangladesh	0.01	4,900	4,900	4,900
Belarus	0.33	161,700	0	0
Belgium	1.16	568,400	111,111	111,111
Bolivia	0.01	4,900	0	0
Brazil	1.43	700,700	250,000	0
Bulgaria	0.15	73,500	73,500	73,500
Cameroon	0.01	4,900	0	0
Canada	3.06	1,499,400	1,086,867	1,086,867
Chile	0.08	39,200	39,200	0
China	0.78	382,200	382,200	382,200
Colombia	0.14	68,600	55,000	55,000
Costa Rica	0.02	9,800	0	0
Cote d'Ivoire	0.02	9,800	0	0
Cuba	0.09	44,100	44,100	44,100
Cyprus	0.02	9,800	9,800	9,800
Czech & Slovak F.R.	0.65	318,500	318,500	318,500
Dem. Kampuchea	0.01	4,900	0	0
Dem. P.R. Korea	0.05	24,500	24,500	24,500
Denmark	0.68	333,200	333,200	333,200
Dominican Rep.	0.03	14,700	0	0
Ecuador	0.03	14,700	0	0
Egypt	0.07	34,300	34,300	34,300
El Salvador	0.01	4,900	0	0
Ethiopia	0.01	4,900	0	0
Finland	0.50	245,000	245,000	245,000
France	6.19	3,033,100	3,033,100	3,033,100
Gabon	0.03	14,700	0	0
Germany	9.27	4,542,300	3,920,000	3,920,000
Ghana	0.01	4,900	5,000	0
Greece	0.39	191,100	191,100	132,065
Guatemala	0.02	9,800	0	0
Haiti	0.01	4,900	0	0
Holy See	0.01	4,900	4,900	4,900
Hungary	0.21	102,900	106,892	106,892
Iceland	0.03	14,700	14,700	14,700
India	0.37	181,300	181,300	181,300
Indonesia	0.15	73,500	39,000	39,000
Iran, I.R.	0.68	333,200	0	0
Iraq	0.12	58,800	0	0

Member State	Base rate %	Share of $49.0 million target for voluntary contributions for 1991 using base rate[a/]	Pledged	Paid
Ireland	0.18	88,200	0	0
Israel	0.21	102,900	0	0
Italy	3.95	1,935,500	0	0
Jamaica	0.01	4,900	0	0
Japan	11.26	5,517,400	5,517,400	5,517,400
Jordan	0.01	4,900	0	0
Kenya	0.01	4,900	4,900	0
Korea, Rep. of	0.22	107,800	107,800	107,800
Kuwait	0.29	142,100	0	0
Lebanon	0.01	4,900	0	0
Liberia	0.01	4,900	0	0
Libyan A.J.	0.28	137,200	0	0
Liechtenstein	0.01	4,900	4,900	4,900
Luxembourg	0.06	29,400	0	0
Madagascar	0.01	4,900	0	0
Malaysia	0.11	53,900	53,900	53,900
Mali	0.01	4,900	0	0
Mauritius	0.01	4,900	0	0
Mexico	0.93	455,700	455,700	455,700
Monaco	0.01	4,900	0	0
Mongolia	0.01	4,900	4,900	4,900
Morocco	0.04	19,600	20,000	0
Myanmar	0.01	4,900	4,900	4,900
Namibia	0.01	4,900	0	0
Netherlands	1.63	798,700	798,700	798,700
New Zealand	0.24	117,600	0	0
Nicaragua	0.01	4,900	0	0
Niger	0.01	4,900	0	0
Nigeria	0.20	98,000	98,000	98,000
Norway	0.54	264,600	264,600	264,600
Pakistan	0.06	29,400	29,400	29,400
Panama	0.02	9,800	0	0
Paraguay	0.03	14,700	0	0
Peru	0.06	29,400	0	0
Philippines	0.09	44,100	5,560	5,560
Poland	0.55	269,500	269,500	269,500
Portugal	0.18	88,200	88,200	88,200
Qatar	0.05	24,500	0	0
Romania	0.19	93,100	0	0
Saudi Arabia	1.01	494,900	0	0
Senegal	0.01	4,900	0	0
Sierra Leone	0.01	4,900	0	0
Singapore	0.11	53,900	0	0
South Africa	0.44	215,600	0	0
Spain	1.93	945,700	180,000	180,000
Sri Lanka	0.01	4,900	6,807	6,807
Sudan	0.01	4,900	4,900	0
Sweden	1.20	588,000	588,000	549,405
Switzerland	1.07	524,300	524,300	524,300

Member State	Base rate %	Share of $49.0 million target for voluntary contributions for 1991 using base rate[a/]	Pledged	Paid
Syrian A.R.	0.04	19,600	4,000	2,000
Thailand	0.10	49,000	49,000	49,000
Tunisia	0.03	14,700	0	0
Turkey	0.32	156,800	156,800	0
Uganda	0.01	4,900	0	0
Ukraine	1.24	607,600	607,600	0
USSR	9.89	4,846,100	3,038,674	3,038,674
U.A. Emirates	0.19	93,100	0	0
United Kingdom	4.81	2,356,900	2,356,900	2,356,900
U.R. Tanzania	0.01	4,900	4,900	0
USA	25.00	12,250,000	11,030,000	10,744,262
Uruguay	0.04	19,600	15,000	0
Venezuela	0.56	274,400	39,905	39,905
Viet Nam	0.01	4,900	4,900	4,900
Yugoslavia	0.45	220,500	220,500	0
Zaire	0.01	4,900	1,000	0
Zambia	0.01	4,900	0	0
Zimbabwe	0.02	9,800	0	0
TOTAL	100.00	49,000,000	38,423,983	36,703,915

[a/] As recommended in GC(V)/RES/100 and amended in GC(XV)/RES/286.

