GC(XXXVII)/INF/317

THE AGENCY'S TECHNICAL CO-OPERATION ACTIVITIES IN 1992

REPORT BY THE DIRECTOR GENERAL

INTERNATIONAL ATOMIC ENERGY AGENCY

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INTERNATIONAL ATOMIC ENERGY AGENCY

CONTENTS

LIST OF ABBREVIATIONS

ACC	Administrative Committee on Co-ordination
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
BWR	Boiling water reactor (Boiling-water-cooled & moderated reactor)
CANDU	Canada deuterium-uranium (reactor)
CC	Convertible currency
CD-ROM	Compact disk - read only memory
CDS/ISIS	Computerized Documentation Systems/Integrated Set of Information Systems
CEC	Commission of the European Communities
DNA	Deoxyribonucleic acid
ELISA	Enzyme-linked immunosorbent assay
ENPEP	Energy and power evaluation package
ESCAP	UN Economic & Social Commission for Asia & Pacific
FAO	Food and Agriculture Organization of the United Nations
FIA	Flow injection analysis
GS/TA	General Service/Temporary Assistance
IAEA	International Atomic Energy Agency
INIS	International Nuclear Information System
IVITA	Veterinary Institute for Tropical and High Altitude Research, Peru
KAERI	Korea Atomic Energy Research Institute
KANUPP	Karachi Nuclear Power Plant, Pakistan
LAN	Local Area Network
MAED	Model for analysis of energy demand
MCA	Multi-channel analyser
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

NPP	Nuclear power plant
OSART	Operational Safety Review Team
PC	Personal computer
PET	Proton emission tomography
PIXE	Proton induced X-ray emission
PSA	Probabilistic Safety Analysis
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
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
SIDA	Swedish International Development Authority
SPECT	Single-photon-emission computerized tomography
TACF	Technical Assistance and Co-operation Fund
TC	Department of Technical Co-operation, IAEA
TCDC	Technical Co-operation among Developing Countries
TCPM	Division of Technical Co-operation Programmes, IAEA
TECDOC	Technical Document
TLD	Thermoluminescence dosimetry
TSH	Thyroid-stimulating hormone
UN	United Nations
UNCED	United Nations Conference on Environment and Development
UNDP	United Nations Development Programme
UNDP/OPS	United Nations Development Programme/Office for Projects Services
UN/DTCD	United Nations Department of Technical Co-operation for Development
UNEP	United Nations Environment Programme
UNFSTD	United Nations Fund for Science and Technology for Development
UNICEF	United Nations Children's Fund
UNPHU	Pedro Henriquez Urena National University, Dominican Republic
UV	Ultra-violet

UV-VIS	Ultra-violet to visible
WAMAP	Waste Management Advisory Programme
WASP	Wien Automatic System Planning Package
WHO	World Health Organization
WWER	Pressurized water-cooled and water-moderated power reactor

PROGRAMME 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, to give 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 standard Implementation Summaries, Tables, Figures and Annexes in a manner which facilitates comparison with prior years.

On the request of some Member States more detailed data on the provenance of the equipment purchased for the Agency's Technical Co-operation programme during the year under review are presented in a new Table, 3C.

Whereas some Member States expressed the opinion that Sections III and IV, which focus on results achieved in narrative form, could be issued as a separate document, others felt that they provide an important insight into the activities carried out and should, therefore, remain an integral part of the report. These sections were, therefore, maintained. In Section III a profile is provided on the activities carried out in the Latin America Region during the past five years. A similar profile of Latin America started this feature in the report on the Agency's Technical Co-operation Activities in 1987 (GC(XXXII)/INF/256). Section IV briefly describes the accomplishments of each project completed during 1992. 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 and 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.

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.

New resources - the total value of funds received in a calendar year not previously reported.

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, 8% assessed programme costs paid by Member States over assistance received and miscellaneous income.

Type II fellowship - fellowships provided by Member States at little or no cost to the Agency.

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

- Contributions to the TACF in convertible currencies increased by 8.6%. The part of the target expected to be met by convertible currencies rose from 80.0% in 1991 to 81.1% in 1992. **para 115**

- These increases were offset by a sharp decline in the value of contributions in major non-convertible currencies, resulting in an overall decline of the TACF target pledged from 77.2% in 1991 to 71.6% in 1992. Decreased amounts were also registered in other sources of funding: Extrabudgetary funds, UNDP and Assistance in kind, so that total resources declined from $49.1 million in 1991 to $40.3 million in 1992. **para 116 Table 2 para 16 Table 1**

- As the weight of the NCC in the TACF resources has now been reduced to 9% further fluctuations in these currencies can no longer have similar major effects in future. **para 118-120**

- The fluctuations noted in the first biennial cycle whereby the second year showed higher implementation in financial terms than the first year may not be inherent to the two year cycle as such. This pattern did not prevail in the second two year cycle: the implementation rates in the TACF in 1992 (61.9%) was below that of 1991 (67.6%). The overall implementation rate of 59.3% is within the range prevailing during the past five years (56.5 - 67.8%). **para 2, 19, 121**

- Office automation and the advantages of the two year cycle helped to cushion the effects of the budget cuts to some extent but the strain is being felt not only in quantitative delivery of the programme but particularly in the resulting limitations on intensifying field monitoring, which are essential to maintain and improve quality. It is anticipated that the availability of deferred funds will significantly alleviate the situation in 1993. **para 11**

- Notwithstanding exchange losses, strict budget and programme control succeeded in keeping the 1992 programme balanced within the financial parameters upon which it was based, both in respect of the NCC as well as the CC portion of the programme. **para 18, 118**

- A total of 1,094 projects were operational during 1992 and 231 of these were completed. A total of 2,154 persons received 3,837 months of training abroad and 2,258 expert/lecturer assignments were carried out providing 1,009 months of expertise. **para 20, 21 Figure 4 Figure 6**

- The largest share of the TC programme is now allocated to Africa: 26%, followed by Asia 25.7%, Latin America 21.4% and Middle East and Europe 20.3%. Global and interregional activities account for 6.6% of the adjusted programme. **Implementation Summary I and Section C**

- Continuing emphasis was placed on radiation protection and safety related activities which accounted for 21.9% of all TC disbursements in 1992, followed by 19.8% for Physical and Chemical Sciences and 18.3% for Food and Agriculture. **para 33-36**

- The emphasis on radiation protection and safety reflects the continuing need to ensure an adequate infrastructure for the transfer of nuclear technology. **para 33, 46, 56, 66, 78**

- In addition to implementing the 1992 programme the new programme for 1993-94 was prepared during the year under review, for which over 700 requests had to be appraised. **para 1**

- Within the Secretariat intensive preparatory discussions were initiated concerning a gradual re-direction of the TC programme towards more end user oriented projects with more visible cost benefits and towards ensuring that future programmes are more firmly in line with national development objectives. A start was made in the selection and development of future model projects to serve as bench marks in this respect. **para 4**

- In the context of the Secretariat's contacts with other organizations in the UN System emphasis is being placed on the role nuclear technology can play in environmental issues in developing countries. Additional and alternative sources of funding for possible TC projects in this area are being actively pursued. **para 14-15**

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

A. Overview

1. General Issues

(a) In-house developments

1. The year under review saw the preparation of the new 1993-1994 biennial programme. This entailed the appraisal of well over 700 project proposals. As many of these were in line with recommendations made by preparatory assistance and country review missions, 67% were included in the new programme. In addition, as the objectives of a considerable number of the remaining requests could be met through consolidation with other requests or through already approved assistance, less than 20% of the requests received could not be included in the programme.

2. Based on performance in the first two year cycle, expectations had been that programme implementation in financial terms would always be higher in a second year of such a cycle but these assumptions were not sustained in the second biennium. Partly due to external factors such as the developments in Eastern Europe which particularly affected programme delivery using suppliers in the countries involved, implementation in financial terms in 1992 did not reach the levels obtained in 1991, although it remained within the range prevailing in the last five years.

3. More important than annual fluctuations in the implementation rate in financial terms is the conclusion reached that the two year cycle has made it possible to place added emphasis on project preparation and quality. It has also stimulated several requesting countries to start moving in the direction of formulating longer-term views on the role nuclear technology can play in the various sectors of their national economies. Particularly during the last quarter of the year the TC Department itself has been actively engaged in brainstorming sessions amongst its own staff as well as with technical divisions to arrive at new concepts and strategies to determine the future direction of the programme that would guarantee its continuing relevance and increase its appeal to donors and recipients alike.

4. Work has been initiated on identifying and developing model projects which would illustrate and stimulate a gradual move towards a more end-user oriented programme with a more direct impact which would be closely in line with national and sectoral development plans. These ideas will be further worked out during 1993 and where feasible the concept will be implemented as early as possible. The helpful decision of the Board in December 1992 to hold a wide ranging policy review seminar in 1994 - as opposed to an earlier one restricted to the two year cycle - will provide an ideal opportunity to thoroughly discuss with Member States any elements of the new strategy which

may require policy decisions.

5. The rules regarding the transfer of title of equipment purchased under TC projects were amended to simplify procedures. Other rules in respect of TC procedures were redrafted. The Secretariat intends to obtain agreement of the Board for a work plan to review the totality of Financial Regulations and Rules including those of special relevance to TC.

6. Training courses for national staff in Agency TC policy and procedures and in TC project design, management and evaluation techniques were continued in 1992 with a workshop in the Philippines. In addition, liaison officers and counterparts from 22 countries received training in Agency procedures at Headquarters. The remainder of the UNDP funds made available to the TC Department in 1991 from UNDP overhead cost earned in 1990, enabled one TC area office staff to participate in the UN Workshop on technical co-operation co-ordination in the field held in Guatemala with a number of country teams of the region. Another staff member went to a similar workshop for countries of the Africa region held at the UN/ILO Training Centre in Turin. These workshops are particularly useful to the Agency since it has no field representatives of its own in developing Member States. In addition three internal workshops on co-ordination between area officers and technical officers took place in 1992.

7. The Information Systems Unit established in 1991 was closely involved in providing support for TC financial activities and reporting responsibilities. During 1992, the Unit also began the process of shifting much of the document production away from highly-specialized software products to Agency-standard tools, in which a sizeable number of staff members have experience and in which training and support are readily available.

8. User support has been provided to computer users throughout the Department on an on-call basis. Much of this involves solving specific problems. The need for this type of user support including training makes a heavy demand on the human resources of the Unit as virtually every staff member in TC is now integrated in the Local Area Network (LAN). It is nevertheless a most essential function to ensure that the potential pay-off from the investment in automation is fully realized.

9. User support also included the establishment of maintenance and repair services for electronic equipment. These services have been made possible by a cost-free expert from China. In addition to procuring diagnostic and repair equipment, an agreement was negotiated with the Seibersdorf Laboratories which enables TC to have rapid access to a large inventory of replacement electronic components.

10. With the help of a staff member from the Experts Section work was also carried out with the Fellowships and Training Section to define and document the user requirements for a LAN-based custom-developed work group system for the Fellowship programme. This project will continue through design and development phases in the coming year. In this connection state of the art software development environments were investigated leading to the high probability that this will be the first custom-developed system within TC to take full advantage of the windows environment.

11. The high degree of automation coupled with the advantages of the two year programming cycle, has made it possible to cushion to some extent the effects of the budget cuts. The forced savings, lapses and deferrals that had to be carried out undoubtedly had some influence on the quantity of assistance delivered and certainly made intense contact with Member States - a pre-condition to improving quality - more difficult. It is expected that the

situation will be alleviated when the deferred funds become available in 1993.

(b) External developments

12. The developments in Eastern Europe continued to have an impact on the TC programme. The influence these developments had on the resource situation and on programme delivery are explained in Section A2, D2 and E1. In addition, the new states in this region which became Agency Members will all become recipients of technical assistance as well. In most cases preliminary requests during 1992 could be handled through on-going projects in predecessor-states but the need for expanded assistance in this area is likely to increase. In order to avoid that accommodation of these needs would result in undue reductions of funds available for developing countries outside Europe, additional funding sources will have to be actively explored. By the end of 1992 a modest amount of such additional funds were indeed obtained from the United Nations Secretariat for Chernobyl for assistance to Belarus while an initiative taken by NENS to co-ordinate activities with UNDP's efforts in the Commonwealth of Independent States (CIS) is likely to result in UNDP co-funding for these activities in 1993.

13. Throughout the year close contact on technical co-operation matters was maintained with UNDP and with the UN System as a whole through participation in the semi-annual meetings of the Consultative Committee on Substantive Questions dealing with Operational Activities (CCSQ(OPS)). Discussions continued to be aimed at operationalizing the various elements of General Assembly resolution 44/211. The committee drafted guidelines on a number of these issues which were, after adoption by ACC, forwarded to the Resident Co-ordinators in the field on behalf of the System as a whole. IAEA, together with other technical agencies, concentrates on these occasions on ensuring that the interests and capacities of agencies without field representation are not overlooked at the field level. This is important since more and more decision making on country programmes and projects takes place at the national level.

14. In the context of these and other meetings the Secretariat has been actively pursuing the possibilities that may be offered through new funding mechanisms specifically created for environmental matters. "Agenda 21" adopted at the UNCED in Rio de Janeiro contains a vast array of recommendations to national governments and the world community to govern action for sustainable, environmentally sound development in the coming decennia. UNDP obtained pledges for separate funding to strengthen the capacity in developing countries to implement "Agenda 21". Since one of the chapters of Agenda 21 deals with the "safe and environmentally sound management of radioactive wastes" the Secretariat has initiated contacts with UNDP to explore the possibility of obtaining financing for projects in this field once the fund (named "Capacity 21") becomes operational.

15. The Secretariat has closely followed developments in and around the GEF, the Global Environment Facility set up by the World Bank, UNDP and UNEP, which has considerable funds available for projects dealing with the prevention of global warming, sustaining biodiversity, decreasing pollution of international waters and with preventing ozone depletion. In-house discussions have indicated that the Agency would be in a position to formulate projects for a number of developing Member States that would be of potential interest to the GEF. A more active stance in UN System deliberations concerning the modalities of utilization of environmental funds will therefore be pursued in 1993 with the aim to formulate concrete proposals in this respect in the Agency's field of competence.

2. Resources and Delivery

New resources	**$40.3 million**
Adjusted programme	**$59.3 million**
New obligations	**$35.2 million**
Implementation rate	**59.3%**
Disbursements	**$47.4 million**

16. Total new resources declined sharply from $49.1 million in 1991 to $40.3 million in 1992, a drop of 17.9%. As will be explained in Part E of this report, this was mainly due to the losses in the NCC component of the TACF so that the very positive development of an increase of nearly $3 million in convertible currency received in pledges for the TACF does not show in the total TACF amount. In addition, declines in all other funds which provide TC resources depressed the overall figure further: In kind contributions in 1992 were lowest since 1977 and the UNDP programme was the smallest since 1959. Due to the fact that funds from a major extrabudgetary donor in CC and all extrabudgetary contributions in NCC were not available in 1992, the amount of extrabudgetary funds received was the second lowest in the last decade. These developments are shown in Table 1. Since the relative weight of the NCC component in TC resources is now much reduced, future devaluations of these currencies will no longer affect the TC resources to the degree they did in the year under review. It is, therefore, unlikely that such pronounced resource decline will re-occur.

17. The relative weight of the various funding sources showed some fluctuation for the year being reviewed. Extrabudgetary funds dropped two percent to 12.3% of the total, in-kind now comprise 3.2% and UNDP has further declined to 1.5%. Of course the TACF is still the main funding source with 82.9%, an increase of 3.7% over 1991.

18. 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 constitutes the "adjusted programme". Events during 1992 led to a reduction in the value of the NCC portion of that programme by $9.2 million. Most of it was due to NCC devaluation and was, therefore, simply a bookkeeping exercise, as the intended project inputs could still be delivered, but at a much lower equivalent dollar value. In other cases, inputs to be financed from NCC had to be cancelled as they were no longer obtainable from previous suppliers. In addition, the CC portion of the TACF programme was very closely monitored during the year and was allowed to increase only marginally, namely by $600,000 to avoid entering the new 1993-94 programme cycle with any overprogramming. As the extrabudgetary and UNDP portions of the adjusted programme showed sharp declines, the overall total adjusted programme was $59.3 million or $8.5 million less than in 1991. It is against this $59.3 million that an implementation rate of 59.3% in financial terms was obtained in 1992.

19. 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 of 1992 is given in the 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
	(%)	(%)	(%)	(%)	(%)
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
1992	61.9	77.7	45.6	48.8	59.3

20. At the beginning of 1992 there were 1,024 operational projects. Since this was the second year of the biennial cycle no new projects were introduced through Board approvals. During the year, however, 70 additional projects were made operational. These included 42 training courses, 12 Reserve Fund projects, and 3 UNDP projects. In addition 13 footnote-a projects were upgraded to operational status with the receipt of extrabudgetary contributions. The total operational projects during the year was therefore 1,094.

21. During the year 231 projects were completed of which 37 were training courses. For the non-training course projects the achievements are described in Section IV of this report. During the year there were also four cancellations of projects, two of which were training courses.

22. At the year end there remained 860 operational projects. These ranged in size from one month of expert services valued at $9,300 to a multi-year manpower training project with a 1992 budget of $1.6 million. During the year there were 645 expert reports registered in the computerized Technical Co-operation Management System, which were communicated to the Government and counterparts. In addition, 37 country programme reviews and special technical reports were published and appear in Annex III. Another 30 reports were published by the Evaluation Section which are also listed in Annex III.

3. Evaluation

23. Despite a reduction of funds available for TC evaluation activities during 1992 efforts were made to follow as closely as possible the evaluation plan that was foreseen at the end of 1991. Special emphasis was placed on the evaluation of large-scale programmes and projects, to determine the contribution made by such endeavours towards developing national and regional capabilities for the application of nuclear science and technology. In doing so, attention was paid to the overall economic situation as poor economic conditions in many of the Agency's recipient countries tend to adversely affect the implementation and the impact of programmes and projects.

24. The Agency's Interim Project Implementation Reporting System (IPIR) continues to be the major instrument by means of which national counterparts report on the progress of their projects and on difficulties encountered. The reports, 305 in 1992, provide Agency staff with up-to-date information on project implementation, allowing corrective action to be taken to solve

reported difficulties. IPIRs also continue to be used by Agency staff to make a non-financial assessment of project implementation. For those projects for which IPIRs were returned and assessed In 1992, the ratings were as follows: On 64% of the projects progress was rated to be "as planned or better". On 28% of the projects progress was rated "as planned; but additional action is being initiated or recommended to meet difficulties that have been encountered". For the remaining 8% of the projects it was indicated that "progress is less than planned; appropriate action is being initiated or recommended."

25. A major programme evaluation of the Regional Co-operative Arrangements for the Promotion of Nuclear Science and Technology in Latin America, ARCAL, was completed in 1992. This evaluation sought primarily to determine the contribution of the ARCAL programme towards developing national/regional capabilities for the application of nuclear science and technology as a contribution to the social and economic development of participating countries and to identify new implementation approaches and directions that might offer opportunities to enhance the impact of the programme in the region. A summary of the report was submitted to the Board in December as part of GOV/INF/671. It was concluded that ARCAL has contributed to a) increasing knowledge in participating countries about nuclear techniques and technology and about the importance of radiological safety; b) developing and/or improving capabilities in the region in various applications of nuclear techniques through extensive training activities; and c) establishing collaborative links, particularly between countries with similar interests, in various fields of application, including agriculture and nuclear medicine. The review also identified problem areas and suggested steps that might be taken to overcome them. The evaluation concluded that the programme be continued, taking into consideration the recommendations included in the evaluation report.

26. A second major evaluation completed in 1992 concerned manpower development in Africa, in particular, and the regional manpower development project RAF/0/003, which was originally approved under the Agency's 1989-1990 Regular Programme. The objectives of the evaluation were to review the overall manpower situation in Africa as well as any improvements made since a 1987 review of the Agency's fellowship programme; to assess the advantages and the disadvantages for Africa of the new regional approach; to identify issues that may be affecting implementation of the project and to propose corrective measures to be taken in time for the 1993-1994 programme. The evaluation concluded that the regional approach to the allocation of funds for the fellowship programme has contributed to ensuring an equitable share of training opportunities for Africa and has brought about a significant increase in the training provided to the region. It also showed that considerable progress has been made since 1987 in reducing the time required for processing nominations for training and that efforts continue to be made to reduce this time. However, the evaluation noted that there was a need for a more equitable distribution of the training awarded among the countries within the region. In order to achieve this it was suggested to approve national manpower development projects for countries which are major recipients of training and to reserve the regional project for the smaller, less developed countries. The evaluation noted that training will need to be provided for many years to come to ensure a sufficiently broad base of national manpower in the region to carry out research, development and practical applications of atomic energy for peaceful purposes.

27. The fifth country evaluation - and the second conducted in a Latin American country - aimed at assessing the impact of the Agency's total programme of co-operation in a Member State was initiated in 1991 and completed in early 1992. Such evaluations include an in-depth examination

of the link between the Agency's assistance and the wider national development programme and thus provide guidance for the future programming of Agency assistance. The country evaluation completed in 1992 covered the Agency's technical co-operation programme with Chile from 1981 to 1991, during which period assistance valued at approximately $6.2 million was provided through 62 projects. The evaluation showed that the Agency's technical co-operation activities have, in keeping with the national priorities concerning peaceful nuclear applications, contributed substantially to the establishment of Chile's nuclear scientific and technical infrastructure, and played a major role in Chile's efforts to introduce nuclear applications in a number of sectors of the economy, with many benefits for broader national development objectives.

28. Country programme summaries (CPS) were prepared of eight Latin American and 18 African countries. These summaries, which cover both completed and on-going projects, as well as training activities, provide a comprehensive picture of the Agency's co-operation with the Member State concerned over the past ten years and have thus become a useful source of consolidated information. It is expected that such summaries will be completed for all Latin American Member States during 1993.

29. A desk review of a regional project concerned with radioimmunoassay (RIA) of thyroid hormones in Asia and the Pacific was completed in 1992. This multi-year project, which was approved in 1986, sought to reduce costs and increase the analytical reliability of RIA of thyroid-related hormones through the improved supply and, ultimately, the local preparation of reagents. The evaluation found that the project's main objectives had been achieved: costs were reduced significantly in participating laboratories by using the bulk-reagent-based methodology introduced by the project, and later by the start of the local reagent production. The analytical reliability of RIA was increased and an External Quality Assessment Scheme (EQAS) was introduced which ensures the validity of the reagents being produced. In addition, the project has contributed, through its "train-the trainers" approach, to the training of over 400 persons in the region.

30. Follow-up to the recommendations made in previous evaluation reports is an important feature of the Agency's approach to evaluation. The Agency's TC evaluation activities are fully integrated into the overall TC management system in a way that allows the information and findings produced, such as those contained in the IPIRs, to be rapidly transmitted to TC programming and implementation staff, as well as to the technical divisions and sections concerned.

31. 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 to the organization and the quality of the support material, such as texts and visual aids.

32. In conformity with the request made by TACC in 1989, the TC Department presented a projection of the major evaluation activities in 1993, the benefits expected and the priorities to be assigned. Work in 1993 is expected to include monitoring activities such as the Interim Project Implementation Reporting system, the survey of participants in the Agency's interregional and AFRA training course programme, and country programme summaries. In specific evaluation activities special emphasis will be placed on the problems of the least developed countries (LDCs); on the lessons learned from the

evaluations and surveys completed during the previous five years and on conducting desk evaluations of one to two projects in each of the four geographical regions.

B. Review by Agency Programme (Field of Activity) and Division

1. Agency Programmes

33. Safety related activities - consisting of projects in the field of Radioactive Waste Management, Radiation Protection and the Safety of Nuclear Installation - accounted for 21.9% of all TC disbursements in 1992, a share that has been slowly but steadily increasing from year to year. This emphasis is essential in order to ensure that an adequate infrastructure for the transfer of nuclear technology exist in recipient Member States.

34. As in the past Physical and Chemical Sciences and Food and Agriculture remained the most important single fields of activity in the TC programme with 19.8% and 18.3% of total disbursements respectively. The benefit of projects in food and agriculture to developing Member States need no explanation. The relevance of Physical and Chemical Sciences may seem less obvious but numerous projects are carried out under this programme which are also of immediate benefit to developing countries. It encompasses the activities related to the maintenance of nuclear instrumentation used in all sectors and is therefore of basic importance. In addition it covers all TC activities related to research reactors and the indigineous production of radiopharmaceuticals and reagents thus contributing to objectives of other projects in the field of Human Health.

35. Human Health itself ranked third in TC activities in 1992 with 14.5% of all disbursements, followed by Industry and Earth Sciences with 13%. The latter programme covers all TC activities dealing with industrial isotope applications and the development of water resources.

36. Figure 2 gives an overview of the disbursements by programme code and component. In Figure 8, a graphic presentation is given of disbursements by programme and region. For easier reference this regional distribution is no longer included in tabulated form in Figure 8, but presented below.

PROGRAMME	Inter-regional	Africa	Latin America	Asia & Pacific	Europe	Middle East	TOTAL
A. Nuclear Power	638.1	301.2	183.4	967.1	782.9	0.0	2,872.7
B. Nuclear Fuel Cycle	65.7	231.3	228.0	778.2	191.9	90.0	1,585.1
C. Radioactive Waste Management	181.5	182.2	249.8	456.2	423.9	0.0	1,493.6
D. Food and Agriculture	390.0	3,413.4	2,194.7	1,909.7	666.7	82.2	8,656.7
E. Human Health	128.6	1,704.5	2,486.4	1,703.2	751.8	118.8	6,893.3
F. Industry and Earth Sciences	47.4	827.1	2,081.4	1,757.0	1,170.3	296.8	6,180.0
G. Physical and Chemical Sciences	612.1	2,486.5	2,596.8	2,235.6	1,206.0	253.6	9,390.6
H. Radiation Protection	546.3	1,296.9	1,293.1	1,557.7	610.7	392.5	5,697.2
I. Safety of Nuclear Installations	500.8	182.6	310.0	832.8	1,380.2	0.0	3,206.4
J. Safeguards	0.0	0.0	0.0	16.9	0.0	0.0	16.9
S. Direction and Support	736.4	28.0	287.6	260.5	16.1	79.3	1,407.9
X. Comparative Assessment	0.0	0.0	0.0	0.0	19.5	0.0	19.5
TOTAL	3,846.9	10,653.7	11,911.2	12,474.9	7,220.0	1,313.2	47,419.9

2. Division

37. For the successful programming and delivery of the Agency's technical co-operation programme the active participation of Technical Officers in the Department of Research and Isotopes and the Department of Nuclear Energy and Safety is crucial. To maintain and strengthen co-operation and understanding between the TC staff and the Technical Officers, special workshops were organized late in 1992 dealing with the respective responsibilities of each of the partners in each of the stages of the TC programme cycle. It will be necessary to arrange such events at regular intervals to ensure that new technical staff are fully aware of the issues involved as well as to ensure that TC staff continues to be alerted to problems Technical Officers face in respect of TC so that these can be addressed before they would impede efficient co-operation.

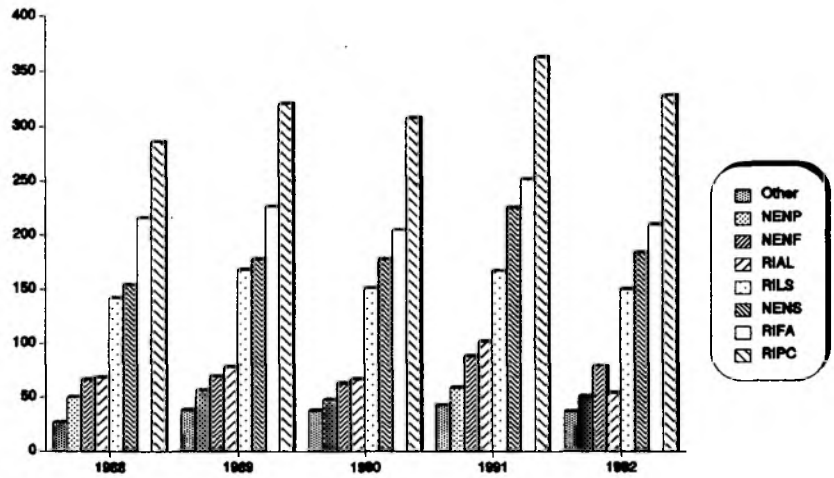
38. During 1992, 165 Technical Officers handled a total of 1,094 projects. This meant an average of 6.6 projects per Technical Officer, compared to 7.5 in the previous year. Although this is a welcome development, the average does not reveal the great differences that exist between Divisions and individual Technical Officers in this respect. In the Department of Research and Isotopes the average is 10 projects per technical officer; in the Department of Nuclear Energy and Safety 4.2. The number of projects handled by an individual technical officer may vary from 1 to 39. It should be stressed however that if a particular technical officer handles a high number of projects this does not necessarily mean that the backstopping such projects receive is less efficient. On the contrary, in such cases the TC work is often the main task of the Technical Officer. In addition some projects may be far more complex and labour intensive than others.

39. The different degrees of involvement of the various technical divisions in TC work judged by the projects they carry as a percentage of all projects, has not fluctuated very much over the years. The Division of Physical and Chemical Science has in each of the past five years carried the highest percentage of projects. The Joint FAO/IAEA Division has held second place throughout this period, followed by the Division of Nuclear Safety. The number of projects by Division fluctuate from year to year, but while these numbers have remained fairly stable in the Joint Division, they increased by 15% in five years in the Division of Physical and Chemical Sciences and by nearly 20% in the Division of Nuclear Safety over the same period.

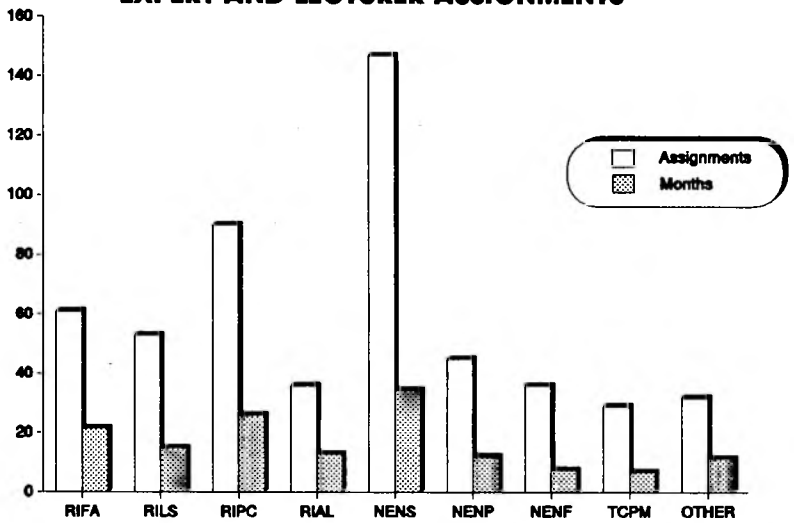
40. The tables and charts at the end of this section as well as Implementation Summary III illustrate in detail the technical co-operation involvement of the various Divisions outside the TC Department.

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	26	210	170	63	21/22
RILS	10	150	136	53	14/29
RIPC	22	329	170	90	26/08
RIAL	16	54	77	36	13/06
Sub-total	74	743	553	242	76/05
Nuclear Energy					
NENS	41	184	151	148	34/26
NENP	15	51	45	45	11/24
NENF	16	79	69	36	7/16
NESI	6	11	9	6	1/07
Sub-total	78	325	274	235	55/13
Other	13	26	27	52	16/12
Total	165	1,094	854	529	148/00

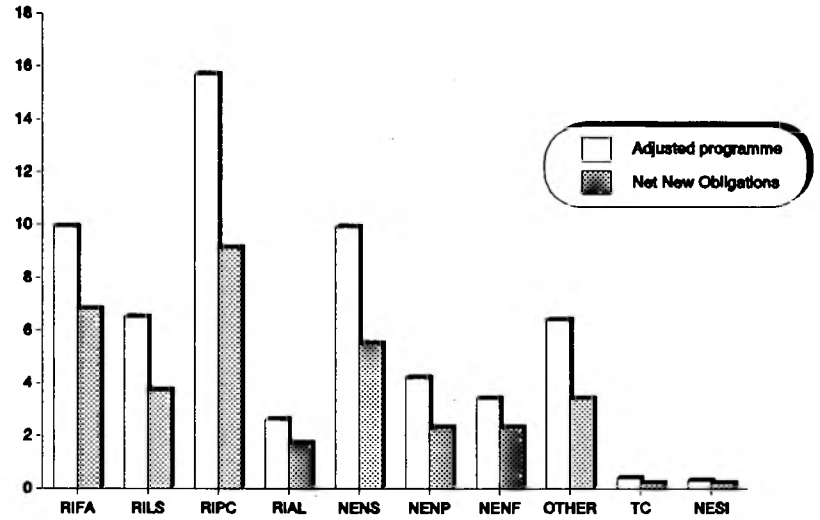
PROJECT WORKLOAD BY DIVISION: 1988 - 1992
(number of projects)



TECHNICAL SUPPORT FOR PROJECTS: 1992
EXPERT AND LECTURER ASSIGNMENTS



IMPLEMENTATION BY DIVISION: 1992
(in millions of dollars)



C. Review by Area

1. Africa

41. Africa accounts for the largest share of the Agency's technical co-operation programme, representing in 1992 26.0% of the adjusted programme when all funds are considered and 26.8% of the TACF financed programme. This emphasis is appropriate for a region where the highest number of Least Developed Countries are located, of which 13 are Member States of the Agency.

42. In line with the priorities defined and the needs expressed by the recipient countries, special emphasis continued to be placed on establishing and strengthening adequate infrastructure, so that nuclear techniques can become an integral part of the efforts being deployed by the countries concerned to resolve major issues, particularly in crucial areas, such as agriculture, public health and water resources. Most of the projects implemented during 1992 in the region were aimed at these objectives.

43. Application of radiation and isotopes in food and agriculture was, as in previous years, the major sector of assistance for country - as well as regional programmes. Projects aimed at improved livestock productivity were mainly concerned with the application of nuclear techniques to achieve a combination of better feeding, reproductive management strategies and diagnosis of endemic animal diseases. In agriculture as such, projects dealt with nuclear methods to quantify the fixation of biological nitrogen by grain legumes and trees in connection with the efforts to improve soil management, to improve crop plant variability and to investigate the fate of agrochemicals and their residues in agricultural products and the environment. The successful FAO-led campaign to eradicate the New World Screwworm (NWS) in North Africa, through the application of the sterile insect technique in Libya was supported by IAEA technical co-operation. In addition, projects aiming at applying the sterile insect technique for the control of tsetse flies were operational in five countries (Ghana, Mali, Nigeria, Uganda and Tanzania). The first phase of the "Maghrebmed" programme to determine the extent of Mediterranean fruit fly infestation in the Maghreb countries was nearing completion by the end of 1992.

44. In the public health sector, most of the Member States of the region benefitted from projects aimed at establishing and strengthening nuclear medicine and radiotherapy infrastructures. Substantial support was provided to develop local capabilities for production and quality control of radioimmunoassay reagents and radiopharmaceuticals. For the year under review, the assistance related to the health sector covered over 30 hospitals and research institutions in the region.

45. In the field of water resources development, assistance continued to be concentrated in Sahelian countries, under a regional project using isotope techniques for groundwater investigations. Several country projects were also implemented. In Senegal, activities were carried out with the objective of refining existing information on groundwater and surface water for the western part of the country. Similar activities were in progress in Sudan with a view to define and determine the extent and significance of replenishment from the Nile river of the adjacent aquifers in Central and Southern Sudan. Assistance was also provided to Mauritius in the use of environmental Isotopes to deliminate underground water basins to prevent pollution by industrial effluents

and fertilizers. Isotope techniques were also applied in Mali to study sediment accumulation in reservoirs and lakes, and to provide complementary data in connection with surface water management plans. In Niger, further support was provided to strengthen the radiocarbon analytical laboratory. Hydrological and sedimentological studies were performed with a view to collecting data for the Eastern Niger Basin, including data on the silting up of reservoirs.

46. During 1992, an important part of IAEA assistance to African countries was geared towards strengthening radiation protection infrastructure as a supportive service to nuclear technology programmes. Various activities took place in this area, through national projects in 19 countries supported by a regional project. These included the provision of assistance in the drafting of proper legislation and enforcement regulations, personnel monitoring, calibration and dosimeter processing, and environmental radiation monitoring. Follow-up RAPAT missions were undertaken to Niger, Côte d'Ivoire, Ghana and Sudan. In line with the recommendations of RAPAT missions, special attention has been given to the development of qualified manpower to sustain radiation protection infrastructure. A workshop on radiation protection and quality assurance in diagnostic radiology was organized in Zimbabwe. A training course took place in Kenya on the control and safe use of radiation sources. Regional co-operation in radiation protection in Africa was the subject of a workshop held in Tanzania. However, more efforts need to be devoted in the future, as many countries of the region still do not have an adequate radiation protection infrastructure.

47. Support for activities related to the maintenance and repair of nuclear instruments continued in many countries. Significant assistance was provided to six countries under a regional project, in the form of expert services and provision of spare parts. In the framework of this project, the Agency assisted Algeria in organizing a national training course on the maintenance of Nuclear Instruments.

48. Emphasis continued to be placed on manpower development activities. During the year under review, the Agency pursued its efforts to upgrade the skills and enhance the capabilities of the human resources of African countries within the many different fields of application of nuclear science and technology. In addition to those already mentioned in the field of radiation protection, workshops and regional training courses were organized on food irradiation (Ghana), on X-ray fluorescence (Kenya), on the use of personal computers in the analysis of animal production data (Ethiopia) and on the use of emission spectrometry in N-15 analysis (Ghana).

49. As reported in Section II A.3 a special evaluation was conducted by the Agency to review the overall situation in Africa with respect to available manpower and manpower development since 1987.

50. The AFRA programme witnessed in 1992 fundamental accomplishments which have essentially consolidated regional co-operation between AFRA Member States and increased their awareness of the benefits that can be derived from such an undertaking. Three regional training courses on waste management and radioimmunoassay techniques were hosted by Algeria, Egypt and Tunisia and attended by scientists drawn from 11 AFRA Member States. Activities under the project on food preservation were reviewed by the project co-ordinators during a meeting held in April in Tunis. Thanks to an extrabudgetary contribution made available by the Government of France, further assistance was provided under the AFRA project on radioimmunoassay techniques, which covered additional equipment, bulk reagents and training of medical doctors and technicians. The Third Technical Working Meeting of AFRA National Co-ordinators was held in Accra in April 1992 while the Second

Meeting of AFRA Representatives took place in September 1992 at the time of the General Conference. For both events, the Agency provided extensive technical and administrative support and circulated relevant working documents.

51. The Government of Namibia addressed a request to the UN Secretary General for assistance to investigate whether Namibia had been the involuntary recipient of nuclear and toxic waste from abroad. In response the Agency sent an expert in September 1992 who made an assessment of the situation based on the available information. The mission concluded that no evidence of past or present radioactive or toxic waste dumping could be found. A short- and medium-term programme of assistance to Namibia in the field of radioactive waste management was recommended.

52. Also in Namibia and as a follow-up to the recommendations made by a multidisciplinary programming mission that had visited the country in 1991, the Agency arranged for an international expert mission to carry out an independent technical appraisal of the radiological safety programme applied at the Roessing uranium mine. Five experts from the Agency, ILO and WHO, reviewed the general radiological situation at the mine and made recommendations, which included future Agency assistance in radiation protection.

2. Asia and the Pacific

53. Amongst the four geographical regions, Asia and the Pacific, with 25.7%, accounts for the second largest share of the technical co-operation programme.

54. A total of 296 projects were operational in support of country programmes, out of which 65 were closed after achievement of project objectives.

55. In terms of the broad fields of activity, 74% of the country projects operational in 1992 were concentrated in five fields, namely safety in nuclear energy, nuclear engineering and technology, application of isotopes and radiation in agriculture, application of isotopes and radiation in industry and hydrology, and application of isotopes and radiation in medicine. At the level of specific areas of activity, industrial application continued to reflect the strongest interest among the Member States of the region, followed by nuclear medicine, utilization of research reactors, and nuclear analytical techniques.

56. As far as safety in nuclear energy is concerned, assistance was provided mainly for various aspects of radiation protection and waste management. Radiation protection activities covered strengthening of infrastructure in a few Member States. Other projects in this field dealt with occupational radiation monitoring and environmental monitoring of radioactivity especially around nuclear establishments. Projects dealing with the establishment and/or operation of waste processing facilities were operational in virtually every country of the region.

57. In agriculture, thirteen Member States had at least one operational project, with ten receiving assistance in more than one specialized area. Focus of activities were soil-plant studies and improved water utilization, plant breeding and genetics, and animal production and health. In the field of industrial applications, one or more TC projects in radiation processing technology, tracer technology, and non-destructive testing were operational in all but two Member States. Major projects relating to the renovation,

relocation, and upgrading of research reactors were operational in Pakistan, the Philippines, Thailand, and Vietnam. Assistance relating to various aspects of research reactor utilization was provided to Bangladesh, Indonesia, and Thailand. In Pakistan, a major project dealing with the safe operation of KANUPP was implemented with the co-operation of the supplier Member State. Projects to facilitate the repair and maintenance of nuclear instruments were operational in half of the Member States.

58. WAMAP missions to Sri Lanka and Vietnam were fielded at the request of their respective Governments. As a follow-up to previous RAPAT and WAMAP missions, assistance was provided to support the implementation of recommendations of such missions. Thirteen projects related to RAPAT follow up, while seven others dealt with WAMAP. A follow up to the Pre-OSART mission to Guangdong Nuclear Power Plant was carried out by two Agency staff members and one outside expert. The full cost of this mission was borne by the counterpart organization. Two safety review missions to Indonesia were organized to review the work plans, schedules, procedures and documents related to quality assurance, as well as topical and technical reports relevant to different aspects of site safety, prepared by an external consulting firm for selecting and evaluating the three possible sites for the first Indonesian nuclear power plant. Similarly, fourteen expert missions were carried out in Pakistan in order to review the investigations performed by the Pakistan Atomic Energy Commission and their consultants, related to the different aspects of site safety, including seismic safety, for the 300 Mwe PWR nuclear power plant, to be constructed at Chashma.

59. Special efforts were made to improve coordination of the Agency's TC programme with that of UNDP in each of the Member States. This was accomplished through consultations with the Resident Co-ordinators of UNDP, both during their missions to Vienna and during duty travel by the section staff. During such consultations the Agency's TC programme , as well as that of UNDP and other UN Agencies were discussed at length. Distribution of project descriptions was used with considerable success to create better awareness of what the Agency could do to assist the Member States in their development plans. UNDP projects were operational in China, Indonesia and Thailand, while partial interfacing of Agency's activities with those of UNDP was achieved in Myanmar and Vietnam through complementary projects. In the Democratic People's Republic of Korea intensive efforts for joint involvement with FAO in the formulation of a UNDP project were not successful on account of co-ordination problems at the national level.

60. A country program review mission was fielded to carry out an in-depth review of the past and present TC programme of the Agency, and to assist the national authorities in Mongolia in formulating the 1993-94 programme consistent with the national development plans in those areas particularly amenable to solutions using nuclear techniques. The manpower development project for the Asia-Pacific region has been replaced by national projects in each of the Member States, allowing a sharper focus on human resource development at the country level. Group training efforts facilitated efficient and cost-effective training. Supplementary training needs of the country projects were, where appropriate, met through the regional (including RCA) and inter-regional training courses. Three workshops of TC project counterparts working in the same field, were organized in order to exchange experiences, to discuss problems encountered, and solutions found. In view of the positive impact of such workshops In promoting TCDC, these have been formally incorporated in the 1993-94 programme.

61. At the request of the national authorities of the Philippines, a "National Workshop on TC Project Design, Management, and Evaluation" was organized in Manila in February 1992. This is the third such workshop conducted in the

region, in as many years. Such workshops are of great value in improving the quality of project design, implementation, and evaluation by the Member States themselves. Moreover, they facilitate a clearer understanding of TC practices and procedures. Workshops like these plus briefing of counterparts during duty travel of section staff have resulted in a decrease of project requests that had to be rejected (from 41% in 1991-92 to 29% in the current biennium) as well as in some consolidation in the number of requests submitted.

3. Latin America

62. In Section III of this report a detailed overview is given of the technical co-operation activities of the Agency with each of the countries in the Latin American Region during the past five years. The following paragraphs therefore only provide a brief summary of some key points of relevance to the TC programme in Latin America during 1992.

63. The structural adjustment of the public sector, under way in most Latin American countries, is having an effect on the implementation of several projects. Because of budgetary constraints in organizations which are recipients of Agency technical co-operation, the turnover of counterparts is rapid, and qualified and trained staff are leaving projects. This fact, together with the limited funds locally available for infrastructure and operational support has in many cases hampered the timely implementation of projects. Nevertheless 65.9% of the total programme for Latin America in 1992 could be implemented during the year, well above the overall implementation rate.

64. In many countries a considerable effort has been made to support activities related to nuclear medicine and radiotherapy. After-loading, remote control intracavitary irradiators have been provided in 1992 to Ecuador, Guatemala and Venezuela together with training and expert services to improve the treatment of cervical cancer in these countries. To upgrade the service provided in nuclear medicine, a gamma camera has been installed in Guatemala through a project supported by extrabudgetary contributions of the United States of America. A refurbished Gamma-camera was provided to the San Juan de Dios Hospital in Santa Cruz, Bolivia, and support of the activities of the National Institute for Nuclear Medicine in La Paz, Bolivia, has been continued to enable the Institute to act as the co-ordination and training centre for nuclear medicine and radiopharmacy in the country.

65. A regional project designed to promote the exchange of information and experience in the construction and operation of nuclear power plants with the participation of Argentina, Brazil, Cuba and Mexico is particularly successful in facilitating the development of co-operation between the nuclear power programmes in the region. Assistance related to the safety of the nuclear power plants was continued in 1992.

66. National and regional projects supported radiation protection activities, mainly by assisting Member States in the establishment of radiation protection regulations and infrastructure. At present half of the Latin American Member States have already enacted relevant legislation and many others have been assisted in the preparation of draft regulations.

67. In the field of industrial applications, a regional project within the framework of the ARCAL programme has been initiated to introduce nuclear technologies such as radiation processing and nucleonic control systems into industrial processes to improve quality and decrease production costs.

68. Through national and regional projects several activities in agriculture

and animal husbandry and health have been supported. Worth mentioning in this respect, is the beginning of the establishment of a network of laboratories for diagnosing animal diseases, an essential first step to control diseases which have a detrimental effect on animal production in the region.