ANNEX V

COST-FREE FELLOWSHIPS OFFERED AND AWARDED: 1991

Donor	Number of fellowships offered	Number of months offered	Number of fellowships awarded [a]	Number of months awarded [a]
Argentina	6	72	0	0
Austria	1	12	2	15
Belgium	5	-	0	0
Brazil	10	-	0	0
Czech & Slovak F.R.	9	-	0	0
Denmark	5	60	1	6
Finland	-	-	3	1
France	-	50	20	65
Germany	-	105	15	47
Hungary	4	48	0	0
India	10	-	1	3
Israel	-	45	1	1
Italy	25	200	3	18
Japan	5	45	0	0
Netherlands	8	-	0	0
Poland	10	-	0	0
Romania	-	-	1	1
Spain	5	60	3	21
United Kingdom	[b]	-	3	16
USA	[b]	-	29	175

[a] Awards less rejections and withdrawals as at 31 December 1991.
[b] A specific amount of money was made available rather than a given number of fellowships.

ANNEX VI

APPROVED AND ON-GOING UNDP PROJECTS AS AT 31 DECEMBER 1991 (in thousands of dollars)

Recipient	Short title	Project code	Total amount approved	Prior to 1991	Approved budgets			
					1991	1992	1993	1994
A. Projects executed by the IAEA								
ALBANIA	STRENGTHENING OF NUCL. TECH. APPLIC. USING RESEARCH REACTOR	ALB87001	2,000	94	1,278	338	215	75
ARGENTINA	NUCLEAR ENGINEERING, PHASE II	ARG89012	274	222	52	0	0	0
BRAZIL	NUCLEAR TECHNIQUES IN AGRICULTURE	BRA91008	17	0	17	0	0	0
CHINA	MANPOWER DEVELOPMENT FOR NUCLEAR POWER PROGRAMME	CPR85085	1,708	1,621	87	0	0	0
	USE OF RADIATION AND ISOTOPES IN FOOD AND AGRICULTURE	CPR86022	418	418	0	0	0	0
CUBA	EXTENSION OF THE APPLICATION OF NUCLEAR TECHNIQUES	CUB86018	609	592	17	0	0	0
EGYPT	NATIONAL CENTRE FOR RADIATION TECHNOLOGY, PHASE III	EGY89015	331	213	118	0	0	0
HUNGARY	STRENGTHENING OF AN ADVANCED AUTOMATED RADIATION LABORATORY	HUN86004	32	24	8	0	0	0
INDONESIA	AGRICULTURAL PRODUCTION, PHASE II	INS88013	465	328	137	0	0	0
KENYA	FATE OF TRYPANOCIDAL DRUGS IN CATTLE	KEN90023	89	51	38	0	0	0
ROMANIA	NUCLEAR SAFETY	ROM87002	587	290	146	151	0	0
THAILAND	IMPROVING FOOD AND AGRICULTURAL PRODUCTION	THA85004	1,508	1,440	68	0	0	0
TURKEY	DEVELOPMENT OF NDT AT NUCLEAR RESEARCH AND TRAINING CENTRE	TUR87016	239	232	7	0	0	0
	INDUSTRIAL STERILIZATION OF MEDICAL SUPPLIES	TUR88040	700	564	56	57	23	0
VENEZUELA	CENTRE FOR NUCLEAR AGRICULTURE	VEN86007	275	263	12	0	0	0
REGIONAL ASIA	FOOD IRRADIATION PROCESS CONTROL AND ACCEPTANCE	RAS89044	650	125	183	170	172	0
	INDUSTRIAL APPLICATION OF ISTOOPES AND RADIATION TECHNOLOGY	RAS86073	3,270	2,636	634	0	0	0
	INCREASING THE CAPABILITIES OF COMMON GRAIN LEGUMES	RAS89045	970	190	266	236	204	74
Sub-total			14,142	9,303	3,124	952	614	149
B. Projects for which IAEA is associated agency								
CHINA	NUCLEAR SAFETY ADMINISTRATION	CPR85067	612	537	75	0	0	0
REG. ARAB STATES	TRAINING OF TECHNICIANS IN WATER RESOURCES USE IN LDAC	RAB86008	22	11	11	0	0	0
Sub-total			634	548	86	0	0	0
TOTAL			14,776	9,851	3,210	952	614	149

ANNEX VII

FOOTNOTE-a/ PROJECTS MADE OPERATIONAL OR EXTENDED DURING 1991

Recipient	Project title and code	Expert services (months)	Equipment ($)	Fellowships ($)	Group training ($)	Sub-contracts ($)	Source[a]
BANGLADESH	Agrochemical residues, BGD/5/014	1	20,000	0	0	0	UK
BOLIVIA	Mutation breeding, BOL/5/007	4	55,000	0	0	0	UK
BRAZIL	Isotope-aided studies in the Brazilian Amazon, BRA/0/010	10	103,900	42,000	0	0	SWE
	Radiation protection in medical practice, BRA/9/035	1	0	0	0	0	GFR
	Tropical radioecology, BRA/9/040	1	20,000	0	0	0	FRA
CHILE	Radioimmunoassay for the diagnosis of chagas disease, CHI/6/012	1	25,000	0	0	0	GFR
CHINA	Radionuclides in food and environmental samples, CPR/7/003	4	44,000	0	0	0	GFR
COLOMBIA	Upgrading of research reactor instrumentation (Phase II), COL/4/011	1	105,000	0	0	0	USA
COSTA RICA	Production of DNA probes, COS/5/013	0	80,000	0	0	0	USA
CZECH & SLOVAK F.R.	Use of burnable absorbers in WWER-type reactors, CZE/4/003	0	30,000	18,000	0	0	FRA
	Assessment of environmental risks in North Bohemia, CZE/9/007	1	0	3,000	0	0	FRA
ECUADOR	Study of sedimentation using nuclear techniques, ECU/8/015	2	45,000	9,000	0	0	UK
EGYPT	Moessbauer spectrometry (Phase II), EGY/1/020	1	22,000	0	0	0	UK
	Radiological emergency preparedness, EGY/9/028	2	20,000	0	0	0	USA
GHANA	Genetic improvement of cocoa and coffee, GHA/5/016	1	35,000	18,000	0	0	UK
	Non-destructive testing (NDT), GHA/8/005	3	53,000	0	0	0	USA
GREECE	Ion implantation using a tandem accelerator, GRE/1/034	0	75,000	0	0	0	USA
HUNGARY	Establishing university courses in nuclear engineering, HUN/0/002	1	50,000	0	0	0	USA
	Training in management and analysis of severe accidents, HUN/9/013	3	0	6,000	0	0	FRA
INDONESIA	University research and teaching, INS/0/011	6	75,000	0	0	0	USA
	Uranium exploration and development, INS/3/009	2	50,000	0	0	0	FRA
	Internal dosimetry service, INS/9/018	2	40,000	0	0	0	USA
JORDAN	Upgrading radiotherapy at Al Bashir Hospital, JOR/6/008	3	30,000	18,000	0	0	UK
	Radioactivity in ground and drinking water, JOR/9/004	1	50,000	9,000	0	0	UK
KENYA	Pesticide research, KEN/5/016	1	62,000	0	0	0	USA
KOREA,REP.OF	Processing of agricultural wastes for animal feed, ROK/5/027	2	0	0	0	0	USA