4. The Middle East and Europe

69. The two sub-groups of countries comprising the Middle East and Europe Region have different interests in the peaceful applications of atomic energy and the programmes in the two sub-regions reflect these dissimilar priorities. The Middle Eastern countries placed emphasis on applications of nuclear energy in agriculture, health, water resources and industry, whereas the European countries concentrated on activities in nuclear safety, in-service inspection of nuclear facilities and quality assurance. Most activities during 1992 pertained to the implementation of the second year of Technical Co-operation projects, approved for the 1991-92 cycle.

70. Food Irradiation continues to be an area of interest among the countries of both sub-regions. A training course in Budapest on the regulatory control of food irradiation was attended by 15 participants drawn from governmental authorities connected with the regulatory control of food irradiation and irradiated food transport in domestic and international trade. A regional project in food irradiation neared completion in 1992 and attained, to a large extent, its stated objectives of providing assistance in programme planning and promoting the harmonization of regulations governing food irradiation, to encourage trade in irradiated foodstuffs. A follow-up review of the programme will be undertaken in the Member States with a view for possible inclusion of further assistance in this field in the 1995-96 Technical Co-operation programme.

71. A growing interest has surfaced among the countries in the region in the use of radioisotope and radiation in industrial applications. This was reflected in several activities under national projects. The Agency provided assistance to some countries in the region towards the construction or the preparation for the construction of cyclotrons, and also in the development of industrial sterilization facilities. These activities were mainly supported under the regional project for industrial application of radiation technology. A regional workshop on industrial applications of isotopes and radiation was held for the Middle East countries in Jeddah, Saudi Arabia, where participants received training on the most important nuclear technologies in radiography, mining, analysis, oil industries, medicine and radiation sterilization of medical supplies, among others.

72. In related activities, the Agency has been supporting the development of electron beam technology in Poland, towards a cost effective and efficient method of pollution control, through the removal of toxic pollutant gases such as SO_2 and NO_x from industrial flue-gases. The new technology has shown promise as an alternative to conventional techniques from the point of view of both economics and process efficiency. A demonstration unit was put into operation in May 1992, with a gas-flow capacity of up to 20,000 m^3h^{-1}. The results looked encouraging from the point of view of the technical feasibility and economic viability of applying this new process on an industrial scale, with good prospects for being competitive with and improving upon existing SO_2/NO_x removal technologies.

73. Whereas regional projects dealing with subjects such as food irradiation and industrial applications were of equal interest to countries in both sub-regions, a number of regional projects were of particular interest to the

countries of the Middle East. These projects dealt with nitrogen fixation studies, radiopharmaceuticals, isotope hydrology and environment radiation monitoring, and radiation protection.

74. In the regional project on nitrogen fixation studies, an in-house expert was retained for six months in 1992, to give technical advice and to organize a training workshop. This ensured the proper co-ordination of planned experiments and other activities in the project. At the workshop experimental methods were taught and instruction was provided on new techniques in rainfed legume-cereal crop rotation systems and on irrigated agriculture.

75. In the TC project on Radiopharmaceuticals in the Middle East, which began in 1988, a regional workshop on quality control in hospital radiopharmacy was organized in Dubai, where participants received training geared to improving the quality control of radiopharmacy practices in hospitals. Emphasis in this regional project under which seven workshops have so far been organized has been placed on the development of local capabilities towards radiopharmaceutical production, an undertaking which is being supported through many national projects in the region.

76. Through the regional project on isotope hydrology in the Middle East region, the Agency has been promoting hydrological knowledge in the arid and semi-arid countries in the region. The emphasis in the project thus far has been on improving the capabilities of the counterparts for undertaking isotopic analysis of water and interpreting the experimental data. In addition to expert missions four regional workshops have so far been organized, during which results of on-going well-water sampling programmes in the participating countries were discussed and linked to the general hydrogeological problems in the region.

77. Under a multi-year project on environmental radiation monitoring in the Middle East, which began in 1987, a regional approach has been chosen to co-ordinate environmental monitoring in participating Member States. The project focused on the determination of radiation levels in the local environment, which become particularly relevant since the accident at Chernobyl nuclear power plant. Automatic Early Warning Environmental Radiation Monitoring Systems (EWERMS) have been established in most countries in the region. The computerized networks that have been established operate over telecommunication lines, assuring continuous remote sensing over a wide area. IAEA experts visited participating countries to review instrumentation, to assist in the planning, operation and maintenance of EWERMS, and to determine further needs and requirements to be addressed under the project.

78. A regional project for strengthening of radiation protection in the Middle East to upgrade and co-ordinate development of radiation protection infrastructure has been in operation since 1989. A training course on the regulatory practices for radiation safety took place in Abu Dhabi targeted at those countries with programmes in the use of radioactive materials and ionizing radiation in industry, medicine, research and teaching, and at countries in the process of establishing or improving national regulatory bodies and practices in radiation safety.

79. In the eastern European sub-region a very marked emphasis is placed on activities related to nuclear power plant planning, construction, operation and safety for countries with ongoing nuclear power programmes. Agency assistance focused on improving nuclear safety and reactor maintenance including in-service inspection and quality assurance, as well as radioactive waste management and spent fuel storage. This emphasis characterizes the intercountry projects in this sub-region as well as the national programmes of

the countries involved.

80. In-Service Inspection (ISI) of nuclear power plants is one of the most important tasks being undertaken. Efforts by Member States operating WWER-type reactors, are being supported through Agency technical assistance, to develop adequate national infrastructures and systems for ISI, through on-the-job training, workshops and expert services. Through an extrabudgetary contribution from Spain provided in 1991, the technical specifications and basic design of appropriate ISI equipment were defined; group training activities and provision of additional equipment for in-service inspection are planned.

81. In 1992, additional extrabudgetary funds were received from the USA to provide technical assistance to Member States within Eastern Europe, operating WWER-type reactors. Expert missions were carried out to review and advise on these aspects and to determine future requirements. As a result, it was decided to use this additional assistance for the provision of PSA related studies and software to the Czech and Slovak Federal Republic. Agency sponsored missions were sent to review the status of in-service inspection capabilities at Kozloduy in Bulgaria, and to determine the most urgent needs.

82. The enhancement of operational safety of nuclear reactors operated by Member States in the Eastern Europe region, continues to have high priority. Nuclear safety review missions under the Agency's OSART and ASSET programmes and other related activities, continued to be supported during 1992 through Technical Cooperation assistance, with a total of seven ASSET workshops and seminars, and one OSART follow-up mission to the sub-region, taking place under TC projects.

83. Several requests were received from the East European Member States with nuclear power programmes, relating to the development of an adequate nuclear regulatory and licensing infrastructure. In particular, the Bulgarian authorities requested assistance in this area for the elaboration of nuclear safety and radiation protection standards. This included evaluation of the licensing procedures for nuclear power plant operators, and upgrading of a mobile dosimetry laboratory. Bulgaria received further expert missions related to the seismic upgrading of Kozloduy nuclear power plant. An International Regulatory Review Team (IRRT), visited Romania to conduct a peer review and comparison of the nuclear safety activities of the Romanian regulatory body, the National Commission on Nuclear Activities Control. Particular attention was paid to enhancing those aspects concerned with the Cernavoda nuclear power plant, and also emphasis was placed in training and transfer of experience in licensing and regulatory activities.

84. Support continued for Romania's ambitious nuclear power programme based upon the construction of five CANDU-type reactor units at Cernavoda. Activities were carried out to strengthen nuclear safety, radiological protection, NPP commissioning, and licensing of plant and operator personnel. Workshops were held on plant operation and accident management, specific to CANDU-600 reactors. Expert missions also took place to advise on emergency response and preparedness planning. An extrabudgetary contribution from Spain of US $300,000 was made available for the provision of a training centre for Romanian nuclear power plants operator personnel.

85. The needs of East European Member States operating WWER-type reactors to define adequate spent fuel storage programmes continued to be of pressing concern during the year. Previously, spent fuel from these countries was returned to the former Soviet Union for reprocessing, but due to economic and political developments in this region, this solution for all spent fuel requirements, can no longer be guaranteed. Agency experts travelled to

Ukraine at the request of the Ukrainian State Committee on Nuclear and Radiation Safety, to review regulatory and operating organizations responsible for atomic energy and for dealing with the problems relating to radioactive waste management and spent fuel storage. Meetings and discussions were held with representatives from regulatory bodies, research institutions, nuclear utility and the radioactive waste operating organization. The mission defined suitable expert services required under future missions to the country, determined future projects, and set priorities for Technical Co-operation assistance. Bulgaria received continuing assistance to put into operation a radioactive waste treatment system through advice on performing feasibility studies on available technologies, and help in developing radioactive waste release limits. Hungary requested a Reserve Fund project in 1992, which provided expert services connected with the principles and safe storage of spent fuel. Poland received further assistance for the safety assessment of the Rozan radioactive waste depository. The construction of a radioactive waste treatment facility in Poland got underway, with the delivery of a cementation plant and additional expert services for the design of a liquid waste evaporator. A training course took place in Slovakia with 23 participants drawn from Member States in the region. The course acquainted the participants with the basic elements of integrated systems for the safe and efficient management of radioactive wastes. Proposals have been made to address at a regional level, the common problems emerging in Member States in Eastern Europe operating WWER-type nuclear reactors, concerning spent fuel storage. Romania will receive assistance in the coming year for its radioactive waste management programme in relation to the operation of Cernavoda nuclear power plant.

86. The results of the first phase of the radioactive waste management project are summarized in a report which will be published in a TECDOC series. The document will provide information on the current status of radioactive waste management at NPPs with WWER-type reactors. The report will include topics on the identification of waste management problems at NPPs with WWER reactors, regional co-operation among countries having WWER-type reactors in operation and assistance to the countries towards emulation of practices at outstanding Western NPPS.

D. Review by Component

1. Experts

87. The provision of expert services remains one of the main modalities through which transfer of technology is achieved. The weight of the expert component in the total adjusted programme increased to 27.2% in 1992.

88. The following tables provide a five year perspective on the delivery of expert services. The number of persons involved remained nearly stable compared to 1991.

Year	Adjusted programme	New obligations	Implementation rate	Earmarkings
	$ millions	$ millions	%	$ millions
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
1992	16.1	9.0	55.9	7.1

Year	Number of persons	Number of assignments	Number of months	Months per assignment
1988	1,263	2,023	1,239	0.61
1989	1,337	2,144	1,246	0.58
1990	1,414	2,221	1,217	0.55
1991	1,463	2,306	1,160	0.50
1992	1,460	2,258	1,009	0.45
Increase over five years(%)	15.6	11.6	(18.6)	

89. As can be noted, the average duration of each assignment has further declined from 0.50 to 0.45 months. This drop in duration is not due to a further decrease in the length of traditional expert missions, but to the fact that a further increase in the number of training courses employing short-term lecturers as well as in the number of workshops and co-ordination meetings where participants have to be handled under the expert component has taken place. Another statistical factor influencing the average assignment duration is that, for example, a technical officer on mission to a particular region to provide advice and backstopping, may visit five countries over a two week period in which case only two days are charged to each of five projects.

90. The work on the expert roster, started in 1991, neared completion during the year under review. Keywords have been established enabling a more specific classification of each expert with a view to obtaining more accurate roster searches. All experts are being classified according to the new keyword system and, as a final step, all experts on the roster (around 4000) are being contacted to establish whether they are still available for expert assignments.

91. As the Experts Section is now the most completely computerized section in the Division of Programme Implementation, it will be difficult to envisage further productivity gains per staff member through automation to the extent achieved over the past five years. Efficiency gains can at most be expected through further streamlining of recruitment procedures including quicker clearance procedures.

92. A total of 1,460 individuals were involved in providing expertise as international or national experts or as lecturers. Of these 490 or 34% came from developing countries in Asia, Africa and Latin America. Similarly, experts from these countries carried out 347 of the 1,370 international expert assignments (not counting assignments by Agency and other international staff) representing just over 25% of all such assignments.

93. Precise data on the nationality of all experts are provided in Table 3A. Additional information on the expert component appears in Figure 4 which summarizes where the experts provided in 1992 came from and to which region they went. Furthermore Table 6A provides a breakdown of expert

services by recipient country.

2. Equipment

94. The share of the equipment component in the adjusted programme which amounted to 43.7% in 1991 decreased to 37.7% in 1993. Equipment remained nevertheless the largest single component in the programme.

95. Whereas disbursements for equipment delivered rose during 1992, the volume of new orders placed was affected by interruption of normal activities in several countries (Yugoslavia, Iraq, Libya, Zaire, Afghanistan). In addition, difficulties in finalizing intended purchases with non-convertible currencies persisted as these currencies continued to be subject to rapid devaluation.

96. The following table provides a five year overview of key indicators for the equipment component. The drop in new obligations has not led to any additional backlog in the earmarked programme by year end. The decrease in the adjusted programme pertaining to this component - largely due to devaluation of some NCC intended for the purchase of equipment - combined with increased disbursements have indeed resulted in a smaller amount of earmarkings: the volume of equipment still to be delivered at year end decreased from 10.5 million to 8.3 million.

Year	Adjusted programme	New obligations	Implementation rate	Earmarkings	Disbursements	Number of purchase orders [a]
	$ millions	$ millions	%	$ millions	$ millions	
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
1992	22.4	14.1	63.0	8.3	21.5	3,315

[a] Including training course equipment and research contract orders

97. Satisfying improvements were achieved with regard to the feedback received from recipients confirming receipt of the equipment shipped to them. In previous years the percentage of equipment for which receipt reports were sent by the consignees hovered between 50 and 60%. In 1992 over 75% of the equipment consignments dispatched during the year were covered by confirmation of receipt-reports.

98. An important step forward in streamlining working methods in respect of equipment was made by a change in the procedures regarding the Transfer of Title of Equipment. In the past such transfer to the recipient took place after closure of the project. As projects can only be closed after all transactions - also those pertaining to non-equipment components - have been completed, transfer of title often took place long after the equipment had been delivered, requiring special correspondence by both parties concerned. Under the new procedures transfer of title is effected immediately after delivery. The new procedures have been warmly endorsed by recipient Member States; not a single country has expressed reservations to date.

99. Detailed information on equipment delivery is given in Figure 5 and in the

new Table-3C which together provide information as to where the equipment was manufactured and to which region it was shipped. Although disbursements for purchases in developing countries only account for 6.5% of total disbursements for equipment, this percentage is increasing. The value of equipment purchased in 1992 in China and in India trebled in both countries compared to the previous year.

3. Fellowships

100. The Fellowships programme continued to increase in importance. Nearly one quarter of the TACF financed programme (23.5%) and over a fifth of the total TC resources (20.3%) were programmed for fellowships in 1992, against 19.0% and 16.1% respectively in 1991. In addition most of the assistance in kind is provided in the form of fellowships.

101. The table below shows the five year trend in the delivery of fellowships. Although a few more fellows were placed in 1992 than in the previous years, the anticipated pattern of appreciably higher indicators in every second year of a two-year cycle did not materialize.

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				
1988	7.7	5.3	68.3	2.4	682	3,056	156	88
1989	9.6	6.0	62.4	3.6	732	2,713	192	129
1990	9.7	6.8	69.9	2.9	814	3,260	243	148
1991	10.9	6.6	60.6	4.3	747	2,926	203	120
1992	12.0	6.0	49.8	6.0	764	2,865	191	114
Increase over five years (%)					12	(6)	22	30

102. The fellowship component is the one component in the programme where the implementation rate in financial terms does not always fully reflect the operational implementation rate: the value of the adjusted programme in this component represents the sum total of the provisions made for the estimated number of months for fellowships and scientific visits required. The monthly costs, in turn, are estimated and based on past expenditure patterns. For 1992 they were assumed to reach $3,300 per month.

103. Through a number of concerted efforts, such as negotiations with Member States and host institutes to obtain lower training fees or a waiver of such fees, through intensifying the use of developing countries as training hosts, through group training modalities and through intensified use of Type II fellowships, the average cost per month at $2,720 was considerably below the budgeted figure. As this achievement meant that less money was used than had been budgeted it resulted in a lower implementation rate in financial terms. Fellowship provisions in 1993 will therefore be adjusted to reflect more precisely the monthly costs now prevailing.

104. A more important factor with direct impact on the Secretariat's ability to fully implement fellowship provisions is the number and timeliness of applications received. A careful analysis of past performance has established that in order to select and place the estimated 1,280 fellowships and scientific visits available in 1992, approximately 1,800 applications would have been needed in 1991. In fact only 1,083 were received, the lowest number since

1985. Less than 20% of the nominations needed had been received at the start of 1992.

105. This is particularly regrettable since during 1992 significant progress has been made in the Fellowship Section in the placement process of fellows and scientific visitors. Whereas, as recently as 1990, the average time required to place a fellow was 12-14 months, placement now requires only 8-10 months. In addition, information to nominating countries is now given more promptly.

106. Close co-ordination between Area Officers, Technical Officers and Fellowship Section staff to provide prompt and appropriate responses to training needs was maintained and intensified during the year. Full and timely utilization of training provisions will however also remain determined by early receipt of nominations.

4. Training Courses

107. The share of the training course provisions in the total programme remained stable at 11.5%. This means that together with fellowships nearly one third of the total Agency's TC programme (31.8%) was devoted to training, if the TACF alone is considered this share increases to well over one third (35.7%).

108. The following table indicates that in the training course programme as such, a decrease occurred in the number of regional and interregional courses held during the year which obviously also resulted in a lower number of participants and a lower number of months of course training provided.

Year	Adjusted programme	New obligations	Implementation rate	Earmarkings	Number of courses	Number of participants	Number of months
	$ millions	$ millions	%	$ millions			
1988	6.9	4.5	65.0	2.4	88	1,109	958
1989	8.3	5.0	60.2	3.3	106	1,265	1,090
1990	9.6	8.3	86.6	1.3	108	1,358	1,188
1991	7.5	6.1	81.6	1.4	109	1,401	1,066
1992	6.8	5.0	73.9	1.8	86	1,199	858

109. A combination of factors have led to this drop. One course that traditionally depended on extrabudgetary contributions could not be programmed when it became clear that these contributions would not be forthcoming. There were also several cases where planned courses had to be postponed or cancelled since the host countries indicated that they would not be able to provide the local facilities originally foreseen. In addition, as has been explained in last year's report, existing staff resources put a certain ceiling on the number of courses that can be handled. The fact that for budgetary reasons one long-term GS/TA staff of the relevant section could not be maintained in 1992, had to be taken into account in the scheduling of the 1992 training course programme.

110. It must be stressed that the above table only reflects interregional and regional training course events. The Training Course Section is also involved in the handling of national training courses, and national workshops. In the year under review 42 such events - against 40 in 1991 - took place.

111. Most of the regional courses continued to be implemented within the

framework of the various regional agreements, 13 under RCA (Asia and the Pacific), 14 under ARCAL (Latin America) and 3 under the AFRA programme (Africa).

112. Developing countries continued to offer most of the venues for the regional and interregional training courses. Of the 86 regional and interregional training events held in 1992, 60 were hosted by developing Member States outside Europe. Details of these events are provided in Annex II.

5. Sub-contracts and Miscellaneous

113. A small portion of the TC programme (1.9% in 1992) is not allocated to any of the traditional four components described above but is delivered through the sub-contract modality. The total amount involved ($1.2 million) was even lower than in prior years and in financial terms only 39% of these provisions were implemented during the year, as is shown in the Implementation Summaries I with corresponding figures for the TACF alone in Implementation Summary II.

114. Also shown in the Implementation Summaries is the separate category of "Miscellaneous" to which 1.4% of the programme (or $829,000) was allocated. Based on an agreement reached in 1988, the TC programme bears 28% of the budgeted costs of the Agency's Radiation Protection Services. Nearly 30% of the miscellaneous component was devoted to this purpose in 1992. The miscellaneous provisions are indispensable to cover a multitude of charges connected to the delivery of the TC programme, such as insurance premiums, mission cancellation costs, and charges by UNDP offices directly related to Agency projects. In view of resource constraints in UNDP, UNDP has been urging their field offices in countries where UN Agencies have large programmes of their own to more actively seek reimbursements for general support given and services rendered to these agencies. An increasing number of requests have been received in this respect in 1992. Where this is considered reasonable in view of the volume of the Agency's programme such costs are met from the miscellaneous component.

E. Review by Fund

1. Technical Assistance and Co-operation Fund

New resources	**$33.4 million (82.9% of total)**
Adjusted programme	**$47.5 million (80.1% of total)**
New obligations	**$29.4 million (83.5$ of total)**
Implementation rate	**61.9%**
Disbursements	**$38.6 million (81.5% of total)**

115. As shown in Table 1, overall resources for the Technical Assistance and Co-operation Fund decreased by 14% from $38.9 million in 1991 to $33.4 million in 1992. This decline is due to factors which affected the non-convertible currency portion of the resources: not only were significant exchange losses incurred in this component, but also, as a result of rapid devaluations, the value of the pledges in NCC expressed in dollars declined

sharply. As can be seen in the following table, contributions in convertible currency rose from $33.7 million in 1991 to $36.5 million in 1992, an increase of 8.6% so that in the convertible currency part of the resources pledges actually show an improvement compared to 1991 (81.1% met in 1992 against 80.0% in 1991).

CC and NCC pledging comparison
(in thousands of dollars)

Pro-gramme year	CC target	CC pledges	% of CC target	NCC target	NCC pledges	% of NCC target
1988	31,985	26,857	84.0	6,015	5,854	97.3
1989	35,352	29,275	82.8	6,648	6,458	97.1
1990	38,607	32,213	83.4	6,893	6,291	91.3
1991	42,071	33,669	80.0	6,929.	4,148	59.9
1992	45,077	36,548	81.1	7,423	1,067	14.4

116. The above table also shows how the pledging towards the NCC portion of the target, which had been stable at a high rate through 1990, suddenly dropped in 1991 and 1992 for the reasons mentioned above. This decline offset the gains in higher CC contributions, resulting in the overall decrease in the percentage of the target met through pledges from 90.7% in 1988 to 71.6% in 1992 when both types of currency are combined. This is illustrated in Table 2 which provides a ten year overview in this respect.

117. The currency exchange fluctuations which affected the resources in 1990 and 1991 were again very high in 1992. As can be seen in the following table, $7,164,000 was booked as a loss. Fortunately other income helped to make up for the loss, so that in the CC category there was an overall gain of $2.4 million. Less fortunate were the developments in the NCC category where the bottom line shows a net loss of $6.6 million.

Miscellaneous and other income
(in thousands of dollars)

Type	Convertible	Selected Non-convertible	Total
Interest and other income	2,081	0	2,081
Assessed programme costs	1,387	406	1,793
Withdrawal of pledges made in prior years	0	(915)	(915)
Exchange adjustments brought foward from prior years	971	(971)	0
Exchange losses	(2,016)	(5,148)	(7,164)
Total	2,423	(6,628)	(4,205)

118. In last year's report (see para 126 of GC(XXXVI)/INF/308) it was stated that it was the intention of the Agency to keep the programme balanced against both the CC and the NCC portion of the resources. This has indeed been achieved. As the following table illustrates, the overall programme still to be

executed at year end was fully funded in 1992 with both currency components showing a small surplus.

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
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
1992	26,460	2,609	29,069	26,217	2,273	28,490	243	336	579

119. The above table also shows the reduced weight of the NCC in overall resources as well as in the programme left on the books. Compared to end 1991 the NCC resources declined by $7.5 million, so that by end 1992 these currencies only represented 9% of the total resources against 29% a year earlier. Likewise the percentage of the programme to be implemented with NCC declined from 23% in 1991 to less than 8% in 1992.

120. Whatever future fluctuations may occur in these currencies, will as a consequence of their reduced weight, no longer have such a perceptible impact on the overall resource and programme picture. It may therefore not be necessary or even warranted to present future TC programmes divided into NCC and CC components.

121. The difficulties in implementing the NCC portion of the programme due to transitions in the major countries supplying equipment and services for NCC had a visible impact on the overall implementation rate of the TACF which reached 61.9% in 1992, just within the long-year range (from 60% to 70%) within which the implementation rate fluctuates, as illustrated below.

TACF comparative summary

Year	Adjusted programme	New obligations	Implementation rate	Earmarkings
	$	$	%	$
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	51,934,343	35,093,180	67.6	16,841,163
1992	47,522,529	29,393,068	61.9	18,129,461

122. In the past, a sizeable amount of future year obligations were made in respect of the NCC portion of the programme, involving large pieces of

equipment for which payments were spread out over several years. For reasons already mentioned, this type of transactions no longer took place in 1992 so that very few obligations were incurred against the future years' programme. A five year comparison in this respect is given in the following table.

Current and future year new obligations

Year	New obligations current year	New obligations future year	Total new obligations
1988	28,383,470	2,470,897	30,854,367
1989	28,320,331	3,102,057	31,422,388
1990	33,422,585	1,211,835	34,634,420
1991	35,093,180	3,834,615	38,927,795
1992	29,393,068	154,272	29,547,340

123. In 1992 a total of 22 projects were funded from the Reserve Fund. The combined value exceeded $695,000 utilizing about 93% of the $750,000 set aside by the Board of Governors for this purpose. The assumption that the Reserve Fund will be utilized more in the second year of the biennial cycle has proven true for both the years 1990 and 1992 as can be seen in the following table.

Reserve fund utilization

Year	No. of projects	Amount allotted	Amount approved by Board	% of Board amount allotted
1988	14	272,314	500,000	54%
1989	25	493,475	600,000	82%
1990	22	685,400	700,000	98%
1991	23	524,840	700,000	75%
1992	22	695,211	750,000	93%

124. Of the 22 projects funded by the Reserve Fund in 1992, twelve were new, and of these seven dealt with safety aspects of one kind or another. For the ten projects where supplementary assistance was granted, five also dealt with safety matters. For Namibia, which had only been able to submit its first requests for the 1993-94 programme, the Reserve Fund made it possible to already launch a project on nuclear law and radiation safety in 1992. Details of all Reserve Fund projects are given in Annex VIII.

2. Extrabudgetary Resources (including Funds in Trust)

New resources	**$ 5.0 million (12.4% of total)**
Adjusted programme	**$10.5 million (17.7% of total)**
New obligations	**$ 5.2 million (14.8% of total)**
Implementation rate	**49.1%**
Disbursements	**$ 6.4 million (13.5% of total)**

125. Affected by an overall reduction in the volume of contributions from a number of traditional large donors, extrabudgetary resources reached $5.0 million in 1992, dropping 29% when compared to the 1991 level. Included in this figure is the funds in trust category ($816,000), consisting of funds for activities in the country of the donor.

126. Most of the new extrabudgetary resources, namely $3 million, were received for footnote-a/ projects for which financing was still being sought at the beginning of 1992. With this amount, 46 projects were supported, 13 of which were made operational for the first time. As illustrated in the table below, only $1.9 million, representing mainly the continuation of previously funded projects, is allocated to the year 1992. The remaining $1.1 million was made available for projects approved in earlier years. In addition, over $780,000 was received to support ongoing technical co-operation activities in Eastern European countries.

Footnote-a/ approvals and upgrading summary

Year	Approved footnote-a/ projects	Footnote -a/ projects & components made operational	Share of footnote-a/ projects made operational
	$	$	%
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
1992	14,017,650	1,858,100	13.3

127. At year end, extrabudgetary implementation, at 49.1%, hovered around the levels reached in 1990 and 1991 of 49.5% and 51.4% respectively. This part of the programme is subject to a variety of constraints which do not apply to the TACF and which are likely to keep implementation below that of the TACF. Continuous co-operation with donors remained excellent and complemented the Secretariat's efforts to optimize the use of these resources.

128. The USA maintained its position as the largest extrabudgetary donor in 1992, followed by the United Kingdom and France. Details by donor on extrabudgetary funds for technical co-operation activities are given in Table 5. Over and above the extrabudgetary funds received, the USA offered an amount $343,950 for priority financing of fellowships connected to footnote-a/ projects supported with their 1992 contribution.

3. UNDP

New resources	**$ 0.6 million (1.5% of total)**
Adjusted programme	**$1.3 million (2.2% of total)**
New obligations	**$0.6 million (1.7% of total)**
Implementation rate	**48.8%**
Disbursements	**$1.1 million (2.3% of total)**

129. In the UNDP programme, "New resources" are equivalent to total delivery as UNDP makes available whatever the executing agency spends for a UNDP project within the approved project budget for that year. The "adjusted programme" reflects the total value of approved UNDP projects at year end. It should also be noted that the UNDP "Disbursements" figure for 1992 includes disbursements incurred against prior year obligations.

130. In accordance with UNDP procedures, budgets are rephased during the year to keep them aligned as closely as possible with the expected delivery in that year. The table below shows that the result of this exercise was again affected by the situation exposed in last year's report surrounding project ALB/87/001 "Strengthening of nuclear technical applications using a research reactor". As 27% of the 1992 UNDP provisions pertain to this project, the implementation rate in 1992 of 48.8% remained around the level attained in 1991.

131. A tripartite meeting of IAEA, UNDP and the Government of Albania took place in October. Against expectation no definite solution was reached concerning the project. The Government felt that it was not in a position to make firm commitments in respect of national inputs required in a second phase, but at the same time it did not wish to officially cancel the project. As a result both UNDP and Agency TACF resources, programmed in conjunction with the UNDP project, remain tied up.

132. The adjusted programme dropped 60% in 1992 to reach the lowest level ever recorded.

UNDP Fund comparative summary

Year	Adjusted programme	New obligations	Implementation rate	Earmarkings
	$	$	%	$
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
1992	1,270,164	620,102	48.8	650,062

133. There is some hope that a slight improvement in this situation might occur as 3 projects currently in the pipeline with total budgets of $5.2 million over 4 years stand a fair chance of being approved. Special efforts in this respect were made to secure UNDP funds for the second phase of the regional RCA project in Industrial Applications. Notwithstanding a drastic reduction in UNDP's regional resources for Asia the Secretariat was successful in obtaining approval in principle for this project, and it is anticipated that funds will be made

available in 1993.

134. During 1992, 6 UNDP financed projects were completed and 3 new ones were approved so that 18 projects were under implementation. These projects are listed in Annex VI. The IAEA co-operated as an associated agency for two UNDP financed projects executed by UNDP/OPS, one by UN/DTCD and by the Government of China.

135. Not reflected in the UNDP provisions for 1992 is an amount $112,000 which was made available by UNDP for sectoral support. In the Africa region these funds made it possible to field radiation protection missions to Côte d'Ivoire and Sudan, to support the Regional Manpower Development evaluation study in Africa and to carry out a follow-up mission to Namibia. In addition, a multi person mission to advise on a cyclotron facility in Mexico took place as well as individual advisory missions on industrial application of radioisotopes to Saudi Arabia and on a multipurpose radiation facility to Uruguay. Finally these funds enabled the Agency Laboratories to carry out sample analyses for Mozambique.

4. Assistance in kind

New resources	**$1.3 million (3.2% of total)**
Disbursements	**$1.3 million (2.7% of total)**

136. A drop was also registered in this resource category. The volume of assistance in kind totalled $1.3 million, $0.4 million less than in 1991. Assistance in kind is only recorded at year end and the resources made available equal disbursements. The concepts of "adjusted programme","new obligations", and "implementation rate" do not apply.

137. Assistance 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 for training course participants. Fellowships inputs are based on the utilization of type II resources.

138. Again the Agency's training programme benefitted the most from this kind of assistance. Eleven countries provided 265 months of fellowship training representing 60.9% of in kind resources. Moreover 181 experts and lecturers were provided cost-free or part-free by 35 countries and 3 international organizations. Stipends and travel costs were provided for 57 regional training course participants by 3 countries and 1 international organization. A five year comparison of in-kind contributions by component is given below.

In Kind contributions comparative summary

(in thousands of dollars)

Year	Experts	Equipment	Fellowships	Group Training	Total
1988	290.0	55.7	1,542.5	434.3	2,322.5
1989	313.9	18.0	1,450.6	512.1	2,294.6
1990	318.1	125.0	1,333.9	436.8	2,213.8
1991	310.5	0.0	1,115.8	275.2	1,701.5
1992	272.9	0.0	792.5	236.3	1,301.7

139. As shown in Annex 1, the USA made the largest contribution followed by France, the United Kingdom and Germany. Noteworthy under this valuable form of assistance is the participation of 21 developing Member States who provided together 19% of this resource category.

III. A PROFILE OF TECHNICAL CO-OPERATION ACTIVITIES IN LATIN AMERICA

Introduction

140. A Profile of Technical Co-operation Activities in one particular region was introduced in the 1987 report on the Agency's Technical Co-operation with an overview of the Agency's activities in the countries of the Latin America region. The profiles now presented describe the Agency's role in the development of nuclear technology in this same region during the past five years.

141. Notwithstanding persistent economic problems which in most countries have impeded advancement in nuclear technology, significant progress has been made in many countries. Infrastructures in the nuclear field have been strengthened, mainly through considerable training efforts. While differences between countries remain, skilled manpower and specialized expertise are becoming increasingly available within the region itself to meet the needs of the region. In addition, regional efforts through ARCAL have stimulated awareness of the human resources present in the region and have made the experience gained by individual countries accessible to others.

142. In many cases Agency-assisted projects have led to important findings in numerous fields, from hydrology to animal husbandry, which will form an invaluable base for socio-economic decision making for years to come.

143. Throughout the region a greater awareness of the importance of radiation protection issues has been achieved and in nearly all countries real progress towards adequate national radiation protection programmes is being made. Sixty percent of all Member States in the Region have now radiation protection legislation in place.

144. There are still vast differences between countries in respect of the status of nuclear applications. Whereas in 1990 the fourth nuclear power plant of the region went operational in Mexico, nuclear activities in other countries are still confined to research institutes and universities. Most of these differences are a logical result of the different sizes of the respective economies and of the different priorities. Nevertheless the strengthening of scientific and technological capacity in the nuclear field which has taken place during the past five years has in most countries created and enhanced the base from which to launch new activities that are directly geared to spreading the benefit of nuclear technologies beyond universities and institutes.

145. The following narratives do not purport to be comprehensive or evaluative; the most important fields of activity in the past five years and in the on-going programmes are described, together with some of the successes achieved and some of the difficulties encountered.

146. In the tables preceding the individual narratives all monetary figures are given in thousands of United States dollars. It should be noted that in the contributions tables (A) the 1992 figures for assessed programme costs have been left blank since these costs, based on precise delivery figures over the previous year, will not be assessed until May 1993 and cannot therefore be included in the current report.

ARGENTINA

A. CONTRIBUTIONS TO AND PARTICIPATION IN TECHNICAL CO-OPERATION ACTIVITIES

Year	TACF					Extra-budgetary funds	In-kind support	Experts from country	Persons trained in country
	Voluntary Contributions			Assessed Programme Costs					
	Share $	Pledged $	Paid $	Assessed $	Paid $	$	$		
1988	231.8	116.0	116.0	1.5	1.5	0.0	38.0	51	99
1989	256.2	50.0	50.0	0.4	0.4	0.0	125.7	60	51
1990	295.8	50.0	50.0	1.2	1.2	0.0	54.2	58	120
1991	318.5	200.0	200.0	16.1	13.7	0.0	64.3	48	72
1992	341.2	252.5	252.5			0.0	43.1	37	63

B. ASSISTANCE APPROVED AND PROVIDED

Year	Assistance approved from TACF				Total assistance provided from all sources					
	CC	NCC	Total	Region	TACF	TACF	Extra-budgetary	UNDP	In-kind	Total
	$	$	$	%	CC $	NCC $	$	$	$	$
1988	0.0	0.0	0.0	0.0	18.9	0.0	0.0	212.4	0.0	231.3
1989	0.0	0.0	0.0	0.0	0.0	5.2	0.0	161.9	0.0	167.1
1990	0.0	0.0	0.0	0.0	10.4	4.0	0.0	115.8	4.7	134.9
1991	282.7	0.0	282.7	3.2	201.4	0.0	0.0	23.7	2.1	227.2
1992	266.8	0.0	266.8	3.0	539.1	0.0	0.0	12.5	0.0	551.6

147. After almost a decade without Agency-funded assistance, in 1990 Argentina requested the Agency to support new projects. During the five years covered by this report (1988-92), Argentina did, however, participate in training course programmes. The Agency also executed a project, funded by the UNDP, which helped consolidate the R&D activities of the nuclear engineering programme at the Bariloche Atomic Centre of the National Atomic Energy Commission (NEAC) and the Balseiro Institute of the Cuyo National University. Consequently, various groups involved with the national nuclear engineering programme and studies conducted with a research reactor, as well as other nuclear research facilities, have become self-sufficient.

148. During the period reviewed, eight Agency-funded projects in the areas of nuclear engineering and technology, agriculture, nuclear applications in industry and hydrology, and nuclear safety were approved. In all cases the CNEA was the recipient institution. Four of the projects relate to aspects of the nuclear fuel cycle. One is helping to establish criteria on the environmental impact of wastes derived from uranium mining and milling operations in deposits closed down or in operation. The main sites being studied are Malargue and San Rafael. Several Argentine scientists have paid visits under this project to Australia, Canada and Spain in order to become familiar with similar operations there. Two projects dealt with continuous inspection of pressure vessels to ensure their safety and with the effects of mechanical, metallurgical and environmental variables on the behaviour of components in the primary circuit of pressurized heavy-water reactors. Several Agency experts have assisted the CNEA on specific subjects related to both topics, and numerous scientific visits were awarded to specialized institutions in industrialized countries. Training of professionals responsible for evaluating safety developments and the use of computer codes associated with probabilistic safety analysis (PSA) is under way through a fourth project. In the coming months a PSA will be concluded for the Atucha Nuclear Power Plant. For these four projects, very little equipment has been supplied, although a considerable amount of expert services and individual training was received.

Fifteen reactor operators received training in operational procedures in a Canadian simulator.

149. In the area of agriculture, assistance is being provided in the development of a radioimmunoassay test for the diagnosis of brucellosis in sheep and goat. It is hoped that all components of the test will soon be developed so that it can be standardized and validated.

150. At the Ezeiza Nuclear Centre of the NEAC, a cyclotron will be installed, with Agency assistance, in the near future. The Agency is also supporting the utilization of cyclotron-produced radioisotopes at a PET facility at the Nuclear Medicine School, Mendoza, where an additional "baby" cyclotron will be located. Expert advice is also being given to help determine the appropriate infrastructure for the cyclotron and the use of its products.

151. Utilization of TANDAR, an electrostatic tandem accelerator located at the Constituyentes Nuclear Centre, is being increased through assistance in R&D in the areas of materials sciences and radiobiological studies. The machine is capable of accelerating a wide range of atomic nuclei and is the only one in Latin America. Several expert missions assisted in the selection of an electron accelerator for industrial applications and advised on the use of irradiation for industrial processes.

152. Argentina usually provides the largest number of experts and lecturers to the Agency from Latin America as well as hosting many individual fellowships and group training events. Transfer of technology from Argentina to other countries through expert services and training is especially important in the area of radiation protection. By end of 1992, Argentina was actively participating in 45 Agency research contracts.

153. It is expected that future Agency assistance will continue to focus on nuclear engineering and technology and on some selected topics of nuclear applications where complementary technologies are needed.

BOLIVIA

A. CONTRIBUTIONS TO AND PARTICIPATION IN TECHNICAL CO-OPERATION ACTIVITIES

Year	TACF					Extra-budgetary funds	In-kind support	Experts from country	Persons trained in country
	Voluntary Contributions			Assessed Programme Costs					
	Share $	Pledged $	Paid $	Assessed $	Paid $	$	$		
1988	3.8	0.0	0.0	12.6	0.0	0.0	0.0	5	0
1989	4.2	0.0	0.0	11.7	0.0	0.0	2.0	4	0
1990	4.6	0.0	0.0	41.0	0.0	0.0	0.0	10	0
1991	4.9	0.0	0.0	17.9	0.0	0.0	3.8	5	18
1992	5.2	0.0	0.0			0.0	0.6	7	0

B. ASSISTANCE APPROVED AND PROVIDED

Year	Assistance approved from TACF				Total assistance provided from all sources					
	CC	NCC	Total	Region	TACF	TACF	Extra-budgetary	UNDP	In-kind	Total
	$	$	$	%	CC $	NCC $	$	$	$	$
1988	107.3	15.0	122.3	2.3	57.4	11.2	89.2	0.0	12.1	169.9
1989	247.0	15.0	262.0	4.2	93.3	4.7	48.6	0.0	1.4	148.0
1990	365.7	15.0	380.7	4.5	396.2	37.8	78.3	0.0	0.4	512.7
1991	201.1	0.0	201.1	2.3	233.2	3.6	-12.7	0.0	0.0	224.1
1992	244.7	0.0	244.7	2.8	309.9	0.0	92.9	0.0	0.0	402.8

154. The difficulties observed at the end of the previous five-year period, ending 1987, have continued to hamper the development of the Agency's technical co-operation programme with Bolivia during the five years covered by this report. The turnover of staff at the Bolivian Institute for Nuclear Science and Technology (IBTEN) has been continuous owing to the low budget of the Institute, and this has led to the loss of trained personnel from IBTEN to better paid opportunities elsewhere. Moreover, economic constraints caused a serious deterioration in the infrastructure of the IBTEN laboratories. Consequently, many of them are at present inactive or underutilized.

155. Agency assistance to IBTEN during the period under review has allowed the expansion of research and analytical capability in the application of X-ray fluorescence and nuclear activation analysis techniques and to the establishment of a laboratory for maintenance of nuclear electronics equipment.

156. As continuation of previous projects, radiation safety in practices involving the use of ionizing radiation was improved through the introduction and establishment of adequate radiation protection procedures, through strengthening the technical capability and through provision of radiation monitoring and calibration equipment. An operational personnel dosimetry service was set up to monitor occupational radiation exposure, using thermoluminescence dosimetry equipment. Up-to-date radiation protection regulations for promulgation by the national authorities were prepared and inspection capability for radiation safety purposes was attained.

157. In the field of agriculture, an IBTEN laboratory was upgraded to increase crop yields by the application of nuclear techniques. However, the expected co-operation between IBTEN, the Ministry of Agriculture and the Agronomy Faculties at Cochabamba and Oruro has not been fully implemented owing to economic difficulties.

158. More lasting results have been obtained through the Agency's assistance to the National Institute of Nuclear Medicine (INAMEN). The Institute's infrastructure was upgraded by the provision of a new gamma camera and complementary equipment and by establishing a maintenance and repair capability for nuclear medicine equipment. As a result, diagnostic services for low-income patients have been considerably improved and INAMEN is being used as a nationwide teaching and training institution for advanced medical students. A project to improve the radioimmunoassay (RIA) programme at INAMEN made it possible to establish an RIA network with the participation of hospitals at La Paz, Sucre, Cochabamba and Santa Cruz. INAMEN's RIA laboratory has become the focal point for training and technology transfer through the co-ordination, production and distribution of reagents at the national level.

159. For the above reasons the Agency's technical co-operation with Bolivia will in the next few years be focussed on strengthening the radiotherapy and

nuclear medicine services in several cities and on upgrading the radiation protection infrastructure by means of new and current projects.

BRAZIL

A. CONTRIBUTIONS TO AND PARTICIPATION IN TECHNICAL CO-OPERATION ACTIVITIES

Year	TACF					Extra-budgetary funds	In-kind support	Experts from country	Persons trained in country
	Voluntary Contributions			Assessed Programme Costs					
	Share $	Pledged $	Paid $	Assessed $	Paid $	$	$		
1988	524.4	262.0	262.0	86.1	86.1	0.0	58.0	33	85
1989	579.6	265.0	265.0	81.0	81.0	0.0	72.1	39	98
1990	650.7	265.0	175.9	97.7	0.0	0.0	39.6	47	109
1991	700.7	250.0	0.0	73.8	0.0	0.0	17.7	43	87
1992	750.7	265.0	0.0			0.0	25.0	41	126

B. ASSISTANCE APPROVED AND PROVIDED

Year	Assistance approved from TACF				Total assistance provided from all sources					
	CC	NCC	Total	Region	TACF	TACF	Extra-budgetary	UNDP	In-kind	Total
	$	$	$	%	CC $	NCC $	$	$	$	$
1988	480.8	0.0	480.8	9.2	602.4	8.7	464.7	0.0	20.9	1,096.7
1989	411.4	0.0	411.4	6.5	487.1	12.3	512.4	0.0	84.7	1,096.5
1990	483.8	0.0	483.8	5.8	628.7	0.0	592.7	0.0	7.7	1,229.1
1991	481.6	0.0	481.6	5.4	337.6	0.0	584.2	14.5	14.9	951.2
1992	488.7	0.0	488.7	5.5	549.0	0.0	147.1	0.0	19.6	715.7

160. During the five years under review, the Agency's technical co-operation programme with Brazil has continued to be the largest in Latin America, and assistance has focussed on activities related to the national nuclear power programme, radiological protection, safety and agriculture. New projects that are now being implemented or have been completed during this period aimed to strengthen these areas and to support the application of nuclear techniques in other activities.

161. In support of the national nuclear power programme, projects were undertaken on safety analysis, licensing and surveillance of nuclear facilities, emergency dose assessment, emergency planning and preparedness, and regulatory matters. Extensive training was provided by experts and by awards of fellowships, scientific visits and training courses to the staff at the National Nuclear Energy Commission (CNEN) and to FURNAS, the nuclear power plant operator. Expert advice has contributed significantly to increasing the capability and operational efficiency of ANGRA 1. An OSART mission was undertaken in 1989 to review the operating practices at ANGRA 1 and carry out an exchange of experience to improve the plant's operational safety. A follow-up OSART visit took place in 1992. Two ASSET activities were also undertaken in 1992 to review safety performance and provide training and advice on safety provisions.

162. In the area of radiological protection, large-scale assistance has been given to CNEN institutes: primarily to the Institute for Radiation Protection and Dosimetry (IRD), which is the national reference institute for such matters and, to a lesser degree, to the Institute for Nuclear Energy and Research (IPEN) and the Centre for the Development of Nuclear Technology (CDTN). Assistance has continued to be provided to develop a general programme to establish the

IRD as an accident diagnostic and training site and to enable it to provide advice and support to all institutions using nuclear techniques and to users of ionizing radiation. During the last five years, current or completed projects included infrastructure, a secondary standards dosimetry laboratory, dosimetry, occupational activities and low-level gamma spectrometry. Agency services provided in the aftermath of the Goiania Accident continued with an extrabudgetary contribution from Germany which made it possible to field expert missions to review national plans for surveillance of radiation protection practices in medical installations. As a result of these activities, significant advances were made in establishing an inventory and control system of radiation sources used in medicine, and in providing advice and training for staff at regional centres. A project was also supported to study the medical and environmental aspects of the Goiania accident, including evaluation of caesium-137 dispersion and the development of models.