Recipient	Project title and code	Expert services (months)	Equipment ($)	Fellowships ($)	Group training ($)	Sub-ontracts ($)	Source[a]
MALAYSIA	Nuclear instrumentation centre, MAL/4/006	0	20,000	0	0	0	USA
	Radiation and isotope applications in industry, MAL/8/010	1	35,000	0	0	0	USA
MEXICO	National nuclear training centre, MEX/0/009	1	75,700	0	0	0	USA
	Reactor fuel fabrication and performance, MEX/4/038	3	100,000	30,600	0	0	SPA
	Improvement of plant species, MEX/5/017	3	30,000	27,000	0	0	UK
	Isotopic studies on groundwater resources, MEX/8/018	2	80,000	24,000	0	0	UK
MOROCCO	Simulation of nuclear reactor operation, MOR/4/009	1	15,000	0	0	0	FRA
	Study on food irradiation, MOR/5/018	2	0	0	0	0	FRA
NIGER	Upgrading the Radiation Protection Inspectorate, NER/9/006	1	55,000	0	0	0	FRA
NIGERIA	Preventing tsetse fly re-invasion (Phase II), NIR/5/021	6	75,000	15,000	0	40,000	UK
	Environmental monitoring of radionuclides, NIR/9/006	4	45,000	0	0	0	USA
PERU	Energy and power assessment programme, PER/0/019	3	15,000	0	0	0	USA
	Methods for neutron activation analysis, PER/2/012	1	32,000	18,000	0	0	UK
PHILIPPINES	Impact of pesticides on the ecosystem, PHI/5/021	1	40,000	0	0	0	USA
POLAND	Upgrading of the nuclear medicine centre, POL/6/003	2	300,000	0	0	0	GFR
PORTUGAL	Neutron scattering spectrometer, POR/1/005	0	55,000	0	0	0	USA
ROMANIA	Radioimmunoassay standardization and quality control, ROM/6/010	1	65,000	0	0	0	USA
THAILAND	Food irradiation on commercial scale, THA/5/040	2	0	6,000	0	0	UK
TUNISIA	Advanced non-destructive testing techniques in industry, TUN/8/010	2	50,000	0	0	0	FRA
YUGOSLAVIA	Maintenance and ageing of nuclear power plants, YUG/9/031	3	0	0	0	0	USA
REGIONAL AFRICA	Local preparation of radioimmunoassay reagents (AFRA V), RAF/6/007	2	51,400	0	30,000	0	FRA
REGIONAL ASIA & PACIFIC	Radioisotopes in industry (RCA), RAS/8/062	9	0	13,500	229,000	0	JPN
	Marine contaminant and sediment transport, RAS/8/065	5	25,000	0	0	0	USA
	Strengthening of radiation protection infrastructures (RCA), RAS/9/006	11	0	0	60,000	0	JPN
		0	0	0	42,800	0	AUL
REGIONAL MIDDLE EAST & EUROPE	In-service inspection design, RER/4/003	0	0	0	0	76,600	SPA
REGIONAL LATIN AMERICA	Nuclear analytical techniques (ARCAL IV), RLA/2/003	2	5,000	0	20,000	0	GFR
	Environmental studies using nuclear techniques, RLA/2/006	6	70,000	0	0	40,000	GFR

Recipient	Project title and code	Expert services (months)	Equipment ($)	Fellowships ($)	Group training ($)	Sub-ontracts ($)	Source[a]
REGIONAL LATIN AMERICA	Research reactor utilization (ARCAL V), RLA/4/007	0	0	0	4,000	0	CHI
	Nuclear instrumentation - Phase II (ARCAL II), RLA/4/008	3	35,000	0	20,000	0	GFR
		0	0	0	6,000	0	COL
	Improvement of cereals through mutation breeding (ARCAL VII), RLA/5/021	3	70,000	0	0	0	USA
	Immunoassay in animal production and health (ARCAL III), RLA/5/028	6	0	0	0	0	SWE
	Non-destructive testing in quality control programmes, RLA/8/017	10	100,000	0	60,000	0	GFR
	Radiation protection - Phase II (ARCAL I), RLA/9/011	1	0	0	0	0	CHI
		0	0	0	4,000	0	COL
		0	30,000	0	20,000	0	FRA

[a] Explanation of abbreviations: AUL = Australia; CHI = Chile; COL = Colombia; FRA = France; GFR = Germany; JPN = Japan; SPA = Spain; SWE = Sweden; UK = United Kingdom; USA = United States of America.