163. Agency assistance over a long period has made the Centre for Nuclear Energy in Agriculture (CENA) one of the best tropical agriculture research centres in the world. During the five years under review, Agency assistance was provided on mutation breeding for tropical and subtropical crops, animal sciences, soil fertility, primary production and the nitrogen cycle. Activities on the hydrological cycle were funded during this period by a contribution from the Swedish Agency for Research Co-operation with Developing Countries (SAREC).

164. From 1991, projects have been funded to improve IPEN's capability to produce radioisotopes with a cyclotron, to establish a laboratory for routine production of doped silicon, to set up the basic structure for production of molybdenum-99, and to produce (together with the Butanta Institute), snake venom attenuated by gamma irradiation for immunization of animals. Projects on waste management were initiated at IPEN and CDTN, and on pesticides at the Instituto Biologico of São Paulo.

165. Institutes in Brazil have become first-class training centres not only for personnel from the Latin America region but also from other regions. Many people have been trained at the IRD, IPEN, CDTN, CENA and at hospitals in Rio de Janeiro and São Paulo. Brazil has also provided experts and lecturers on topics such as radiological protection, agriculture, radioimmunoassay and waste management. As an example of co-operation between developing countries, the IRD is establishing a whole-body counting facility in Cuba, under an Agency TC project.

CHILE

A. CONTRIBUTIONS TO AND PARTICIPATION IN TECHNICAL CO-OPERATION ACTIVITIES

Year	TACF					Extra-budgetary funds	In-kind support	Experts from country	Persons trained in country
	Voluntary Contributions			Assessed Programme Costs					
	Share $	Pledged $	Paid $	Assessed $	Paid $	$	$		
1988	26.6	26.6	26.6	19.1	19.1	30.0	41.0	12	50
1989	29.4	29.4	29.4	60.6	60.6	11.2	13.3	14	57
1990	36.4	36.4	35.3	52.9	52.9	6.0	9.3	22	21
1991	39.2	39.2	39.2	38.2	0.0	69.0	24.2	18	45
1992	42.0	42.0	0.5			142.3	3.5	18	70

B. ASSISTANCE APPROVED AND PROVIDED

Year	Assistance approved from TACF				Total assistance provided from all sources					
	CC	NCC	Total	Region	TACF	TACF	Extra-budgetary	UNDP	In-kind	Total
	$	$	$	%	CC $	NCC $	$	$	$	$
1988	400.9	7.0	407.9	7.8	238.3	0.0	2.6	0.0	22.3	263.2
1989	385.6	47.0	432.6	6.9	732.4	24.5	20.4	0.0	16.4	793.7
1990	521.9	5.0	526.9	6.3	653.0	7.7	0.0	0.0	6.8	667.5
1991	432.8	0.0	432.8	4.9	462.8	15.1	0.0	0.0	9.2	487.1
1992	418.0	0.0	418.0	4.7	772.4	0.0	93.1	0.0	0.0	865.5

166. During the past five years, the scope of the Agency's technical co-operation with Chile has remained as wide as before, and only slight changes of emphasis are noticeable. Although a large proportion of approved projects has involved the Chilean Nuclear Energy Commission (CChEN), the benefits have been extended to other institutions through training, co-operative efforts and services. CChEN still sets priorities and ensures efficient co-ordination. Nuclear analytical techniques are now available for practical applications, in addition to neutron diffraction facilities at the 5 MW research reactor and Moessbauer spectroscopy techniques as tools for the solution of basic problems in solid state physics, chemistry and metallurgy.

167. One important result of prospecting activities for nuclear raw materials in Chile was the discovery, through the application of radiometric techniques during an Agency-assisted project, of a phosphate deposit which is now being exploited by a private enterprise on a commercial basis. Facilities for solvent extraction and ion exchange studies were set up at the Lo Aguirre Nuclear Centre, and staff were trained in these procedures. The facilities were used: to purify raw uranium from the Chuquicamata Pilot Plant and determine the uranium content of the copper-leach solutions, to produce yellow cake with laboratory scale nuclear purity and controlled precipitation of yellow cake, and to obtain concentrate with suitable granulometry for the production of pellets. A reliable technique was established to analyse the uranium content in geological samples and to set up a facility to measure trace impurities in nuclear grade uranium compounds.

168. In the field of nuclear engineering and technology, projects were set up for computer services and nuclear electronics instrumentation which were essential to the establishment of a nuclear instrumentation maintenance and repair service and to enable some technical personnel at the CChEN to specialize in microprocessors. Further training was provided in fuel fabrication techniques, an important activity for the CChEN, since present projections indicate that new fuel elements will be needed by 1996. The repair of fuel elements consisting of the whole core at the Lo Aguirre research reactor has been satisfactorily completed, and work on a burnup determination facility is proceeding. The laboratory for corrosion studies has been able to prescribe water chemistry specifications for half the corrosion experienced in some structural parts of the La Reina reactor facility. The Agency also assisted in the approach to criticality of the La Reina reactor with medium enriched uranium fuel. Routine reactivity measurements, as required by the operating procedures, have since been performed. The facility has also served educational purposes exemplified by its use in an ARCAL V course on research reactor parameter determination.

169. Significant developments were made in the application of nuclear techniques in agriculture. In soil fertility and plant nutrition, Agency assistance contributed to incorporating nuclear techniques using phosphorus-32 into soil-plant-fertilizer relationship studies. Quantitative information was obtained on

phosphate retention by volcanic soils and on the relative availability of several phosphorus sources. The use of phosphorus-32 and nitrogen-15 based techniques was instrumental in implementing recommendations on fertilizer placement to wheat and various fruit trees. In animal production, Agency assistance contributed to setting up laboratory facilities at the Southern University of Chile, Valdivia, and to training staff in the use of radioimmunoassay methods to determine the causes of reproductive failure in dairy cattle and to study the reproductive behaviour of vicuñas in captivity. The training facilities are being used not only by undergraduate and postgraduate veterinarian students, regional training course participants, and Agency fellows, but also by private veterinarian and dairy co-operatives. The laboratory also provides services to individual farmers and to the Ministry of Agriculture's extension service.

170. In the area of nuclear medicine, all the counterpart institutions have, or will have, a modern SPECT system, access to reliable, high quality radiopharmaceuticals, and well trained staff. At the Institute of Neurosurgery, Santiago, clinical studies of the brain, kidney and vascular system are being carried out, including good quality SPECT studies of the brain and other organs. The J.J. Aguirre Hospital now has a programme of computer-aided gamma camera quality control, which ensures optimum performance of existing equipment. The CChEN group is reproducing a number of newly developed radiopharmaceuticals released by commercial companies. The local product is of equal quality or better than what is commercially distributed.

171. In the field of hydrology, the Agency transferred the technology for the study of seepage in lakes and reservoirs, using tracer and conventional techniques, to the National Electricity Company and the CChEN. As a result, much has been learnt about leaks in the El Colorado dike and seepage in Lake Laja. Radioactive tracer techniques are also being used to determine operational plant parameters and for experimental data processing in mining and industry, as well as to optimize ore concentration processes. In the mining industry, the flow of water or leaching solutions through porous media has been studied in order to optimize in-situ lixiviation work for recovering copper from copper dumps at the Chuquicamata mine. Radioactive tracer techniques were also used to measure the dispersion of liquid waste in the sea. As a side effect, and taking advantage of the knowledge obtained during the evaluation of environmental impact and marine contamination studies, Chilean legislation on this subject was improved.

172. Agency assistance in regulatory assessment of safety analysis reports resulted in the establishment of a small group of well trained staff.

173. A telemetered seismographic network was established to help in the study of the Chilean seismology and to facilitate access to other financial sources and to promote scientific exchange with other earthquake-stricken countries.

174. A Radioactive Waste Management Unit has been established within the Division of Nuclear Safety and Radiation Protection at La Reina Nuclear Centre. Effluents from the research work on uranium hydrometallurgy had been stored in an ad-hoc facility and will now be neutralized in another installation built for that purpose. In addition, a facility for waste treatment is being built at Lo Aguirre. Through the Agency's assistance, the Radiation Medicine Service of La Reina Nuclear Centre has developed the capability to assay and evaluate cases of internal contamination with alpha, beta and gamma emitters. An environmental radiation measurements programme at the CChEN provides data for the scientific evaluation of local and global patterns of radiation contamination, including foodstuffs and potential local sources of

contamination such as hot springs and mine tailings. A national policy, written regulations and the administrative organization to control radiation exposure were developed and a national emergency plan for radiation accidents established.

175. Agency assistance enabled the CChEN to produce two types of radon detectors: activated charcoal detectors and nuclear track detectors. These are being used in a programme to evaluate radon levels in buildings throughout the country. The CChEN is now providing nationwide dosimetry services to radiation workers. With Agency assistance, the technology of thermoluminescence dosimetry-based personal dosimetry was reviewed and refined, and the level of the services provided has improved significantly.

176. It is expected that a concentration of activities on some large-scale projects with high impact will further improve Chile's already excellent record of technical co-operation during the next five-year period.

COLOMBIA

A. CONTRIBUTIONS TO AND PARTICIPATION IN TECHNICAL CO-OPERATION ACTIVITIES

Year	TACF					Extra-budgetary funds	In-kind support	Experts from country	Persons trained in country
	Voluntary Contributions			Assessed Programme Costs					
	Share $	Pledged $	Paid $	Assessed $	Paid $	$	$		
1988	49.4	0.0	0.0	24.9	24.9	0.0	57.0	6	34
1989	54.6	49.4	49.4	45.1	45.1	3.3	6.8	6	21
1990	63.7	50.0	50.0	51.7	51.7	10.0	0.0	13	23
1991	68.6	55.0	55.0	34.1	0.0	60.0	4.3	9	10
1992	73.5	50.0	0.0			142.0	1.0	7	36

B. ASSISTANCE APPROVED AND PROVIDED

Year	Assistance approved from TACF				Total assistance provided from all sources					
	CC	NCC	Total	Region	TACF	TACF	Extra-budgetary	UNDP	In-kind	Total
	$	$	$	%	CC $	NCC $	$	$	$	$
1988	323.9	10.0	333.9	6.4	311.5	0.0	0.0	0.0	28.2	339.7
1989	263.3	10.0	273.3	4.3	378.9	19.5	167.5	0.0	27.9	593.8
1990	453.2	65.0	518.2	6.2	398.9	34.3	212.6	0.0	35.0	680.8
1991	365.1	0.0	365.1	4.1	423.2	2.6	28.8	0.0	0.0	454.6
1992	414.2	0.0	414.2	4.7	411.7	0.0	145.1	0.0	3.0	559.8

177. While the Agency's very extensive technical co-operation programme with Colombia has been maintained during the past five years, the emphasis has been moved to projects of a more practical nature, and this will be reflected in the 1993-94 Programme. Major projects were implemented in the fields of agriculture, research reactor modernization, nuclear analytical techniques, nuclear instrumentation, dosimetry, radiopharmaceuticals, radioimmunoassay (RIA) training and the construction of an irradiation facility.

178. The Institute of Nuclear Affairs (IAN) in Santa Fé de Bogotá continued to be the channel for the Agency's technical co-operation in Colombia, but efforts have been made to involve (or at least to associate) other research institutions more directly in the implementation of the programmes. This applies particularly to agricultural projects with which the Colombian Institute for Agriculture and Livestock (ICA), together with the National University of

Colombia, was either associated or directly put in charge of projects, with technical support from IAN. A soil science project helped to strengthen analytic capabilities and to extend soil fertility studies using phosphorus-32 and nitrogen-15 and contributed to the improvement of fertilizer use. A promising co-operation with ICA and the University was gradually established for projects on mutation breeding, where considerable progress was achieved in obtaining new varieties of sorghum, barley and wheat, with some major results expected in rice breeding in the next two years. The three institutions also co-operated in a current project on the use of RIA techniques in animal reproduction to improve the reproductive efficiency of cattle. A project on livestock disease diagnosis, concentrating on brucellosis, is being implemented entirely by the ICA. This exemplifies the trend towards a more practical approach to technical co-operation, which should lead to a transfer of well tested nuclear techniques from the IAN to other research institutions with more facilities for direct application of the results, such as experimental farms.

179. Major hydrological achievements were made possible through the Isotope Hydrology Laboratory which was set up with Agency assistance. Studies focussed on the Magdalena River, Colombia's most important river transport system. Using both environmental and artificial tracers, significant data were obtained on river sediments and contamination, so that harbour planning can now be modified to reduce the high cost of dredging involved in keeping the ports navigable. A follow-up project will deal with dredging problems in the major ports of Baranquilla and Buenaventura, with the full co-operation of other institutions including the Ministry of Public Works Directorate for Ports. Groundwater resources in different regions are being studied and some valuable results are expected on the availability of water resources in the Tunja area.

180. The IAN's analytical capability was strengthened by two projects on neutron activation analysis as a result of which ore samples, pastures and foodstuffs are now being analysed on a routine basis. These capabilities will be further improved when the reactor modernization and core conversion projects are completed.

181. With major extrabudgetary contributions from the USA, key projects have assisted the modernization of IAN's 30 kW research reactor, upgrading its control and operation systems and improving the safety installations. A core conversion to lower enriched fuel is planned for 1993-94 and a power increase will be aimed at during the following years. Reactor modernization and upgrading projects have provided Colombia with a major up-to-date research tool while also increasing awareness of nuclear safety and radiation protection problems. This increased sensitivity to safety caused a delay in establishing a higher capacity gamma facility for radiation sterilization of medical products and for studies of food irradiation processing. All necessary additional safety measures having been taken, the 100 kCi cobalt-60 facility was ordered and is expected to start operation in 1993.

182. Radiation protection projects had previously been limited to environmental radioactivity measurements and control of internal contamination and to protection measures around the reactor. However, increased safety awareness has led to a more comprehensive project which will include nuclear legislation at the national level and the appropriate regulations. A secondary standards dosimetry laboratory was also established at the IAN, which is now handling the full range of calibrations needed in Colombia, from individual therapy to radiation protection and environmental measurements. A quality assurance programme has been initiated which is being pursued under a current project.

183. National training programmes in RIA were set up and further expanded,

and the Universidad del Valle at Cali made considerable progress in the development of DNA probes for the diagnosis of malaria. As a result of several projects intended to produce radiopharmaceutical kits, a well equipped laboratory for production of technetium-99m labelled radiopharmaceuticals was set up, with adequate quality control, enabling the IAN to provide products and services to all nuclear medicine centres in the country.

184. Although considerable progress was made in most of the fields assisted by the Agency, some less successful projects in nuclear instrumentation (where IAN still lacks an appropriate maintenance and repair service) and in hydrology (where little progress was achieved in solving water problems on the island of San Andrés) indicate that there is still room for improvement. Concentration on some major projects with greater impact and continuation of the internal reorganization at the IAN are most likely to improve the situation.

COSTA RICA

A. CONTRIBUTIONS TO AND PARTICIPATION IN TECHNICAL CO-OPERATION ACTIVITIES

Year	TACF					Extra-budgetary funds	In-kind support	Experts from country	Persons trained in country
	Voluntary Contributions			Assessed Programme Costs					
	Share $	Pledged $	Paid $	Assessed $	Paid $	$	$		
1988	7.6	0.0	0.0	4.5	0.0	0.0	0.0	2	10
1989	8.4	0.0	0.0	10.5	0.0	0.0	0.0	5	25
1990	9.1	0.0	0.0	9.2	0.0	0.0	0.0	6	1
1991	9.8	0.0	0.0	20.2	0.0	0.0	0.0	6	0
1992	10.5	0.0	0.0			0.0	0.0	4	1

B. ASSISTANCE APPROVED AND PROVIDED

Year	Assistance approved from TACF				Total assistance provided from all sources					
	CC	NCC	Total	Region	TACF	TACF	Extra-budgetary	UNDP	In-kind	Total
	$	$	$	%	CC $	NCC $	$	$	$	$
1988	104.5	0.0	104.5	2.0	48.6	7.0	0.0	17.1	4.8	77.5
1989	61.5	0.0	61.5	1.0	122.0	9.4	0.0	0.0	3.1	134.5
1990	81.4	0.0	81.4	1.0	95.4	19.0	0.0	0.0	0.0	114.4
1991	280.7	0.0	280.7	3.2	181.5	0.0	71.3	0.0	0.0	252.8
1992	242.2	0.0	242.2	2.7	221.9	0.0	22.3	0.0	0.0	244.2

185. In the previously reported five-year period, the Costa Rican technical co-operation programme was limited to nuclear physics and prospecting for nuclear materials. During the five years reviewed here, the programme has been extended to include agriculture (animal sciences and mutation breeding), hydrology, the exploration of geothermal resources, and broadening the use of nuclear analytical techniques. A project on radiation protection was also prepared. The improved planning that followed a reorganization of the small Atomic Energy Commission (AEC) and better overall co-ordination at the implementation stage - both with the AEC and between counterpart organizations - are likely to further increase the future impact of the programme.

186. While the exploration of possible energy resources other than nuclear lies outside the Agency's competence, a project on the exploration of geothermal resources around the Miravalles volcano was pursued by reinjection and radiotracer-aided studies and demonstrated an interaction

between the various geothermal wells. Exploitation of the geothermal resources of Mount Miravalles and adjoining volcanic areas looks possible and could ultimately contribute to meeting the country's growing demand for energy.

187. A major hydrology project was initiated in 1991 and will continue into the next programming period; it is expected to counteract the excessive exploitation of groundwater resources, the lack of sewers and the infiltration of agricultural fertilizer residues. Encouraging results are reported from the Barranca aquifer, demonstrating a much smaller saline intrusion into groundwater than originally expected.

188. Agricultural programmes included projects in animal sciences and mutation breeding at the National University at Heredia, near San José, and a fruitfly eradication project at the University of Costa Rica's School of Biology. In animal sciences, a completed project provided considerable insight into the Zebu cattle's reproductive physiology, behaviour and production; another current project aims at the diagnosis of livestock diseases such as brucellosis and babesiosis through application of the ELISA technique. A project on fruitfly eradication started in 1987 as a joint effort with the European Community and the Ministry of Agriculture; a cobalt-60 irradiation source for the production of sterile male insects is being purchased by the Agency and the considerable progress achieved so far in fighting the fruitflies shows promising prospects for an increase of Costa Rica's export-oriented fruit and coffee production. Agricultural production increases are also aimed at through identification of viral diseases in various basic crops (e.g. maize, kidney beans, potatoes and tropical fruits) and other biological samples by providing and using DNA probes; to this end the Centre for Research on Cellular and Molecular Biology at the University of Costa Rica has developed the polymerase chain reaction (PCR) technique and is now providing the essential Taq polymerase to the Central American research communities. A mutation breeding project concerned with the development of new higher yield and disease-resistant varieties of the common bean, banana, yam and cowpea has produced very encouraging results, particularly with in-vitro grown bean varieties.

189. The development of nuclear analytical techniques was and is continuing to be supported at the Nuclear Physics Department of the University of Costa Rica, which now disposes of a series of well established analytical techniques such as X-ray fluorescence, neutron activation, solid state nuclear track detection and low level counting. These techniques are being applied in programmes for analysis of environmental samples and food contamination and will also be applied to monitoring the country's seismic activity.

190. Finally, and also as a consequence of improved internal co-ordination, it was possible to send an expert mission to prepare a 1993-94 project on radiation protection, which is likely to remedy a rather precarious situation in this field.

CUBA

A. CONTRIBUTIONS TO AND PARTICIPATION IN TECHNICAL CO-OPERATION ACTIVITIES

Year	TACF					Extra-budgetary funds	In-kind support	Experts from country	Persons trained in country
	Voluntary Contributions			Assessed Programme Costs					
	Share $	Pledged $	Paid $	Assessed $	Paid $	$	$		
1988	34.2	34.2	34.2	27.7	27.7	0.0	0.0	2	17
1989	37.8	37.8	37.8	41.9	41.9	0.0	3.8	3	24
1990	41.0	41.0	41.0	36.7	36.2	0.0	35.9	8	85
1991	44.1	44.1	44.1	46.4	0.0	0.0	1.5	6	11
1992	47.2	47.2	47.2			0.0	0.6	12	1

B. ASSISTANCE APPROVED AND PROVIDED

Year	Assistance approved from TACF				Total assistance provided from all sources					
	CC	NCC	Total	Region	TACF	TACF	Extra-budgetary	UNDP	In-kind	Total
	$	$	$	%	CC $	NCC $	$	$	$	$
1988	315.0	0.0	315.0	6.0	283.7	62.8	0.0	86.0	0.0	432.5
1989	381.9	95.0	476.9	7.6	479.4	44.7	0.0	168.4	5.4	697.9
1990	450.9	600.0	1,050.9	12.5	437.6	21.3	0.0	336.9	11.7	807.5
1991	406.2	555.0	961.2	10.8	540.5	40.1	0.0	10.1	0.0	590.7
1992	476.4	65.0	541.4	6.1	596.8	118.6	0.0	9.2	0.0	724.6

191. As is evident from table A above Cuba is one of the few countries in the region which has consistently pledged and paid its full share of the target for voluntary contributions. Some of the projects implemented during the period reviewed were extensions of previous activities, particularly those in nuclear medicine, hydrology and nuclear measurements.

192. The successful completion of two projects on food irradiation resulted in the establishment of a large facility and the start of irradiation, mainly foodstuffs. New projects were initiated, mainly in radiological protection, agriculture, nuclear power plant safety and the establishment of a SSDL. Some of these projects were completed within the five-year period covered by this report. A secondary standards dosimetry laboratory was established. Projects were approved on environmental radiation monitoring, the establishment of a whole-body counter facility, and (as a result of a WAMAP mission in 1989) a project was approved in various areas of radiological protection. Agricultural projects were implemented or are current in the areas of animal sciences, soils and mutation breeding in sugar cane. Projects are being implemented on the application of nuclear techniques in the nickel industry, metal pollution of the marine ecosystem, the encapsulation of mammalian cells, the development of irradiation techniques, and activities related to a neutron generator which will be provided when the construction of the laboratory has been completed.

193. Advances were made in nuclear medicine, particularly under a project mainly funded by the UNDP, for which most of the fellowships and some expert missions were provided by the Agency. A gamma camera and ancillary equipment, experts and training were supplied to the Institute of Oncology and Radiobiology, and as a result Cuba now has an adequate infrastructure for diagnosis in various medical specialities in Havana and in the provinces. The project also assisted in the establishment of several teaching and research laboratories at the Advanced Institute of Sciences and Nuclear Technology. The establishment of a whole-body counter and a secondary standards dosimetry facility are advancing satisfactorily and, in spite of some delays in

the construction of the laboratories, are expected to be completed in 1993. With the successful completion of a project in nuclear electronics, the Centre for Studies Applied to Nuclear Development can now provide maintenance and repair services to all the institutions using nuclear instrumentation.