ANNEX VIII

APPROVALS AGAINST THE RESERVE FUND IN 1991

Recipient	Project title and number	Expert mm.dd	Expert $	Equip-ment	Other $	Total $
A. New Projects						
Brazil	Safety Review - Angra I, BRA/9/041	4.00	35,400	0	0	35,400
Bulgaria	Upgrading of INIS system, BUL/0/003	0.00	0	7,500	0	7,500
China	Workshop on the management and evaluation of TC projects, CPR/0/004	1.00	12,000	0	0	12,000
	Nuclear power plant safety, CPR/9/017	2.08	26,000	0	0	26,000
Cuba	Upgrading of irradiation facility, CUB/8/012	0.00	0	50,000	0	50,000
Czech and Slovak Fed. Rep.	Quality assurance and site safety of NPP's, CZE/9/008	4.00	35,400	0	0	35,400
Ethiopia	Isotope investigations in selected geothermal fields, ETH/8/002	3.00	26,550	7,000	0	33,550
Poland	Health effects of ionizing radiation, POL/9/015	0.25	16,000	0	0	16,000
Romania	Environmental radiation monitoring, ROM/9/010	2.00	17,700	0	0	17,700
Ukraine	INSARR mission to WWR-M research reactor, UKR/4/002	2.01	11,459	0	0	11,459
Interregional	Strengthening radiation protection, INT/9/124	1.00	8,850	0	0	8,850
Sub-total		20.04	189,359	64,500	0	253,859
B. Supplementary assistance to existing projects						
Afghanistan	Dosimetry in radiotherapy, AFG/6/010	2.00	17,700	12,000	0	29,700
Bulgaria	OSART Missions to Kozloduy and Belene NPPs, BUL/9/011	8.00	29,800	0	200[a]	30,000
China	Pre-OSART follow-up review of Qinshan Nuclear Power Plant, CPR/9/012	1.00	13,500	0	0	13,500
El Salvador	Radiation protection, ELS/9/005	0.07	4,500	0	0	4,500
Haiti	Radiation protection and therapy, HAI/9/002	3.16	32,860	15,000	0	47,860
Libyan A.J.	Eradication of the screwworm, LIB/5/007	0.00	0	2,221	0	2,221
Pakistan	Sterile insect technique, PAK/5/018	0.10	4,000	0	0	4,000
Poland	Improving radioactive waste treatment technologies, POL/9/014	0.0	0	12,000	0	12,000
Spain	Nuclear techniques in agriculture, SPA/5/002	0.00	0	10,000	0	10,000
Ukraine	Radiation protection, UKR/9/002	1.00	8,850	25,350	6,000[a]	40,200
Yugoslavia	Nuclear analytical laboratory, YUG/1/010	0.00	0	27,000	0	27,000
Regional Africa	Water desalination using nuclear heat reactors, RAF/4/010	0.00	0	0	50,000[b]	50,000
Sub-total		16.03	111,210	103,571	56,200	270,981
TOTAL		36.07	300,569	168,071	56,200	524,840

[a] Approval for fellowship. [b] Approval for sub-contract.

ANNEX IX

NET PROGRAMME CHANGES BY RECIPIENT: 1991

Recipient	Component	Existing Approval	Net change
AFGHANISTAN	EXPERTS (M/M)	1/10	2/00
	EQUIPMENT (CC)	0	12,000
	FELLOWSHIPS (CC)	0	9,000
ALBANIA	EXPERTS (M/M)	6/02	-0/16
	EQUIPMENT (CC)	1,204,723	12,680
	FELLOWSHIPS (CC)	6,150	-6,150
ALGERIA	EXPERTS (M/M)	19/12	-4/20
	EQUIPMENT (CC)	949,361	59,578
	EQUIPMENT (NCC)	45,000	-25,000
	FELLOWSHIPS (CC)	79,500	-12,018
ARGENTINA	EQUIPMENT (CC)	55,000	-1,500
	FELLOWSHIPS (CC)	76,950	28,730
BANGLADESH	EXPERTS (M/M)	45/05	-8/16
	EQUIPMENT (CC)	1,631,047	71,622
	EQUIPMENT (NCC)	108,000	-7,500
	FELLOWSHIPS (CC)	246,098	6,782
BELARUS	EQUIPMENT (CC)	50,000	-1,200
	FELLOWSHIPS (CC)	0	1,200
BOLIVIA	EXPERTS (M/M)	28/08	-0/06
	EQUIPMENT (CC)	759,504	22,359
	FELLOWSHIPS (CC)	63,900	-37,921
	TRAINING COURSES (CC)	7,300	10,328
BRAZIL	EXPERTS (M/M)	228/28	-14/03
	EQUIPMENT (CC)	2,032,992	35,000
	FELLOWSHIPS (CC)	465,254	-20,648
BULGARIA	EXPERTS (M/M)	37/02	6/01
	EQUIPMENT (CC)	1,339,962	-250,379
	EQUIPMENT (NCC)	1,121,976	-252,973
	FELLOWSHIPS (CC)	124,300	29,850
	FELLOWSHIPS (NCC)	0	12,305
	SUB-CONTRACTS (CC)	0	481,764

Recipient	Component	Existing Approval	Net change
CAMEROON	EXPERTS (M/M)	8/18	-2/21
	EQUIPMENT (CC)	211,650	21,883
	FELLOWSHIPS (CC)	16,297	812
CHILE	EXPERTS (M/M)	30/00	-4/25
	EQUIPMENT (CC)	1,360,100	64,331
	FELLOWSHIPS (CC)	224,700	-1,077
CHINA	MISCELLANEOUS (NCC)	0	8,000
	EXPERTS (M/M)	60/05	0/19
	EQUIPMENT (CC)	1,398,504	11,515
	EQUIPMENT (NCC)	2,400	-216
	FELLOWSHIPS (CC)	533,613	29,143
	FELLOWSHIPS (NCC)	0	14,139
	SUB-CONTRACTS (CC)	0	9,510
COLOMBIA	EXPERTS (M/M)	28/02	-4/13
	EQUIPMENT (CC)	1,307,934	11,266
	EQUIPMENT (NCC)	36,800	2,680
	FELLOWSHIPS (CC)	118,317	73,198
COSTA RICA	EXPERTS (M/M)	25/01	-0/10
	EQUIPMENT (CC)	185,720	32,360
	FELLOWSHIPS (CC)	102,300	-50,350
COTE D'IVOIRE	EXPERTS (M/M)	10/20	-3/00
	EQUIPMENT (CC)	438,016	12,134
	FELLOWSHIPS (CC)	26,795	4,915
CUBA	EXPERTS (M/M)	12/05	-0/22
	EQUIPMENT (CC)	1,326,558	28,897
	EQUIPMENT (NCC)	1,978,376	-674,694
	FELLOWSHIPS (CC)	135,728	-7,061
	FELLOWSHIPS (NCC)	0	7,860
CYPRUS	EXPERTS (M/M)	12/26	-5/06
	EQUIPMENT (CC)	429,150	25,677
	FELLOWSHIPS (CC)	32,550	-2,100
	SUB-CONTRACTS (CC)	5,000	24,845
CZECH AND SLOVAK FEDERAL REPUBLIC	EXPERTS (M/M)	2/00	2/00
	EQUIPMENT (CC)	56,000	-7,270
	FELLOWSHIPS (CC)	24,300	-3,015
	SUB-CONTRACTS (CC)	0	32,000

Recipient	Component	Existing Approval	Net change
DEM. P.R. KOREA	MISCELLANEOUS (NCC)	0	10,000
	EXPERTS (M/M)	7/23	-0/15
	EQUIPMENT (CC)	1,398,127	11,545
	EQUIPMENT (NCC)	2,437,446	-151,832
	FELLOWSHIPS (CC)	0	2,000
	FELLOWSHIPS (NCC)	14,115	-1,103
DOMINICAN REPUBLIC	EXPERTS (M/M)	16/02	-4/03
	EQUIPMENT (CC)	527,465	42,984
	EQUIPMENT (NCC)	10,000	-5,055
	FELLOWSHIPS (CC)	77,700	-5,386
ECUADOR	EXPERTS (M/M)	43/18	-5/15
	EQUIPMENT (CC)	1,576,508	194,104
	EQUIPMENT (NCC)	227,963	-216,518
	FELLOWSHIPS (CC)	163,734	-27,102
	FELLOWSHIPS (NCC)	0	9,000
EGYPT	EXPERTS (M/M)	48/16	-8/04
	EQUIPMENT (CC)	1,635,361	226,867
	EQUIPMENT (NCC)	92,000	-61,620
	FELLOWSHIPS (CC)	128,800	56,881
	TRAINING COURSES (CC)	135,000	-35,449
EL SALVADOR	EXPERTS (M/M)	22/01	-4/03
	EQUIPMENT (CC)	683,093	28,600
ETHIOPIA	EXPERTS (M/M)	22/22	-2/29
	EQUIPMENT (CC)	142,605	1,475
	FELLOWSHIPS (CC)	63,950	24,780
GABON	EXPERTS (M/M)	5/04	-0/07
	EQUIPMENT (CC)	32,200	2,065
GHANA	EXPERTS (M/M)	38/04	-1/28
	EQUIPMENT (CC)	1,476,303	134,264
	EQUIPMENT (NCC)	224,000	90,000
	FELLOWSHIPS (CC)	99,685	-26,079
GREECE	EXPERTS (M/M)	3/06	-1/00
	EQUIPMENT (CC)	573,070	92,382
	EQUIPMENT (NCC)	307,909	263,500
	FELLOWSHIPS (CC)	56,300	-27,794

Recipient	Component	Existing Approval	Net change
GUATEMALA	EXPERTS (M/M)	18/18	-2/22
	EQUIPMENT (CC)	872,820	-68,490
	EQUIPMENT (NCC)	29,000	-22,048
	FELLOWSHIPS (CC)	82,800	-5,445
HAITI	EXPERTS (M/M)	5/00	0/13
	EQUIPMENT (CC)	44,000	23,165
	EQUIPMENT (NCC)	7,170	800
	FELLOWSHIPS (CC)	27,000	-27,000
HUNGARY	EXPERTS (M/M)	4/00	-2/08
	EQUIPMENT (CC)	504,854	-10,736
	FELLOWSHIPS (CC)	29,320	10,038
ICELAND	EQUIPMENT (CC)	132,224	-4,339
INDONESIA	EXPERTS (M/M)	70/16	-5/18
	EQUIPMENT (CC)	782,214	61,228
	EQUIPMENT (NCC)	197,623	-67,623
	FELLOWSHIPS (CC)	142,400	5,013
INTERREGIONAL	MISCELLANEOUS (CC)	0	1,726
	EXPERTS (M/M)	189/16	4/08
	SUB-CONTRACTS (CC)	0	44,250
IRAN, ISLAMIC REPUBLIC OF	EXPERTS (M/M)	77/21	-9/02
	EQUIPMENT (CC)	1,350,187	111,606
	EQUIPMENT (NCC)	275,000	-5,000
	FELLOWSHIPS (CC)	55,750	117,000
	FELLOWSHIPS (NCC)	13,426	11,600
IRAQ	EXPERTS (M/M)	92/13	-28/00
	EQUIPMENT (CC)	495,000	-98,755
	EQUIPMENT (NCC)	946,363	-446,363
	FELLOWSHIPS (CC)	352,965	-202,937
	FELLOWSHIPS (NCC)	25,650	-237
	SUB-CONTRACTS (NCC)	6,400	-3,108
IRELAND	EXPERTS (M/M)	1/00	-0/12
	EQUIPMENT (CC)	37,742	3,540
JAMAICA	EXPERTS (M/M)	2/00	-0/10
	EQUIPMENT (CC)	132,000	3,700
	FELLOWSHIPS (CC)	104,700	-55,000