DOMINICAN REPUBLIC

A. CONTRIBUTIONS TO AND PARTICIPATION IN TECHNICAL CO-OPERATION ACTIVITIES

Year	TACF					Extra-budgetary funds	In-kind support	Experts from country	Persons trained in country
	Voluntary Contributions			Assessed Programme Costs					
	Share $	Pledged $	Paid $	Assessed $	Paid $	$	$		
1988	11.4	0.0	0.0	9.4	0.0	0.0	0.0	1	16
1989	12.6	0.0	0.0	8.9	0.0	0.0	0.0	3	0
1990	13.7	0.0	0.0	13.3	0.0	0.0	0.0	2	0
1991	14.7	0.0	0.0	16.2	0.0	0.0	0.0	0	15
1992	15.7	0.0	0.0			0.0	1.0	2	0

B. ASSISTANCE APPROVED AND PROVIDED

Year	Assistance approved from TACF				Total assistance provided from all sources					
	CC	NCC	Total	Region	TACF	TACF	Extra-budgetary	UNDP	In-kind	Total
	$	$	$	%	CC $	NCC $	$	$	$	$
1988	101.7	10.0	111.7	2.1	114.8	2.2	0.0	0.0	4.8	121.8
1989	115.5	0.0	115.5	1.8	110.6	0.6	0.0	0.0	0.0	111.2
1990	80.8	0.0	80.8	1.0	161.6	4.8	0.0	0.0	0.0	166.4
1991	216.3	10.0	226.3	2.5	202.2	0.0	0.0	0.0	0.0	202.2
1992	195.5	0.0	195.5	2.2	243.3	0.1	0.0	0.0	0.0	243.4

194. During the past five years, the Agency's technical co-operation programme with the Dominican Republic became diversified: while nuclear analytical techniques continued to receive support, hydrology projects were expanded and new projects on animal sciences and radiation protection were initiated. The recent restructuring of the very small National Commission for Nuclear Affairs and the establishment of a National Council for Radiation Protection indicate increased interest by the Government in nuclear matters. Reorganization of the Commission's activities was supported by the award of a scientific visit to neighbouring Costa Rica, where a successful reorganization had already taken place under similar conditions.

195. The project on radiation protection, initiated in 1991 and to be continued under the 1993-94 Programme, was instrumental in encouraging the establishment of a National Council in this field. All radiation protection regulations and procedures will be the responsibility of the Council, which also plans to set up a National Centre for Radiation Protection in charge of countrywide technical implementation of the regulations. In this task the Council and the Centre would rely heavily on the expertise, laboratory facilities and equipment made available to the Pedro Henríquez Ureña National University (UNPHU) through several Agency projects for the application of nuclear analytical techniques.

196. Alpha, beta and gamma spectrometry and, in particular, X-ray fluorescence analysis, have reached a very high level, and analyses for radiation protection purposes (thermoluminescence dosimetry) are performed as well as analyses of water and food samples. Environmental samples for

regulation of industrial pollution levels are being analysed at the Agency-assisted Nuclear Science Laboratory of the Autonomous University of Santo Domingo (UASD), whose facilities were supplemented with a laboratory for trace metal analysis. Atomic absorption and X-ray fluorescence techniques were also strengthened by an Agency project. While recent improvements in co-ordination of the analytical capabilities should ultimately lead to a tripartite environmental monitoring project, both UASD and UNPHU are already collaborating with the National Institute of Water Resources (INDRHI) in Santo Domingo in the analysis of water samples performed for the hydrology projects carried out with Agency assistance.

197. Although the recent reorganization of INDRHI diminished its capability to carry out future projects, activities during the last five years produced a number of significant results. Seepage in the Chacuey and Maguaca Reservoirs was studied and remedial solutions proposed; in the areas of the Los Bolos and Sabaneta dams, more than 300 water samples were measured, and fluorescent tracers and artificial tritium were used in the experimental work. As a result, the country is now able to study all problems related to karst hydrology, which concerns most of the country's water resources. A fully equipped laboratory for chemical analysis of water was established and the sedimentological study of the Nizao River was undertaken. As the Nizao River is the main source of water and hydroelectric power for the Santo Domingo area, this work will improve the economic efficiency of the infrastructure for both irrigation and power generation.

198. In the field of animal sciences, a project started in 1991 is continuing at the Central Veterinary Laboratory on the diagnosis of animal diseases such as brucellosis and babesiosis by use of the ELISA technique. As a result, a new laboratory for the evaluation of livestock diseases was established at San Cristóbal near Santo Domingo.

ECUADOR

A. CONTRIBUTIONS TO AND PARTICIPATION IN TECHNICAL CO-OPERATION ACTIVITIES

Year	TACF					Extra-budgetary funds	In-kind support	Experts from country	Persons trained in country
	Voluntary Contributions			Assessed Programme Costs					
	Share $	Pledged $	Paid $	Assessed $	Paid $	$	$		
1988	11.4	0.0	0.0	42.5	0.0	-0.1	0.0	6	5
1989	12.6	0.0	0.0	54.2	0.0	0.0	2.0	6	1
1990	13.7	0.0	0.0	43.7	0.0	0.0	0.9	8	10
1991	14.7	0.0	0.0	42.6	0.0	0.0	3.4	4	40
1992	15.7	0.0	0.0			0.0	1.0	7	27

B. ASSISTANCE APPROVED AND PROVIDED

Year	Assistance approved from TACF				Total assistance provided from all sources					
	CC	NCC	Total	Region	TACF	TACF	Extra-budgetary	UNDP	In-kind	Total
	$	$	$	%	CC $	NCC $	$	$	$	$
1988	375.9	15.0	390.9	7.5	255.8	178.5	96.9	0.0	21.2	552.4
1989	319.5	46.0	365.5	5.8	381.4	130.1	168.8	0.0	42.8	723.1
1990	295.2	227.0	522.2	6.2	338.0	46.5	162.5	0.0	52.0	599.0
1991	312.0	180.0	492.0	5.5	367.5	31.5	133.8	0.0	14.4	547.2
1992	440.1	0.0	440.1	5.0	731.7	17.6	90.1	0.0	20.2	859.6

199. The Agency's technical co-operation programme with Ecuador during the last five years covered a wide rage of activities: agriculture, animal sciences, nuclear medicine, industrial applications of irradiation, analytical techniques, uranium prospection, nuclear data and radiation protection.

200. The Ecuadorian Atomic Energy Commission (CEEA) received significant support for agricultural activities with the aim of promoting collaboration between the University of Agriculture, the University sector and farmers on programmes of national economic importance. A laboratory for isotope techniques in soil science was established at the CEEA. The National Institute for Agricultural Research (INIAP) collaborated successfully with the Central University of Ecuador in research on fertilizer and water use efficiency. Biological fixations of legumes and nitrogenous fertilizer efficiency in oil palm were studied by means of nitrogen-15, leading to improved fertilizer management practices. Future Agency assistance is intended to extend the laboratory's N-15 analytical service to other countries in the region. In mutation breeding, the Agency supplied the CEEA with a gamma cell for seed irradiation, and a tissue culture laboratory was installed at the INIAP. Collaboration among these institutions has been difficult to achieve but some success was obtained in isolated efforts by the CEEA.

201. In the field of animal sciences, a laboratory for radioimmunoassay (RIA) was established at the CEEA. Subsequent assistance provided under several projects in animal reproduction and nutrition which had been initiated previously made it possible to identify problems affecting cattle reproduction in the Cayamse area and to control, to a certain extent, the nutritional value of animal feed. A laboratory for RIA techniques is being established at the Animal Health Laboratory of the Ministry of Public Health in collaboration with the CEEA to develop a programme on diagnosis in the control and eradication of foot-and-mouth disease and brucellosis.

202. The CEEA has started to carry out extensive research and field work on fruitfly control in order to introduce the sterile insect technique (SIT). Through a project recently completed, fruitfly species affecting horticultural products were identified and field surveys conducted on the basis of which a national programme on fruitfly eradication has been established. With a commitment from the Ministry of Agriculture, assistance in this area is expected to continue in line with the national programme. Under a project initiated in 1985 and continuing into 1993, the CEEA has established a well equipped laboratory to study the problems caused by intensive use of agricultural chemicals and pesticides. Practical data have been obtained on residues in corn, tomato, palm oil and vegetables as well as on the behaviour of some chemicals in the environment. The CEEA has established fruitful links with the University sector for collaboration on current problems.

203. Earlier Agency assistance to the Carlos Andrade Marin Hospital was continued into the 1980's for the expansion of nuclear medicine services. Equipment for diagnostic studies was provided, financed partially by funds-in-trust from Ecuador. In 1992, a brachytherapy machine as well as expertise and training was supplied to the Cancer Hospital (SOLCA) in Quito and is expected to be fully operational in 1993.

204. Under a long-term project on industrial applications, the National Polytechnic School received an electron beam accelerator ELU 6U (LINAC) with a capacity of 4-5 kW of radiation power. The machine is being used to conduct applied research on radiation processing of plastic, curing of coatings and for the radiosterilization of medical supplies.

205. Analytical techniques have been established at the CEEA laboratories. Through an extrabudgetary contribution from the USA, atomic absorption

spectroscopy, X-ray fluorescence analysis, gamma spectroscopy and Moessbauer techniques were introduced and, with German funding, use of the eddy current technique was established for NDT activities. All these facilities are now operational and offer services to the industrial sector.

206. As a result of several projects on uranium prospection implemented during the five years under review, funded by the Agency and the UNDP, two areas have been identified as showing favourable uranium characteristics. Uranium favourability in Ecuador was assessed and a prognostic map was produced as a basis for future work. Staff from the CEEA acquired field experience in prospecting and exploration techniques which would enable the studies to be continued.

207. As a basic support for research in nuclear sciences, a Nuclear Information Centre was created, which the Agency supplied (from 1987 to 1990) with essential material and equipment as well as expert advice, in order to computerize the operations and create databases. A CD-ROM system was also provided and the staff was trained in its use and in all aspects of the INIS system.

208. Within the essential legal frame of the Radiation Protection Act, promulgated in 1979, the CEEA is developing a well organized national programme on radiation protection and nuclear safety, basically concerned with inspection of the medical facilities, transport of radioactive materials, and personal dosimetry. Services are offered through three offices, in Quito, Guayaquil and Cuenca. Further Agency assistance is envisaged to establish a national emergency plan.

EL SALVADOR

A. CONTRIBUTIONS TO AND PARTICIPATION IN TECHNICAL CO-OPERATION ACTIVITIES

Year	TACF					Extra-budgetary funds	In-kind support	Experts from country	Persons trained in country
	Voluntary Contributions			Assessed Programme Costs					
	Share $	Pledged $	Paid $	Assessed $	Paid $	$	$		
1988	3.8	0.0	0.0	7.2	0.0	0.0	0.0	2	0
1989	4.2	0.0	0.0	20.9	0.0	0.0	0.0	0	0
1990	4.6	0.0	0.0	20.2	0.0	0.0	0.0	0	2
1991	4.9	0.0	0.0	17.2	0.0	0.0	0.0	1	0
1992	5.2	0.0	0.0			0.0	0.0	0	0

B. ASSISTANCE APPROVED AND PROVIDED

Year	Assistance approved from TACF				Total assistance provided from all sources					
	CC	NCC	Total	Region	TACF	TACF	Extra-budgetary	UNDP	In-kind	Total
	$	$	$	%	CC $	NCC $	$	$	$	$
1988	77.4	0.0	77.4	1.5	57.4	0.0	32.7	0.0	0.0	90.1
1989	195.5	0.0	195.5	3.1	194.7	22.4	44.7	0.0	3.2	265.0
1990	189.0	0.0	189.0	2.3	211.5	3.4	37.8	0.0	0.0	252.7
1991	157.4	10.0	167.4	1.9	150.6	5.1	59.7	0.0	0.0	215.4
1992	97.8	0.0	97.8	1.1	95.7	0.0	90.2	0.0	0.0	185.9

209. Nuclear medicine has always been one of the main areas of Agency technical co-operation with El Salvador. The recipient institution has been the Department of Nuclear Medicine of the Ministry of Public Health's Rosales Hospital.

210. During the five years under review, the infrastructure to expand services for in-vitro clinical diagnosis was established. Under a current project, a refurbished gamma camera was supplied in 1990. By 1992, training of all medical and technical staff of the Department had been completed. Radiation protection had previously been a priority for Agency assistance, and a national Radiation Protection Service was established at the Rosales Hospital. Expert advice, training and equipment had been provided by the Agency to improve radiation protection measures for the hospital personnel, and this assistance was later extended to other institutions in the medical sector. In 1989, assistance was provided in evaluating radiation doses received by three workers and in the medical treatment of overexposed persons as a consequence of the accident that year at a private industrial irradiation plant for disposable medical supplies.

211. The draft law on Radiation Protection by the Ministry of Public Health, completed in 1991, has not yet been promulgated. In 1992, the Agency provided the Radiation Protection Service with equipment for individual monitoring, quality assurance of X-ray machines and for inspection services. In the future programme, the necessity for regulations and the establishment of a national radiation protection programme within the appropriate legal frame will be emphasised.

212. Considerable support was given to animal reproduction and health. The Agency supplied progesterone kits for the radioimmunoassay (RIA) laboratory at the Centre for Livestock Development of the Ministry of Agriculture and Stockbreeding, which had been set up earlier with Agency support and an extrabudgetary contribution from the USA. Agency assistance will continue to establish RIA techniques for animal disease diagnosis and to train new staff in its use. Thanks to an extrabudgetary contribution from the United Kingdom, the Agriculture Technology Centre of the Ministry of Agriculture and Stockbreeding was provided with equipment, expertise and training for the installation of a tissue culture and, under a current project, the installation of a facility to conduct studies on agrochemicals.

213. Assistance is still being provided to the Geothermal Research Centre of the Hydroelectric Executive Commission for the Rio Lempa. Several studies have been conducted on geothermal dynamics in the Berlín Geothermal Field. Fluids and minerals have been analysed to elaborate the general characterization of the field in order to optimize its exploration.

214. With Agency support, the facilities of the Nuclear Applications Research Centre of the Faculty of Engineering and Architecture, University of El Salvador, were rebuilt. The Centre now houses nuclear instrumentation and electronic laboratories equipped through an extrabudgetary contribution from the USA. Advisory services and staff training made it possible for the Centre to offer maintenance services to other institutions in El Salvador.

GUATEMALA

A. CONTRIBUTIONS TO AND PARTICIPATION IN TECHNICAL CO-OPERATION ACTIVITIES

Year	TACF					Extra-budgetary funds	In-kind support	Experts from country	Persons trained in country
	Voluntary Contributions			Assessed Programme Costs					
	Share $	Pledged $	Paid $	Assessed $	Paid $	$	$		
1988	7.6	7.6	0.0	14.8	0.0	0.0	2.0	6	7
1989	8.4	8.0	0.0	44.8	0.0	0.0	2.9	3	19
1990	9.1	9.1	0.0	30.3	0.0	0.0	3.4	8	30
1991	9.8	0.0	0.0	34.5	0.0	0.0	0.0	6	15
1992	10.5	0.0	0.0			0.0	0.0	2	5

B. ASSISTANCE APPROVED AND PROVIDED

Year	Assistance approved from TACF				Total assistance provided from all sources					
	CC	NCC	Total	Region	TACF	TACF	Extra-budgetary	UNDP	In-kind	Total
	$	$	$	%	CC $	NCC $	$	$	$	$
1988	127.3	0.0	127.3	2.4	148.8	11.9	24.9	0.0	0.0	185.6
1989	251.9	15.0	266.9	4.2	308.1	5.9	246.7	0.0	9.1	569.8
1990	256.1	326.0	582.1	6.9	259.3	3.0	115.9	0.0	0.0	378.2
1991	284.5	35.0	319.5	3.6	326.5	0.0	104.8	0.0	0.0	431.3
1992	247.6	0.0	247.6	2.8	292.8	0.0	268.3	0.0	4.5	565.6

215. For the last five years, the Agency's programme of technical co-operation with Guatemala has supported the continuation of previous activities, mainly concerning medfly control, nuclear medicine, the secondary standards dosimetry laboratory (SSDL), nuclear analytical techniques and agriculture. New projects were approved on radiological protection, radiotherapy and brachytherapy, geothermics and agriculture.

216. With the help of an extrabudgetary contribution from the USA, significant advances have been made in controlling the medfly by the sterile insect technique with the establishment of a facility for fly production and quality control.

217. The General Directorate of Nuclear Energy was designated by the Government as the national authority on radiological protection matters, and projects have been approved to provide the Directorate with equipment, extensive training, and expert services in all related aspects, including legislation and procedures for licensing, inspection and training.

218. In the area of nuclear medicine, Agency assistance resulted in the establishment of laboratories for the preparation and control of radiopharmaceuticals, and good progress has been made in the production of primary reagents for radioimmunoassay such as those needed for thyroid-related hormones through an extrabudgetary contribution from the USA. A gamma camera was supplied to the San Juan de Dios Hospital, which will help to improve diagnostic services for the low-income population. To assist in providing adequate treatment for cervical cancer, which accounts for 40% of the cancer incidence in the country, a brachytherapy unit was supplied to the Bernardo del Valle Cancer Institute.

219. A geothermal project is being implemented which has a great potential for increasing the electrical capacity of the country.

220. The assistance provided in nuclear analytical techniques has led to a great advance in total reflection X-ray fluorescence analysis and to the provision of expert advice by Guatemala to other countries in the region. Projects on mutation breeding for the improvement of cereals, diagnosis of animal diseases, and the utilization of nuclear techniques in soils are advancing satisfactorily. The SSDL, thanks to extrabudgetary contributions from the USA and the UK, is expected to be completed soon and will enable Guatemala to provide calibration services at the national and Central American levels.

HAITI

A. CONTRIBUTIONS TO AND PARTICIPATION IN TECHNICAL CO-OPERATION ACTIVITIES

Year	TACF					Extra-budgetary funds	In-kind support	Experts from country	Persons trained in country
	Voluntary Contributions			Assessed Programme Costs					
	Share $	Pledged $	Paid $	Assessed $	Paid $	$	$		
1988	3.8	0.0	0.0	0.0	0.0	0.0	0.0	0	0
1989	4.2	0.0	0.0	0.0	0.0	0.0	0.0	0	0
1990	4.6	0.0	0.0	0.0	0.0	0.0	0.0	0	0
1991	4.9	0.0	0.0	0.0	0.0	0.0	0.0	0	0
1992	5.2	0.0	0.0			0.0	0.0	0	0

B. ASSISTANCE APPROVED AND PROVIDED

Year	Assistance approved from TACF				Total assistance provided from all sources					
	CC	NCC	Total	Region	TACF	TACF	Extra-budgetary	UNDP	In-kind	Total
	$	$	$	%	CC $	NCC $	$	$	$	$
1988	70.1	0.0	70.1	1.3	59.2	1.6	0.0	0.0	0.0	60.8
1989	0.0	0.0	0.0	0.0	33.7	1.7	0.0	0.0	0.0	35.4
1990	7.0	0.0	7.0	0.1	54.2	0.0	0.0	0.0	0.0	54.2
1991	104.7	0.0	104.7	1.2	77.9	0.0	0.0	0.0	0.0	77.9
1992	37.9	0.0	37.9	0.4	18.8	0.1	0.0	0.0	0.0	18.9

221. The Agency's previous technical co-operation programme with Haiti had been concerned only with hydrological projects. Under a small Reserve Fund project approved in 1986 as a continuation of an earlier project, the Agency has been assisting the National Water Resources Service (SNRE) in setting up a hydrochemistry laboratory, training local staff and providing expert services at short intervals.

222. Isotope-aided studies of some of Haiti's major aquifers and periodic isotope monitoring programmes yielded some significant results which supported the SNRE drilling campaign for water supply in several plains of the northern peninsula as well as the Cayes Plain in the southern peninsula. Scientific achievements were included in the final report of the UNDP-assisted project on development and management of water resources in Haiti, which is a unique document on the country's water resources. A 1991-92 follow-up project considered the isotopic and chemical analysis of groundwater resources in the country's karst aquifers. Unfortunately, all activities relating to the hydrology project came to a halt owing to the political unrest in 1991.

223. In 1989 the Agency fielded a pre-programming mission to Haiti, with major emphasis on agriculture and nuclear medicine. In spite of signs of

considerable interest shown by various agricultural research institutions in the country, a jointly elaborated proposal in the field of soil science was never actually submitted to the Agency. However, a Reserve Fund project was set up in 1989 for assistance in radiation protection legislation and regulations as well as for the treatment of patients at the National Oncology Institute. Although several short-term experts produced a set of proposals for action in both fields, it was not until 1991 that a decision was made to send a long-term radiotherapy expert to the country. Some progress had been made in the treatment of patients, and collaborators were being selected for further training when political unrest also stopped this project and led to the evacuation of the Agency expert. However, the expert produced comprehensive plans for future activities in radiotherapy and brachytherapy on the basis of which the project is expected to be resumed on a larger scale when the situation once again permits meaningful activities.

JAMAICA

A. CONTRIBUTIONS TO AND PARTICIPATION IN TECHNICAL CO-OPERATION ACTIVITIES

Year	TACF					Extra-budgetary funds	In-kind support	Experts from country	Persons trained in country
	Voluntary Contributions			Assessed Programme Costs					
	Share $	Pledged $	Paid $	Assessed $	Paid $	$	$		
1988	7.6	0.0	0.0	9.7	0.0	0.0	0.0	3	7
1989	8.4	0.0	0.0	2.5	0.0	0.0	0.0	3	0
1990	4.6	0.0	0.0	2.8	0.0	0.0	2.0	6	14
1991	4.9	0.0	0.0	7.6	0.0	0.0	0.0	0	0
1992	5.2	0.0	0.0			0.0	3.0	1	0

B. ASSISTANCE APPROVED AND PROVIDED

Year	Assistance approved from TACF				Total assistance provided from all sources					
	CC	NCC	Total	Region	TACF	TACF	Extra-budgetary	UNDP	In-kind	Total
	$	$	$	%	CC $	NCC $	$	$	$	$
1988	78.8	0.0	78.8	1.5	66.1	0.0	55.0	0.0	0.0	121.1
1989	16.2	0.0	16.2	0.3	26.3	0.0	5.1	0.0	0.0	31.4
1990	16.8	0.0	16.8	0.2	34.7	0.0	0.0	0.0	0.0	34.7
1991	222.4	0.0	222.4	2.5	94.4	0.0	0.0	0.0	0.0	94.4
1992	296.2	0.0	296.2	3.3	240.0	0.0	0.0	0.0	0.0	240.0

224. As long ago as 1967 expert services were already being provided under the Agency's technical co-operation programme with Jamaica to advise the Central Planning Department on the application of radioisotopes and radiation sources in the fields of medicine, agriculture and industrial applications, and on basic and applied research in general, including infrastructure, training and equipment requirements. As a result of these missions, joint activities have been carried out mainly with the University of the West Indies, Kingston, where the Centre for Nuclear Sciences has been playing a major role.

225. A multi-year project financed by the Reserve Fund and an extrabudgetary contribution from the USA assisted the Centre for Nuclear Sciences in commissioning and testing the 20 kW SLOWPOKE reactor acquired by the University. The reactor is the focal point of activities at the Centre, where excellent facilities and professional staff of high academic level are

available. Nuclear activation analysis has been established and is operating continuously. By 1991, more than 8000 samples had been irradiated (mainly soils, stream and sea sediments, bauxite and bauxite residues, lichen, peat, rock specimens, dust fallout) as part of a geological survey of Jamaica conducted by the Centre in collaboration with other faculties. The introduction of X-ray analysis and the provision of equipment and expert services took place in 1992. Equipment and expert services were also provided for the installation of an electronics unit to provide maintenance services. A new building connected to the reactor was constructed to house the unit, facilitating its operation and allowing for anticipated expansion.

226. Facilities of the Nuclear Medicine Department of the University Hospital are being upgraded and the medical staff is being trained in advanced nuclear medicine techniques.