Recipient	Component	Existing Approval	Net change
JORDAN	EXPERTS (M/M)	45/26	-5/22
	EQUIPMENT (CC)	618,770	86,863
	EQUIPMENT (NCC)	31,056	8,000
	FELLOWSHIPS (CC)	59,306	3,876
KENYA	EXPERTS (M/M)	71/01	-1/02
	EQUIPMENT (CC)	771,446	9,440
KOREA, REP. OF	EXPERTS (M/M)	96/18	-3/16
	EQUIPMENT (CC)	20,000	8,950
	FELLOWSHIPS (CC)	472,486	12,290
LIBYAN ARAB JAMAHIRIYA	EXPERTS (M/M)	51/24	-1/02
	EQUIPMENT (CC)	260,070	15,006
	FELLOWSHIPS (CC)	208,561	-5,161
MADAGASCAR	EXPERTS (M/M)	21/05	-3/29
	EQUIPMENT (CC)	105,230	-15,000
	FELLOWSHIPS (CC)	99,366	-29,976
MALAYSIA	EXPERTS (M/M)	81/04	-1/11
	EQUIPMENT (CC)	987,854	22,198
	FELLOWSHIPS (CC)	136,962	-9,030
MALI	EXPERTS (M/M)	16/23	-3/27
	EQUIPMENT (CC)	854,098	26,407
	FELLOWSHIPS (CC)	90,000	-29,894
MAURITIUS	FELLOWSHIPS (CC)	74,563	-34,217
MEXICO	EXPERTS (M/M)	126/21	-5/01
	EQUIPMENT (CC)	1,551,303	90,775
	EQUIPMENT (NCC)	775,000	-8,000
	FELLOWSHIPS (CC)	396,158	-81,197
	FELLOWSHIPS (NCC)	0	24,700
MONGOLIA	EXPERTS (M/M)	17/27	-1/19
	EQUIPMENT (CC)	451,100	43,720
	EQUIPMENT (NCC)	298,006	-113,130
	FELLOWSHIPS (CC)	150,200	-12,660
	FELLOWSHIPS (NCC)	41,651	18,671
	SUB-CONTRACTS (CC)	50,000	-13,105
MOROCCO	EXPERTS (M/M)	76/00	-8/04
	EQUIPMENT (CC)	418,440	157,294
	EQUIPMENT (NCC)	130,000	-110,000
	FELLOWSHIPS (CC)	240,000	8,455

Recipient	Component	Existing Approval	Net change
MYANMAR	EXPERTS (M/M)	9/00	-1/00
	EQUIPMENT (CC)	517,500	-12,773
	FELLOWSHIPS (CC)	72,700	21,623
NICARAGUA	EXPERTS (M/M)	4/00	0/16
	EQUIPMENT (CC)	174,200	-4,720
	EQUIPMENT (NCC)	15,000	7,400
	FELLOWSHIPS (CC)	47,700	-3,000
	TRAINING COURSES (CC)	0	3,000
NIGER	EXPERTS (M/M)	23/00	-3/12
	EQUIPMENT (CC)	333,850	3,160
	FELLOWSHIPS (CC)	91,200	-27,000
NIGERIA	EXPERTS (M/M)	90/05	-17/09
	EQUIPMENT (CC)	1,206,513	67,378
	FELLOWSHIPS (CC)	64,500	23,218
	SUB-CONTRACTS (CC)	160,000	60,000
PAKISTAN	EXPERTS (M/M)	78/23	-6/08
	EQUIPMENT (CC)	1,355,575	33,631
	EQUIPMENT (NCC)	34,000	21,425
	FELLOWSHIPS (CC)	163,615	33,637
	SUB-CONTRACTS (CC)	0	52,078
PANAMA	EQUIPMENT (CC)	196,418	5,500
	FELLOWSHIPS (CC)	108,300	-55,000
PERU	EXPERTS (M/M)	73/27	-5/01
	EQUIPMENT (CC)	995,651	117,938
	FELLOWSHIPS (CC)	310,170	-15,561
PHILIPPINES	EXPERTS (M/M)	18/23	-3/07
	EQUIPMENT (CC)	1,422,137	76,033
	FELLOWSHIPS (CC)	106,112	-1,310
	SUB-CONTRACTS (CC)	10,000	-2,437
POLAND	EXPERTS (M/M)	10/05	-2/09
	EQUIPMENT (CC)	912,242	70,529
	EQUIPMENT (NCC)	1,777,474	122,538
	FELLOWSHIPS (CC)	99,300	100
PORTUGAL	EXPERTS (M/M)	28/20	-6/24
	EQUIPMENT (CC)	1,060,582	64,478
	EQUIPMENT (NCC)	1,063,181	-659,271
	FELLOWSHIPS (CC)	114,086	-32,435