227. A project was financed from the Reserve Fund for a comprehensive analysis of the benefits and constraints of the use of nuclear techniques in agriculture. The Agency provided expert advice on soil fertility, food preservation, mutation breeding, animal production and health, entomology and agrochemicals. It was concluded that the introduction of nuclear techniques would certainly contribute to the development of agriculture in many areas, in line with national priorities. Animal health activities in collaboration with the Ministry of Agriculture will be initiated in the next two years.

228. The Nuclear Energy Authority Act, drafted in 1984, has not yet been promulgated. A 1988 RAPAT mission identified as a first priority the creation of a legal basis to regulate all radiation protection activities in the country. Assistance was provided under a current radiation protection project to review the text and update it according to the latest ICRP standards. This Act is expected to be approved by the Government and enter into force during 1993.

229. Under the same project, assistance was provided to expand the monitoring services supplied by the Radiation Monitoring Unit of the Centre for Nuclear Sciences. A pilot project for personnel monitoring was developed and later converted into services for the University and hospitals. The draft regulations on radiation protection are expected to be completed within the frame of an existing law, and radiation monitoring services are expected to be implemented for individuals in all sectors as well as for the environment.

MEXICO

A. CONTRIBUTIONS TO AND PARTICIPATION IN TECHNICAL CO-OPERATION ACTIVITIES

Year	TACF					Extra-budgetary funds	In-kind support	Experts from country	Persons trained in country
	Voluntary Contributions			Assessed Programme Costs					
	Share $	Pledged $	Paid $	Assessed $	Paid $	$	$		
1988	334.4	261.0	261.0	32.4	32.4	8.5	27.0	24	4
1989	369.6	369.6	369.6	41.7	41.7	0.0	18.9	23	42
1990	423.2	423.2	423.2	45.9	19.8	0.0	25.4	23	97
1991	455.7	455.7	455.7	51.6	0.0	0.0	2.2	20	77
1992	488.2	488.2	488.2			0.0	0.4	23	63

B. ASSISTANCE APPROVED AND PROVIDED

Year	Assistance approved from TACF				Total assistance provided from all sources					
	CC	NCC	Total	Region	TACF	TACF	Extra-budgetary	UNDP	In-kind	Total
	$	$	$	%	CC $	NCC $	$	$	$	$
1988	369.9	0.0	369.9	7.1	254.4	0.0	150.9	0.0	39.3	444.6
1989	386.5	15.0	401.5	6.4	348.1	12.4	169.5	0.0	60.4	590.4
1990	317.3	247.0	564.3	6.7	390.2	54.9	128.7	0.0	71.3	645.1
1991	411.5	405.0	816.5	9.2	427.6	11.4	206.0	0.0	92.2	737.2
1992	406.7	0.0	406.7	4.6	633.5	25.2	457.8	0.0	11.3	1,127.8

230. The Agency's technical co-operation with Mexico has always supported a very broadly based programme and has continued to do so during the five-year period under review.

231. Major efforts have assisted Mexican institutions in the commissioning, startup and operation of the Laguna Verde Nuclear Power Plant (LVNPP) by providing expert services and training on quality assurance, safety analysis, fuel management, quality certification and commissioning procedures. Equipment was also provided to complement the existing infrastructure. The LVNPP, which was constructed under the management of the Federal Electricity Commission (CFE), started commercial operation in 1990 and since then its performance has been outstanding.

232. Several projects related to nuclear power were completed in the period under review. A project on ecological modelling contributed to the development at the Institute of Electricity Research (IIE) of a mathematical numerical simulation of hydrothermal flows and radionuclide dispersion for the effluents of the power plant. Another project assisted the CFE to establish an independent fuel management system to support safe and economic operation of the plant. The establishment of a Probabilistic Assessment Programme was achieved through a project that involved the CFE and the IIE and was monitored by the National Commission of Nuclear Safety and Safeguards. A long-term project, also completed during this period, provided the Commission with expert services and training to review and evaluate procedures for the startup and operational testing of the LVNPP, thus allowing complete control of the commissioning programme. Current projects on reactor fuel fabrication, accident analysis, operational safety, radiation protection and probabilistic safety analysis supported the strengthening of the nuclear power programme in Mexico.

233. In the field of radioisotopes and radiopharmaceuticals, a project has been concluded at the National Institute for Nuclear Research (ININ) for the local production of kits and quality assurance for radioimmunoassay of thyroid-related hormones. Also at ININ, current projects are developing the technology for local production of molybdenum-99 of pharmaceutical quality to cover the national requirements of technetium-99 generators. These projects also aim at increasing the radiopharmaceutical production capacity and improving quality controls; when they are completed, Mexico is expected to be able to meet most of its radiopharmaceutical needs from local production. To support the production of radioisotopes and to widen the use of the Mexican research reactor, a recently completed project contributed to the buildup of local capacity for core calculations and thermohydraulics analysis, which will be used by ININ to design mixed cores.

234. In the field of environmental studies, the Agency is assisting ININ to determine the existing condition of radionuclides in the environment and to become capable of determining environmental radioactive contamination.

Another project with ININ studies the possibility of removing nitrogen and sulphur compounds from combustion gases by means of accelerated electrons. A particle-induced X-ray emission laboratory has been established to obtain data on atmospheric contamination in Mexico City and at selected industrial sites.

235. The Agency contributed to a multi-disciplinary study by the Ministry of Agriculture and Water Resources to determine the water dynamics, ecology and pollution of Lake Chapala In order to improve water resource management. Another project has contributed to the development of models of groundwater recharge using carbon-14 dating. The use of nuclear techniques in the study of natural resources was promoted through a project with the CFE for characterization and assessment of geothermal fields. As a result, conceptual models have been derived from isotopic data for the geothermal fields of Cerro Prieto, Los Azufres and Los Humeros. Another activity under way with the Mexican Institute of Water Technology is to develop the application of isotopic techniques in the characterization of aquifers.

236. In the area of agriculture, the Autonomous National University of Mexico received Agency assistance in the determination of reproductive hormone levels in ruminants and in the study of the effects of nutritional and management practices in the reproductive physiology of cattle. A current project concerns the nutrition/reproduction interaction in zebu. Completed and current projects are assisting the University of Guanajuato in mutation breeding activities to increase the production yields of several plants of economic importance. Promising results have been obtained from the generation of sorghum and bean mutants that show improved yields and resistance to disease. To minimize nitrogen fertilizer losses in the Guanajuatan Bajio region, the Agency contributed to the activities of the Centre for Research and Advanced Studies of the National Polytechnic Institute in order to evaluate the relative effectiveness and fate of different forms of applied nitrogen fertilizers, using N-15 techniques.

237. Technical co-operation with Mexico in the near future will follow the same general pattern as before. Assistance will continue on safety aspects of nuclear power plants and on production of radioisotopes and radiopharmaceuticals. The Agency will participate in a project related to the installation of a cyclotron to be used for the production of short-lived radiopharmaceuticals. Co-operation in the application of nuclear techniques in agriculture, hydrology and environmental studies is also foreseen.

NICARAGUA

A. CONTRIBUTIONS TO AND PARTICIPATION IN TECHNICAL CO-OPERATION ACTIVITIES

Year	TACF					Extra-budgetary funds	In-kind support	Experts from country	Persons trained in country
	Voluntary Contributions			Assessed Programme Costs					
	Share $	Pledged $	Paid $	Assessed $	Paid $	$	$		
1988	3.8	0.0	0.0	0.0	0.0	0.0	0.0	0	0
1989	4.2	0.0	0.0	0.0	0.0	0.0	0.0	0	0
1990	4.6	0.0	0.0	0.0	0.0	0.0	0.0	0	0
1991	4.9	0.0	0.0	0.0	0.0	0.0	0.0	0	0
1992	5.2	0.0	0.0			293.0	0.0	0	0

B. ASSISTANCE APPROVED AND PROVIDED

Year	Assistance approved from TACF				Total assistance provided from all sources					
	CC	NCC	Total	Region	TACF	TACF	Extra-budgetary	UNDP	In-kind	Total
	$	$	$	%	CC $	NCC $	$	$	$	$
1988	153.4	40.0	193.4	3.7	115.7	10.0	0.0	0.0	0.0	125.7
1989	247.2	10.0	257.2	4.1	97.1	176.2	0.0	0.0	0.0	273.3
1990	150.6	10.0	160.6	1.9	146.1	21.9	0.0	0.0	0.0	168.0
1991	318.8	110.0	428.8	4.8	224.6	17.4	0.0	0.0	0.0	242.0
1992	288.2	245.0	533.2	6.0	245.3	0.0	0.0	0.0	0.0	245.3

238. During the five years under review, the Agency continued its technical co-operation with Nicaragua in uranium exploration and hydrology. New activities were undertaken in the areas of geothermal resources, agriculture and animal sciences, nuclear medicine and radiation protection.

239. The Agency provided equipment and expert services in order to continue previous activities in uranium exploration. Regional surveys had already been established within the frame of a nationwide project to develop a metallogenic map of the country. Field gamma ray spectrometry was introduced to complete the methods used for the exploration and assessment of national raw materials resources, including radioactive raw materials.

240. In the field of water resources, the Nicaraguan Institute for Territorial Studies received substantial support from the Agency in equipment, advisory services and training in order to set up laboratories and for field work using environmental isotope techniques and hydrogeochemical analysis. The origin of ground hot water flooding, coming from a deep regional system at the El Limon gold mine, was determined. It was concluded that the flooding probably came from the Marabios mountains and that the heating was caused by a geothermal anomaly. It was also concluded that the contamination of Lake Asososca, which provides 30% of Managua's potable water, is not related to Lake Managua. The causes of low recharge at the Sebaco Valley aquifer, which is restricting the expansion of agriculture in this area, were also established. Through ongoing hydrology studies of the aquifers of Managua, information has been obtained on the origin, dynamics and function of a part of the Las Sierras aquifer. In future years, the study will cover the entire aquifer in order to verify the charge and recharge areas, groundwater renewal and other characteristics that will allow rational exploitation of the supply of potable water.

241. Isotope techniques have been introduced to complement hydrochemical and geochemical techniques in the study of geothermal energy resources. Exploitation of geothermal fields had already been initiated by the Nicaraguan Institute for Energy. The first 35 MW geothermal plant had been installed at the Momotombo Field in 1983, and a second 35 MW unit began operation in 1989 in the same area. The two plants provide 35% of the electricity needs of the country. Agency assistance will continue in the coming years to complete information on the Momotombo Field and other areas under exploration along the Pacific Coast, thus assisting in the development and rational exploitation of electricity resources.

242. In agriculture, the Directorate General for Agriculture's National Agrometeorological Programme was assisted in carrying out water balance studies on selected crops and improving water management practices. As part of the introduction of isotope techniques, the use of nitrogen-15 for optimizing fertilizer use was initiated in 1991 at the Faculty of Natural Resources and the Environment of the National Agriculture University. Equipment and

expert services were provided for carrying out field experiments. Results from the first trials are now being analysed and interpreted.

243. Assistance in the field of animal sciences has been provided since 1991 to the National Centre for Animal Protection of the Ministry of Agriculture for the establishment of radioimmunoassay techniques in the diagnosis and control of animal diseases.

244. In nuclear medicine, Agency assistance is focussed on radiotherapy in order to improve the services at the Berta Calderón Hospital of the Ministry of Health. Substantial support has been given through training and advisory services. For the future the provision of a teletherapy cobalt-60 facility in joint efforts with the Norwegian Authority for Development (NORAD) is foreseen. (NORAD has a co-operation agreement with Nicaragua for that purpose).

245. Radiation protection has received special attention since only minimal basic radiation safety procedures are available in Nicaragua. As a result of a RAPAT mission in 1985, a radiation protection law was drafted by the Ministry of Health and the National Autonomous University and awaits promulgation. The Agency will work closely with these two counterpart institutions to establish an executive regulatory body and a national programme on radiation protection within a legal framework.

PANAMA

A. CONTRIBUTIONS TO AND PARTICIPATION IN TECHNICAL CO-OPERATION ACTIVITIES

Year	TACF					Extra-budgetary funds	In-kind support	Experts from country	Persons trained in country
	Voluntary Contributions			Assessed Programme Costs					
	Share $	Pledged $	Paid $	Assessed $	Paid $	$	$		
1988	7.6	0.0	0.0	10.5	0.0	0.0	0.0	3	0
1989	8.4	0.0	0.0	13.9	0.0	0.0	0.9	0	0
1990	9.1	0.0	0.0	11.6	0.0	0.0	0.0	1	0
1991	9.8	0.0	0.0	22.0	0.0	0.0	0.0	0	1
1992	10.5	0.0	0.0			0.0	0.0	3	0

B. ASSISTANCE APPROVED AND PROVIDED

Year	Assistance approved from TACF				Total assistance provided from all sources					
	CC	NCC	Total	Region	TACF	TACF	Extra-budgetary	UNDP	In-kind	Total
	$	$	$	%	CC $	NCC $	$	$	$	$
1988	153.9	10.0	163.9	3.1	100.5	0.4	30.0	0.0	5.6	136.5
1989	113.3	0.0	113.3	1.8	153.3	3.5	17.1	0.0	21.2	195.1
1990	152.2	0.0	152.2	1.8	142.0	0.0	2.5	0.0	0.0	144.5
1991	224.3	0.0	224.3	2.5	275.0	0.0	0.0	0.0	0.0	275.0
1992	145.7	0.0	145.7	1.6	150.2	0.0	18.0	0.0	0.0	168.2

246. During the five-year period reviewed, the Agency's technical co-operation activities with Panama have been in the areas of analytical chemistry, agriculture, medicine and radiation protection. Since the country has no Atomic Energy Commission or equivalent, counterparts were those institutions most involved with the subjects of the projects.

247. The Agency assisted the University of Panama in establishing a radiochemistry laboratory for teaching and research. This later became the

Centre for Research Using Nuclear Techniques and is now able to perform atomic absorption, Moessbauer spectroscopy, X-ray fluorescence analysis and thermoluminescence analysis. The Centre also supports research work carried out by other University Departments as well as serving other Panamanian institutions and industries.

248. The Department of Agriculture of the University of Panama was assisted in a project to improve fertilizer use and water management, mainly in relation to rice crops. The Agricultural and Stockbreeding Research Institute of Panama (IDIAP) was assisted thanks to an extrabudgetary contribution in transferring the technology for mutation breeding of banana combined with in-vitro culture techniques. A laboratory was set up at IDIAP to study pesticides in the tropical environment by means of radioisotopes, and is helping to establish norms for maximum limits for pesticide residues in crops. Through a project implemented at the Research Centre for Biology and Animal Reproduction at the University of Panama, technology to establish methods for increasing milk and meat production through the application of radioimmunoassay (RIA) was transferred.

249. A nuclear medicine unit was established at the Santo Tomas Hospital. The unit received a gamma camera, which is the only one at the hospital and is being used intensively; in 1991 a total of 1951 studies were made. The Centre for Research and Diagnosis of Parasitic Diseases of the University of Panama received expert advice on the use of DNA probes in diagnosis of leishmania, a parasitic disease of great concern to Panama because of the permanent morbidity it can cause.

250. The Radiation Protection Service of the Social Security Fund which operates the largest number of hospitals and medical units in Panama, received assistance in establishing a film dosimetry service, which has been extended to many other institutions. A national programme was later established for monitoring and control of radioactive contamination, and a Radiation Protection Manual for the Social Security Fund was prepared and approved. The Radiation Protection Service was upgraded to become the Department of Radiological Health, and national legislation on radiation protection has not yet been enacted.

251. Future assistance from the Agency in nuclear applications is expected to emphasise projects on environmental monitoring, the use of RIA in detecting animal diseases, studies on the effects of pesticide residues, and other agricultural applications.

PARAGUAY

A. CONTRIBUTIONS TO AND PARTICIPATION IN TECHNICAL CO-OPERATION ACTIVITIES

Year	TACF					Extra-budgetary funds	In-kind support	Experts from country	Persons trained in country
	Voluntary Contributions			Assessed Programme Costs					
	Share $	Pledged $	Paid $	Assessed $	Paid $	$	$		
1988	7.6	0.0	0.0	12.4	0.0	0.0	0.0	7	5
1989	8.4	0.0	0.0	19.9	0.0	0.0	0.9	3	24
1990	13.7	0.0	0.0	15.5	0.0	0.0	0.0	3	18
1991	14.7	0.0	0.0	7.0	0.0	0.0	0.0	3	0
1992	15.7	0.0	0.0			0.0	0.0	2	16

B. ASSISTANCE APPROVED AND PROVIDED

Year	Assistance approved from TACF				Total assistance provided from all sources					
	CC	NCC	Total	Region	TACF	TACF	Extra-budgetary	UNDP	In-kind	Total
	$	$	$	%	CC $	NCC $	$	$	$	$
1988	188.6	15.0	203.6	3.9	151.6	3.3	0.0	0.0	0.0	154.9
1989	174.4	15.0	189.4	3.0	191.1	10.9	46.2	0.0	0.0	248.2
1990	156.7	0.0	156.7	1.9	188.5	0.0	5.0	0.0	0.0	193.5
1991	104.4	0.0	104.4	1.2	87.1	0.0	0.0	0.0	19.9	107.0
1992	138.6	0.0	138.6	1.6	34.0	0.0	0.6	0.0	0.0	34.6

252. The Agency has been assisting the National Atomic Energy Commission (CNEA) and the Institute of Basic Sciences Department of Physics of the National University of Asunción (UNA) in the development of nuclear physics, under which a well organized nuclear analytical laboratory had been set up by earlier projects. During the five years under review, the Agency assisted in the establishment of an electronics laboratory for repair and maintenance of nuclear instrumentation, and ongoing support is strengthening the applications of nuclear techniques, particularly in solving problems in the industrial sector and public services. The CNEA initiated collaborative work with the Sanitary Works Corporation (CORPOSANA) for analysis of water samples in studies of the quality of potable water.

253. A laboratory for non-destructive testing at the Faculty of Physics and Mathematics at UNA was established and equipped with an X-ray system and gamma-radiographic equipment using iridium-192 and cobalt-60 sources. The laboratory is used for training, quality control and inspection services to industry.

254. In continuation of an earlier project, a radiochemistry laboratory was established at the Faculty of Chemical Sciences of UNA to improve the teaching curriculum in radiochemistry and to perform practical work, mainly analysis of geological and biological samples.

255. A Nuclear Medicine Centre was established at the Institute of Research in Health Sciences of UNA. The Agency provided equipment, advisory services and training for research and clinical applications. Further assistance was provided to establish RIA techniques for medical diagnostic services in Asunción and in other parts of the country.

256. The Agency supplied the Ministry of Agriculture and Livestock Breeding with basic equipment, expertise and training to conduct research on soil-plant relationships using isotopic techniques, mainly to assess fertilizer efficiency and study nitrogen fixation in legumes. Preliminary studies have been conducted on soya bean, wheat and maize.

257. The Agency has continued to provide assistance in establishing an active Regulatory Body and in organizing a national programme on radiation protection. In 1991, a RAPAT mission visited Paraguay and recommended, as an essential requisite for subsequent assistance, the designation of a Joint Committee composed of members of the CNEA, the Ministry of Health and Social Security, and a representative of the Agency. This was accomplished in December 1992, after approval of a law transferring responsibility from the Ministry of Foreign Affairs to UNA and permitting the nomination of the committee members.

258. Future technical co-operation with Paraguay will have as first priority radiation protection activities in the medical field. For future activities in

animal sciences, the National Service for Animal Health, with Agency assistance, plans to introduce RIA techniques in the diagnosis and control of foot-and-mouth disease, brucellosis and babesiasis.

PERU

A. CONTRIBUTIONS TO AND PARTICIPATION IN TECHNICAL CO-OPERATION ACTIVITIES

Year	TACF					Extra-budgetary funds	In-kind support	Experts from country	Persons trained in country
	Voluntary Contributions			Assessed Programme Costs					
	Share $	Pledged $	Paid $	Assessed $	Paid $	$	$		
1988	26.6	0.0	0.0	72.4	0.0	0.0	3.0	11	55
1989	29.4	0.0	0.0	25.3	0.0	0.0	0.0	12	0
1990	27.3	0.0	0.0	45.8	0.0	0.0	2.0	14	27
1991	29.4	0.0	0.0	49.0	0.0	0.0	1.0	14	25
1992	31.5	0.0	0.0			0.0	0.0	8	0

B. ASSISTANCE APPROVED AND PROVIDED

Year	Assistance approved from TACF				Total assistance provided from all sources					
	CC	NCC	Total	Region	TACF	TACF	Extra-budgetary	UNDP	In-kind	Total
	$	$	$	%	CC $	NCC $	$	$	$	$
1988	315.6	150.0	465.6	8.9	301.2	555.3	67.9	108.3	5.5	1,038.2
1989	343.1	32.0	375.1	6.0	263.7	0.9	75.2	9.3	0.0	349.1
1990	314.9	150.0	464.9	5.5	511.5	4.2	56.4	0.0	6.3	578.4
1991	486.1	0.0	486.1	5.5	580.2	1.6	30.7	0.4	17.2	630.1
1992	367.2	0.0	367.2	4.1	445.4	0.0	41.0	0.0	12.1	498.5

259. The Agency's technical co-operation programme with Peru during the past five years, while maintaining a wide range, reflects a change of priorities. Most of the activities are, however, still being carried out at the Peruvian Institute of Nuclear Energy (IPEN), Lima. Nuclear energy programmes have been phased out. Uranium exploration activities showed potentially valuable deposits of Macusani. A Government decision to concentrate effort and manpower on the new Nuclear Research Centre, combined with the importance given to gas-fuelled thermal plants, led to the abandoning of nuclear power planning and siting projects, and a new programme to study the general demand for energy with a nuclear power option is under way.

260. During the period reviewed, the highest priority was given (and is expected to continue in the medium term future) to activities aimed at a fully operational and safe utilization of the Nuclear Research Centre at Huarangal, near Lima, which operates a 10 MW research reactor. Deteriorating economic circumstances and the consequent high turnover of staff compelled IPEN to place increasing emphasis on potentially productive activities at the Centre; efforts are now made to launch a number of joint ventures with local enterprises.

261. A large-scale Agency project is aiming at the production of isotopes for medical and industrial use such as iodine-125 and iodine-131, sealed sources of iridium and radioimmunoassay (RIA) kits. An export-oriented project on silicone doping is expected to yield tangible results during the next two years. Reactor operations at the Nuclear Research Centre also required a number of ancillary projects: nuclear analytical techniques were extended, particularly

at the neutron activation analysis laboratory, at which a neutron generator with accessory equipment now permits analysis of materials of economic importance, such as coal samples. With Agency assistance, a series of national training courses for operators and staff attached to facilities surrounding the reactor was organized at the Centre. A maintenance and repair workshop for nuclear electronics was also arranged, along with a small radiation protection project.

262. Continuous attention is being paid to nuclear safety measures relating to reactor operations; projects on safety and reactor calculations will receive major support from a US-assisted computer network program. A plant for chemical treatment of solid radioactive wastes was designed and implemented.

263. A high-priority project for the establishment of a multi-purpose pilot irradiation plant had been delayed for a number of years owing to funding problems at the national level, but is now being actively pursued, and construction is advancing at a major food market in Lima with assistance from future commercial users. Both agricultural products and medical supplies are expected to benefit from the new plant, which should become operational in the next few years.

264. Agricultural activities are centered on the National Agricultural University, La Molina, the University of San Marcos, and in the Departments of Tacna and Moquegua. In spite of difficulties caused by politically motivated unrest, substantial results were obtained at these institutions.