Recipient	Component	Existing Approval	Net change
REGIONAL AFRICA	EXPERTS (M/M)	167/09	0/27
	EQUIPMENT (CC)	736,180	-2,614
	FELLOWSHIPS (CC)	1,932,100	155,288
	FELLOWSHIPS (NCC)	155,861	14,463
	TRAINING COURSES (CC)	450,245	-123,027
	SUB-CONTRACTS (CC)	0	20,000
REGIONAL ASIA AND PACIFIC	EXPERTS (M/M)	268/11	-7/22
	EQUIPMENT (CC)	302,700	58,607
	FELLOWSHIPS (CC)	2,129,500	957
	FELLOWSHIPS (NCC)	945,000	-8,071
	TRAINING COURSES (CC)	1,190,390	-15,858
	TRAINING COURSES (NCC)	1,100	3,500
REGIONAL EUROPE	MISCELLANEOUS (CC)	0	5,720
	MISCELLANEOUS (NCC)	0	9,030
	EXPERTS (M/M)	160/04	37/12
	EXPERTS (M/M) (NCC)	2/23	10/27
	EQUIPMENT (CC)	977,300	20,600
	EQUIPMENT (NCC)	310,000	-18,065
	FELLOWSHIPS (CC)	3,101,909	-27,304
	FELLOWSHIPS (NCC)	354,681	-26,330
	TRAINING COURSES (CC)	799,583	-12,726
	TRAINING COURSES (NCC)	28,945	-13,690
	SUB-CONTRACTS (NCC)	60,000	-50,000
REGIONAL LATIN AMERICA	EXPERTS (M/M)	758/05	6/14
	EQUIPMENT (CC)	3,563,517	-10,830
	FELLOWSHIPS (CC)	1,551,688	-100,988
	FELLOWSHIPS (NCC)	270,000	-33,560
	TRAINING COURSES (CC)	3,585,325	133,652
	TRAINING COURSES (NCC)	53,300	5,286
	SUB-CONTRACTS (CC)	477,000	17,364
ROMANIA	EXPERTS (M/M)	57/09	-0/02
	EQUIPMENT (CC)	835,675	56,225
	EQUIPMENT (NCC)	388,239	-95,700
	FELLOWSHIPS (CC)	198,750	22,219
	FELLOWSHIPS (NCC)	0	24,486
	TRAINING COURSES (CC)	88,000	-15,655

Recipient	Component	Existing Approval	Net change
SENEGAL	EXPERTS (M/M)	8/00	-1/21
	EQUIPMENT (CC)	126,100	295
	FELLOWSHIPS (CC)	44,100	-3,400
SIERRA LEONE	EXPERTS (M/M)	23/12	-0/25
	EQUIPMENT (CC)	265,000	7,375
	FELLOWSHIPS (CC)	195,900	-36,000
SINGAPORE	EXPERTS (M/M)	4/00	-0/21
SPAIN	EXPERTS (M/M)	1/00	-0/17
	EQUIPMENT (CC)	79,000	15,014
SRI LANKA	EXPERTS (M/M)	26/26	-10/06
	EQUIPMENT (CC)	1,126,511	74,668
	EQUIPMENT (NCC)	50,000	-3,000
	FELLOWSHIPS (CC)	13,300	15,151
SUDAN	EXPERTS (M/M)	3/00	0/07
	EQUIPMENT (CC)	1,314,478	-52,130
	EQUIPMENT (NCC)	54,100	1,200
	FELLOWSHIPS (CC)	130,550	26,700
SYRIAN ARAB REPUBLIC	EXPERTS (M/M)	54/12	-7/07
	EQUIPMENT (CC)	212,771	70,379
	EQUIPMENT (NCC)	1,384,863	-468,869
	FELLOWSHIPS (CC)	161,858	-13,739
	FELLOWSHIPS (NCC)	0	4,000
	SUB-CONTRACTS (CC)	39,200	15,002
	SUB-CONTRACTS (NCC)	34,500	-7,602
THAILAND	EXPERTS (M/M)	61/21	0/16
	EQUIPMENT (CC)	701,696	-22,146
	EQUIPMENT (NCC)	5,617	15,000
	FELLOWSHIPS (CC)	340,757	-1,343
TUNISIA	EXPERTS (M/M)	34/08	-7/03
	EQUIPMENT (CC)	954,040	61,591
TURKEY	EXPERTS (M/M)	5/00	-1/10
	EQUIPMENT (CC)	215,000	26,400
	FELLOWSHIPS (CC)	57,800	-9,050
UGANDA	EXPERTS (M/M)	27/25	-3/20
	EQUIPMENT (CC)	239,280	32,380

Recipient	Component	Existing Approval	Net change
UKRAINE	EXPERTS (M/M)	1/00	2/01
	EQUIPMENT (CC)	50,000	25,350
	FELLOWSHIPS (CC)	0	6,000
UNITED ARAB EMIRATES	EXPERTS (M/M)	13/04	-4/18
	EQUIPMENT (CC)	642,888	38,645
	FELLOWSHIPS (CC)	8,400	2,065
U.R. TANZANIA	EXPERTS (M/M)	34/26	1/00
	EQUIPMENT (CC)	117,010	6,433
	EQUIPMENT (NCC)	91,489	-150
	FELLOWSHIPS (CC)	97,250	-35,309
	FELLOWSHIPS (NCC)	0	300
URUGUAY	EXPERTS (M/M)	20/06	-3/12
	EQUIPMENT (CC)	522,139	59,234
	EQUIPMENT (NCC)	0	5,500
	FELLOWSHIPS (CC)	153,019	-16,314
VENEZUELA	EXPERTS (M/M)	18/14	-4/00
	EQUIPMENT (CC)	877,275	185,412
	EQUIPMENT (NCC)	115,851	-115,851
	FELLOWSHIPS (CC)	262,850	-42,017
VIET NAM	EXPERTS (M/M)	23/03	0/12
	EQUIPMENT (CC)	989,299	10,410
	EQUIPMENT (NCC)	76,500	-57,007
	FELLOWSHIPS (CC)	298,970	-10,000
	FELLOWSHIPS (NCC)	0	17,000
YUGOSLAVIA	EXPERTS (M/M)	3/00	-0/15
	EQUIPMENT (CC)	173,500	42,925
	FELLOWSHIPS (CC)	12,000	-10,000
ZAIRE	EXPERTS (M/M)	9/00	-0/28
	EQUIPMENT (CC)	594,536	4,720
	FELLOWSHIPS (CC)	13,037	16,040
ZAMBIA	EXPERTS (M/M)	32/04	-1/21
	EQUIPMENT (CC)	421,695	-22,280
	EQUIPMENT (NCC)	126,628	9,300
	FELLOWSHIPS (CC)	80,985	13,689
	FELLOWSHIPS (NCC)	0	1,800

Recipient	Component	Existing Approval	Net change
ZIMBABWE	EXPERTS (M/M)	13/18	-5/03
	EQUIPMENT (CC)	285,640	-14,393
	FELLOWSHIPS (CC)	76,500	-18,000
TOTALS	MISCELLANEOUS (CC)	0	7,446
	MISCELLANEOUS (NCC)	0	27,030
	EXPERTS (M/M)	4,007/06	-192/15
	EXPERTS ($)	29,114,630	-1,937,749
	EXPERTS ($) (NCC)	72,205	180,120
	EQUIPMENT (CC)	57,668,219	2,455,243
	EQUIPMENT (NCC)	15,605,570	-3,038,145
	FELLOWSHIPS (CC)	17,628,369	-416,339
	FELLOWSHIPS (NCC)	1,820,385	91,022
	TRAINING COURSES (CC)	6,277,844	-55,735
	TRAINING COURSES (NCC)	83,345	-4,904
	SUB-CONTRACTS (CC)	751,200	741,273
	SUB-CONTRACTS (NCC)	100,900	-60,711
	TOTAL ALLOTTED	129,122,670	-2,011,450

ANNEX X

NET REPHASINGS UNDERTAKEN DURING 1991

Recipient	Project component	Net allotted/ Net rephased	Current year	1992	1993
DOMINICAN REPUBLIC	EQUIPMENT	ALLOTTED	46,000	37,000	37,000
	(CC)	REPHASED	4,000	-4,000	0
PANAMA	EQUIPMENT	ALLOTTED	65,000	95,000	0
	(CC)	REPHASED	51,000	-51,000	0
PERU	EQUIPMENT	ALLOTTED	18,000	15,000	0
	(CC)	REPHASED	4,000	-4,000	0
TOTALS	EQUIPMENT	ALLOTTED	129,000	147,000	37,000
	(CC)	REPHASED	59,000	-59,000	0
	TOTAL ALLOTTED		129,000	147,000	37,000
	TOTAL REPHASED		59,000	-59,000	0

ANNEX XI

EXTRABUDGETARY CONTRIBUTIONS FOR ACTIVITIES RELATING TO TECHNICAL CO-OPERATION WHICH ARE NOT INCLUDED IN THE TECHNICAL CO-OPERATION PROGRAMME: 1991 (in US dollars)

Donor	Activity	Funds Received
BRAZIL	INTERNATIONAL CENTRE FOR THEORETICAL PHYSICS, TRIESTE	16,000
FRANCE	INTERNATIONAL CENTRE FOR THEORETICAL PHYSICS, TRIESTE	16,500
IRAN, I.R.	INTERNATIONAL CENTRE FOR THEORETICAL PHYSICS, TRIESTE	109,100
ITALY	INTERNATIONAL CENTRE FOR THEORETICAL PHYSICS, TRIESTE	7,472,200
JAPAN	NUCLEAR MEDICINE	7,300
	INTERNATIONAL CENTRE FOR THEORETICAL PHYSICS, TRIESTE	39,100
KUWAIT	INTERNATIONAL CENTRE FOR THEORETICAL PHYSICS, TRIESTE	9,100
LIBYAN A.J.	NUCLEAR DESALINATION PROJECT	100,000
NETHERLANDS	IMMUNOASSAY TECHNIQUES TO IMPROVE THE REPRODUCTIVE EFFICIENCY AND HEALTH STATUS OF INDIGENOUS AFRICAN LIVESTOCK	315,900
QATAR	INTERNATIONAL CENTRE FOR THEORETICAL PHYSICS, TRIESTE	2,000
SPAIN	INTERNATIONAL CENTRE FOR THEORETICAL PHYSICS, TRIESTE	15,000
SWEDEN	INTERNATIONAL CENTRE FOR THEORETICAL PHYSICS, TRIESTE	322,700
	IMMUNOASSAY AND DNA PROBE METHODS FOR SEROSURVEILLANCE OF RINDERPEST IN AFRICA AND FOR THE DIAGNOSIS AND CONTROL OF ANIMAL DISEASES IN LATIN AMERICA	498,000
	RESEARCH AND DEVELOPMENT IN SUPPORT OF NEW WORLD SCREWWORM ERADICATION FROM NORTH AFRICA	317,100
	ADVERSE SIDE EFFECTS ON FLORA AND FAUNA FROM THE USE OF ORGANOCHLORINE PESTICIDES ON THE AFRICAN CONTINENT	341,800
	INCREASING AND STABILIZING PLANT PRODUCTIVITY IN LOW PHOSPHATE AND SEMI-ARID AND SUB-HUMID SOILS OF THE TROPICS AND SUB-TROPICS	184,600
SWITZERLAND	INTERNATIONAL CENTRE FOR THEORETICAL PHYSICS, TRIESTE	37,200
UK	INTERNATIONAL CENTRE FOR THEORETICAL PHYSICS, TRIESTE	34,500
USA	DEVELOPMENT OF GENETIC MEANS TO SEPARATE MEDITERRANEAN FRUIT FLY MALES FROM FEMALES FOR SUPPRESSION OF WILD POPULATION BY MEANS OF THE STERILE MALE TECHNIQUE	49,300
	DEVELOPMENT OF BACILLUS THURINGIENSIS AS A CONTROL FOR ADULT MEDITERRANEAN FRUIT FLY	40,000
OTHER DONORS[a/]	INTERNATIONAL CENTRE FOR THEORETICAL PHYSICS, TRIESTE	1,091,700
TOTAL		11,019,100

[a/] Includes contributions from various international organizations and national institutes.