265. A UNDP-funded project to eradicate the medfly by means of the sterile insect technique in Tacna and Moquegua led to successful field operations based on an eradication plan and a substantial increase in the production of sterile flies at La Molina University which were also intended for export. An increase in olive production in the Tacna region and the extension of the operation into Northern Chile have demonstrated its success.

266. The reproductive efficiency of alpacas and llamas was studied at the IVITA Experimental Station of San Marcos University, yielding valuable data for increasing the alpaca population in the Andean countries. A current project also showed encouraging results in the determination of progesterone level in dairy cattle, and an RIA laboratory was equipped for all activities related to the reproductivity of farm animals. At La Molina, progress was reported in mutation breeding of wheat (resulting in a FAO-assisted project) and the Andean cereal quinoa.

267. Several hydrological projects involving isotope-assisted studies showed inter alia the lack of a local water recharge at the La Yarada aquifer in Tacna and contributed to the development of irrigation zones by improved groundwater exploitation in the drought-affected northern coastal areas.

268. A Nuclear Medicine Pilot Centre was established at IPEN in Lima, with regional subsidiaries in Arequipa and Trujillo. RIA diagnostic procedures for thyroid hormones and studies of the reproduction hormones were developed; the repair and upgrading of existing gamma cameras will be pursued in a new project.

269. In spite of continuing economic problems, it is expected that the encouraging results obtained in a variety of fields during the past five years will be followed up with equally positive results but on a reduced number of higher impact projects. This trend is reflected in the technical co-operation programme for the next two years.

URUGUAY

A. CONTRIBUTIONS TO AND PARTICIPATION IN TECHNICAL CO-OPERATION ACTIVITIES

Year	TACF					Extra-budgetary funds	In-kind support	Experts from country	Persons trained in country
	Voluntary Contributions			Assessed Programme Costs					
	Share $	Pledged $	Paid $	Assessed $	Paid $	$	$		
1988	15.2	0.0	0.0	17.2	0.0	0.0	2.0	8	9
1989	16.8	15.0	15.0	18.9	0.0	0.0	4.4	7	37
1990	18.2	15.0	15.0	28.4	0.0	0.0	1.7	10	2
1991	19.6	15.0	15.0	13.6	0.0	0.0	2.8	5	12
1992	21.0	15.0	0.0			0.0	0.6	7	16

B. ASSISTANCE APPROVED AND PROVIDED

Year	Assistance approved from TACF				Total assistance provided from all sources					
	CC	NCC	Total	Region	TACF	TACF	Extra-budgetary	UNDP	In-kind	Total
	$	$	$	%	CC $	NCC $	$	$	$	$
1988	181.8	5.0	186.8	3.6	161.2	0.0	53.7	0.0	4.5	219.4
1989	133.9	47.4	181.3	2.9	176.6	35.4	24.7	0.0	0.0	236.7
1990	178.9	5.0	183.9	2.2	232.6	-9.6	132.6	0.0	1.5	357.1
1991	229.4	0.0	229.4	2.6	166.3	0.0	4.3	0.0	0.0	170.6
1992	263.6	0.0	263.6	3.0	294.9	4.6	11.5	0.0	0.0	311.0

270. The Agency's technical co-operation programme with Uruguay continues to be focussed mainly on nuclear medicine, agriculture and animal sciences, followed by nuclear physics, raw materials and nuclear safety. The Nuclear Technology Centre, set up with previous Agency assistance, is now being extensively utilized.

271. The Nuclear Medicine Centre of the Montevideo Clinical Hospital, jointly operated by the Ministry of Health and the Faculty of Medicine of the University of the Republic, is at present the only nuclear medical service in Uruguay and continues to receive Agency support. By 1990, the introduction was completed of computer processing of scintigraphic images, for which equipment and expert services had been provided under an earlier project. Through a multi-year project, the facilities were upgraded to allow three-dimensional and dynamic patient diagnostics. Equipment and expert advice established procedures for clinical aspects, equipment operation and quality control of single-photon emission computer tomography (SPECT). Diagnostic capability by means of in-vitro and in-vivo radioimmunoassay (RIA) procedures was improved in the areas of cardiovascular, gastroenterological, endocrinological, oncological and neurological disorders. As a result of training received by the local staff, the Nuclear Medicine Centre has reached a very high level, frequently serving as host for regional fellowships and training activities sponsored by the Agency. In the coming years new equipment will be provided, with a financial contribution from the counterpart, to meet the demands for services and to improve health care of the population.

272. Since 1989, the Agency has been assisting the Radiochemistry Department and the Nuclear Research Centre at the University of the Republic in radiopharmacology. Equipment, expertise and training in radiopharmacokinetics, autoradiography and optimization in radiopharmacy have made possible the local design of radiopharmaceuticals for diagnosis and kinetic studies, using carbon-15, tritium and technetium-99m as tracers.

An extrabudgetary contribution from the USA funded work on increasing the shelf life of reagents and kits and the introduction of new techniques in quality control of radiopharmaceuticals, which are now being produced on a routine basis and delivered regularly to users at hospitals. This support has led to the production of a wider variety of radiopharmaceuticals for the health sector.

273. Isotopic techniques have been used to establish efficient fertilizer management practices for selected crops and in animal sciences, animal health and reproduction studies. Results obtained from work performed at a laboratory installed under a previous project and developed up to 1989, established the best timing for the application of nitrogen fertilizer in wheat and confirmed the benefit of crop rotation with legumes such as red clover, to take advantage of the nitrogen provided by those plants through symbiotic fixation. A multi-disciplinary group at the Soil Microbiology and Inoculant Control Laboratory of the Ministry of Stockbreeding, Agriculture and Fisheries has been conducting extensive research on the problems affecting biological fixation in pastures, using nitrogen-15 techniques. The quantification of biological nitrogen fixation was studied with a view to application by farmers for improved nitrogen fertilizer practices.

274. Through an extrabudgetary contribution, a study was conducted on soil erosion losses. A technique was introduced by which determination of the caesium-137 fallout in uneroded soils, when compared with data from eroded soils, enabled erosion rates to be established. The results were used to set up a programme for land use in agriculture. During the last five years, a closer interaction has been achieved between the divisions of the Ministry of Stockbreeding, Agriculture and Fisheries in order to carry out a very successful programme in soil sciences to meet the needs of the country. A laboratory for isotope techniques is functioning at the National Directorate for Nuclear Technology. In 1990 its capabilities were strengthened by the provision of a nitrogen-15 analyser which is now fully operational. The laboratory has reached a high level and acts as host institute for training activities in the region. Future activities are foreseen as a continuation of preliminary studies and the establishment of radioisotope techniques with phosphorus-32 for field experiments in crops of economic importance.

275. In animal sciences, with Agency assistance and an extrabudgetary contribution from the USA, a laboratory for RIA techniques was established at the Faculty of Veterinary Medicine at the University of the Republic. Relevant data have been obtained on cattle reproduction, and services to farmers and co-operatives are now available for determining pregnancy of dairy cattle.

276. The Agency's support played an important role in the establishment of the Nuclear Technology Centre. Its nuclear information service now forms part of a national information network in science and technology. An X-ray analysis was set up and is being used for services to external institutions and in environmental studies.

277. A prospection programme for raw materials has been in operation since 1973. The Atomic Energy Commission received expert advice and some items of equipment for the interpretation of existing data and in setting up the programme. Continuing Agency support until early 1990 supported aerial and surface surveys and uranium analysis of sediments and soils, by means of which the paleozoic Godwana Basin and the geological formations belonging to the upper Precambrian were identified as the most promising areas.

278. Previous Agency assistance in radiation protection began with the establishment of an appropriate legal frame. The promulgation of the Radiation Protection Act in 1989 gave a definite impulse to the approval of subsequent regulations and the establishment of an infrastructure to support

them. During the five years under review, the Agency provided the National Directorate of Nuclear Technology with a thermoluminescence dosimetry system and expert advice in order to set up an individual monitoring service. In the coming years this Directorate is expected to become the national authority for radiation protection and nuclear safety.

VENEZUELA

A. CONTRIBUTIONS TO AND PARTICIPATION IN TECHNICAL CO-OPERATION ACTIVITIES

Year	TACF					Extra-budgetary funds	In-kind support	Experts from country	Persons trained in country
	Voluntary Contributions			Assessed Programme Costs					
	Share $	Pledged $	Paid $	Assessed $	Paid $	$	$		
1988	224.2	40.0	40.0	10.2	10.2	0.0	0.0	8	14
1989	247.8	40.0	40.0	28.7	28.7	0.0	0.0	9	0
1990	254.8	9.2	9.2	35.6	35.6	0.0	0.0	6	3
1991	274.4	39.9	39.9	21.2	0.0	0.0	4.4	9	2
1992	294.0	0.0	0.0			0.0	1.0	15	3

B. ASSISTANCE APPROVED AND PROVIDED

Year	Assistance approved from TACF				Total assistance provided from all sources					
	CC	NCC	Total	Region	TACF	TACF	Extra-budgetary	UNDP	In-kind	Total
	$	$	$	%	CC $	NCC $	$	$	$	$
1988	179.3	0.0	179.3	3.4	126.2	1.7	0.0	40.7	0.0	168.6
1989	366.9	40.0	406.9	6.5	284.9	14.6	59.8	135.3	0.0	494.6
1990	258.2	0.0	258.2	3.1	422.0	0.0	22.4	72.4	2.9	519.7
1991	261.8	0.0	261.8	2.9	254.4	0.0	11.0	7.6	11.9	284.9
1992	245.7	0.0	245.7	2.8	526.9	0.0	0.0	5.3	5.1	537.3

279. During the past five years the Agency's technical co-operation with Venezuela has been characterized by a high degree of dispersion among various research institutions and by major emphasis on agricultural projects. While the absence of a central institution dealing with nuclear matters could be seen as an opportunity to take nuclear techniques directly to institutions dealing with practical applications, co-ordination problems cannot always be successfully dealt with by the limited manpower of the Division of Nuclear Affairs of the Ministry of Energy and Mines.

280. Ministry officials have, however, been very active in furthering legislation and regulations in the field of radiation protection. An Agency project led to a pilot training course at the Technology Institute of the Central University of Venezuela, Caracas, as a result of which Ministry staff are now organizing national courses on radiation protection, using (and developing and adapting) material that was part of the pilot course. A Master Plan for Radiation Protection was elaborated by the Ministry and there has been considerable progress in its implementation.

281. The Division of Nuclear Affairs of the Ministry of Energy and Mines is expected to play a major role in a waste management project, scheduled for 1993-94, which was the result of a 1991 WAMAP mission. The main responsibility for the storage of spent radioactive sources will, however, have to lie with a specialized institution. A solution to the serious radioactive waste disposal problems will be one of the challenges of the years ahead. The

Venezuelan Institute of Scientific Research (IVIC) could possibly also play an active role in this field, since it has gained some experience with temporary waste deposits and is also housing the 3 MW research reactor which was shut down owing to safety problems. Although efforts were made during the last few years, with the help of expert advice from the Agency, to evaluate the magnitude of these problems, no solution has yet been found to the financial burden that modernization and upgrading of reactor facilities would place on the Government.

282. A feasibility study by an Agency expert failed to lead to a decision to undertake activities in food irradiation.

283. Although a large-scale (partly UNDP-assisted) project completed in 1991 had to overcome innumerable co-ordination difficulties and did not result in the creation of a nuclear research centre for agriculture, it disseminated the use of nuclear techniques in agriculture and livestock breeding to research institutions including the University of Zulia, Maracaibo, the Central University of Venezuela, Maracay, and the National Fund for Agricultural and Livestock Breeding Research. While the main achievement of this project was the provision of specialized training to a large number of researchers from these institutions, its scientific results were supplemented and completed by follow-up projects in the three areas of soil science, mutation breeding and animal science. Researchers at the Central Western University In Barquisimeto (animal science) and at the IVIC in Caracas also joined these projects and some significant results were obtained which should be implemented in the second phase of the project during the next two years. The successes include: improved mutants of sesame and promising progress in the domestication of Canavalia, a high-content protein source (mutation breeding); progress in nitrogen fixation in legumes and phosphorus availability in agricultural soils (soil science); and studies of the productivity and reproductive efficiency of ruminants (goats and cattle) under tropical conditions as well as Initiation of studies on livestock diseases such as babesiasis (animal science).

284. In the area of nuclear medicine, an intracavitary irradiator with accessories and brachytherapy planning software will enable the Central University's Hospital in Caracas to improve treatment of cervical cancer.

285. An Agency-assisted national training course in 1992 on nuclear techniques in mineral exploration had participants from the Ministry of Energy and Mines and related organizations and from the Central University. The course demonstrated the usefulness of this technique in the exploration of mineral resources such as gold and phosphate and led to a future project which is expected to explore phosphate resources in western Venezuela by means of a carborne gamma ray spectrometry survey.

286. Two projects at the Simon Bolivar University, Caracas, strengthened the nuclear analytical capabilities of the Faculty of Physics in X-ray fluorescence and low-level radioactivity measurements and have enabled the University to provide training for fellows from other Latin American countries. Applied nuclear technology in engineering and industry was added to the syllabus of specialized courses provided at the Technology Institute of the Central University, Caracas, and training for practical application in this field will be continued during the next two years.

287. The well equipped secondary standards dosimetry laboratory at the IVIC can now support a centralized standardizing system for radiation measurements and is also serving some neighbouring countries.

REGIONAL ACTIVITIES IN LATIN AMERICA

Regional Co-operative Arrangements for the Development of Nuclear Science and Technology in Latin America (ARCAL)

ASSISTANCE APPROVED AND PROVIDED

Year	Assistance approved from TACF				Total assistance provided from all sources					
	CC	NCC	Total	Region	TACF	TACF	Extra-budgetary	UNDP	In-kind	Total
	$	$	$	%	CC $	NCC $	$	$	$	$
1988	855.8	0.0	855.8	16.3	1,250.9	78.7	740.2	100.8	296.7	2,467.3
1989	1,317.5	168.0	1,485.5	23.6	1,275.2	0.0	1309.6	9.4	260.4	2,854.6
1990	1,817.2	191.3	2,008.5	23.9	1,556.4	77.6	868.9	-0.1	181.9	2,684.7
1991	1,705.6	105.0	1,810.6	20.3	1,624.8	1.1	159.4	1.2	3,288.9	5,075.4
1992	2,123.7	165.0	2,288.7	25.7	1,987.0	36.8	661.0	33.8	115.8	2,834.4

288. The twenty Latin American and Caribbean countries that are members of the Agency have much in common, including, for most of them, a language. All these countries make wide use of nuclear applications, particularly in the medical field, and to a lesser extent in agriculture and industry, and four have established nuclear power programmes. Some have reached such an advanced stage of development in the applications of nuclear techniques that they are able to transfer technologies to other countries in the region under co-operative arrangements. This was the main intention when a regional co-operative arrangement with the acronym ARCAL was established in 1984 to provide a framework within which Member States in Latin America may co-operate in the area of nuclear science and technology.

289. During the five-year period reviewed here, the number of Member States of the Agency participating in the ARCAL Programme increased from thirteen to seventeen. (Only El Salvador, Haiti and Nicaragua are not participating.) Of the eleven projects that were being implemented in 1988, eight have been concluded during the period under review and the remaining three were extended to allow their objectives to be reached. Four new projects were initiated during the same period. The subjects of these projects reflect the common interest of the countries participating in ARCAL, and they are discussed at periodic meetings held in the region. The technologies required to implement most of the projects are already available in the most developed countries within the region and it is not necessary to resort to technologies from outside. In this way ARCAL pursues one of its main objectives --- to develop the concept of technical co-operation between developing countries (TCDC). Under ARCAL projects, over 90% of the expert services and training, either group or individual, are provided by participating countries, which supply cost-free experts and lecturers, act as hosts to group training events at a minimum cost to the Programme, and in many cases offer type II fellowships.

290. In 1989, when the first five years of the ARCAL Programme ended, Lines of Action for the Second Phase of the Programme (1990-1994) were drafted, by which countries strengthen the TCDC concept by playing a more active role in planning and implementing the projects and by making better use of the infrastructure available in the region. It was agreed that projects should be linked to the social and economic priorities set by the region; they should involve whenever possible the end-users of the technology to ensure

sustainability of activities at the conclusion of the projects and they should be more practically oriented. Countries participating in ARCAL agreed to limit the number of projects to those with a significant impact and to ensure better implementation by taking into account the limited resources available. In 1992 a major effort to strengthen the Programme was made by revising the original guidelines. It is believed that the revised guidelines will provide greater clarity about the operation of the Programme and will encourage stronger commitment to its goals in the participating countries.

291. The level of funding of ARCAL has stabilized at about two million dollars per year, nearly two-thirds of which is provided by the Agency through the regular technical co-operation programme, research contracts and the regular budget of the other Divisions of the Agency. The other one-third comes from extrabudgetary contributions by Germany, the USA, France, Sweden, Italy, Spain, Canada, the European Community and the UNDP. In addition, ARCAL Members provide logistic support for meetings, cost-free experts and lecturers for regional and national events, expert support and laboratories for research contracts and agreements, and in some cases type II fellowships and payment of per-diem to participants in training activities. This contribution amounts to about 1.3 million dollars per year.

292. During the period covered by this report, 132 regional training events and 96 national courses were organized, with the participation of more than 4300 scientists and technicians. Many of the regional training courses were of the "train the trainers" type and they are helping to transfer the technologies without further assistance from the Agency. Regional co-ordinated research programmes in animal sciences, maintenance of nuclear instruments, analytical techniques in food and agriculture, calculation of reactor cores using low enriched uranium, food irradiation, utilization of bulk reagents for radioimmunoassay (RIA) of thyroid-related hormones, mutation breeding to improve rice and other cereals, use of isotope and geochemical techniques in exploration of geothermal resources, were important components of several projects since they not only achieved the results expected from these co-ordinated research efforts but contributed to the establishment of networks of scientists working on the same subject. Another important aspect of several ARCAL projects is the optimization of the technical co-operation provided by the Agency through different channels. ARCAL projects co-ordinate the assistance provided through national projects, co-ordinated research programmes and regional projects.

293. The main achievements of the projects concluded are as follows: The project on nuclear science and technology development established a solid ARCAL programme by facilitating periodic meetings for planning and co-ordination of activities and by sponsoring project preparatory missions. The project on RIA in animal reproduction developed techniques that are being used in several countries to increase the reproductive efficiency of cattle. The research reactor utilization project established an infrastructure in physics and thermohydraulics calculations of cores converted to low enriched uranium, and widened the range of utilization of research reactors in countries where they are operated. The food irradiation project concluded that much legislation, public acceptance and development of procedures are needed before this technology can be industrialized. The project on improvement of cereals through mutation breeding established in-vitro laboratories which led to the development of some promising varieties of rice and other cereals in some of the participating countries. However, additional assistance is needed before mutation breeding programmes can be self-sustained in most of the countries. The project on RIA of thyroid-related hormones established the bulk-reagent methodology, and the cost of the assays has decreased since commercial kits no longer have to be imported. Quality control programmes have also been established for these procedures. All reagents for production

of T-3 and T-4 kits can now be produced in the region. The project on nuclear information established comprehensive information centres in Chile, Colombia, Costa Rica, Cuba, Ecuador, Guatemala, Panama and Peru, where library processes have been computerized. A regional network for the exchange of information was also established. A co-ordinated research programme incorporated the dependable isotope and geochemical techniques in the exploration of geothermal resources.

294. Three projects which have partially achieved their objectives were extended beyond 1992. One, on radiation protection, has strengthened existing infrastructures in participating countries by helping to establish adequate national legislation and standard regional procedures and units, training personnel in specific radiation protection practices and supplying equipment to improve existing programmes. A project on nuclear instrumentation has established in each participating country a laboratory to provide preventive and corrective maintenance of nuclear instruments, organized a service to provide spare parts not available in participating countries, supported the assembly of equipment such as area monitors to be distributed in the region, and, through training events, upgraded the capacity to diagnose failures and operate the most widely used equipment. A project on nuclear analytical techniques has established quality assurance concepts to increase precision and sensitivity in nuclear activation analysis and X-ray fluorescence.

295. New projects have been initiated. One, on RIA in animal production and health, is developing more adequate feeding practices to increase production in small farms and methods of diagnosing disease to help participating countries to apply control measures. Another project on production of RIA reagents is establishing self-sufficiency in commercial production of reagents for T-3, T-4 and TSH kits and their use in national programmes for detection of hypothyroidism in newborns. A third project deals with the use of isotope techniques in the study of water resources and their contamination. Finally, in 1992, two projects on production of radiopharmaceuticals and on industrial applications of nuclear technology were initiated. The first intends to establish production of the most commonly used radiopharmaceuticals to replace imports, and the second will introduce nuclear technologies (mainly radiation technology, nucleonic control systems and industrial tracers) into industrial processes to improve their control, decrease costs and lead to the manufacture of better products.

296. Two short-term ARCAL projects were training events on the use of the sterile insect technique to control flies, and the provision of expert services for studies of plant-soil productivity and the use of labelled fertilizers in research work.

Non-Destructive Testing in Latin America

297. The activities in non-destructive testing (NDT) that were initiated through a regional project in 1982 and were subsequently strengthened through two additional projects came to an end in 1991. The original objective of building up an autonomous capacity for NDT in the region was achieved and surpassed. The number of participating countries in the activities grew to 18 with the inclusion of Costa Rica in 1988. These countries committed themselves to providing facilities, personnel, equipment and funds as the counterpart contribution and, most important, they established a strong base for horizontal co-operation through a regional network. Differences in languages, customs, education, industrial development, political systems and economics were overcome.

298. Argentina, Canada, Germany, Italy, the IAEA, UNIDO and UNFSTD provided funds and assistance-in-kind in an amount close to 7.8 million dollars for the duration of the activities. The projects were managed from a regional office hosted by the National Atomic Energy Commission in Argentina.

299. As a result of these projects, industry throughout the region is now aware of the need for NDT and there is widespread application following international standards. All countries participating in the projects have functioning national committees which co-ordinate NDT activities and unite the majority of NDT users in each country. The results and achievements of these activities can be summarized as follows:

1) From the small groups competent in specific NDT techniques which were identified at the beginning of the project, there are now more than twenty thousand persons trained and working in these techniques throughout the region.

2) All 18 participating countries have sufficient personnel trained in the five basic NDT techniques to at least level 2 to meet their everyday NDT needs. All countries are able to provide training in the basic techniques with their own personnel.

3) A total of 6275 persons participated in 85 regional and 254 national training events with project input. At least 22 213 persons were trained in national events without project input but following project training guidelines and methodology. This demonstrates the multiplying effect achieved by adhering to the original project design.

4) A total of 258 expert missions were carried out by regional lecturers from 13 project countries. A total of 98 missions were undertaken by international experts, mainly from donor countries but including experts from other countries (France, the Netherlands and the USA).

5) The region played a major role in drafting a standard of the International Organization of Standardization (ISO) for qualification and certification of NDT personnel, thus assuring that the needs of developing countries were respected and included. Fourteen project countries now have national standards for qualification and certification of NDT personnel following the ISO standard.

6) Training programmes for the main NDT techniques were elaborated and published by the IAEA as TECDOC-628. This document is also a recommended guideline in the ISO standard.

7) An efficient and effective computer-based management system was developed. A communications network, based on the Co-ordination Office but active between countries, was built up, permitting frequent and rapid exchange of information. Using the Agency's mainframe computer, an electronic mail system was developed and is in constant use. This system permits direct access to an NDT and quality databank installed in the co-ordination office.

8) A Regional Federation of National Non-Destructive Testing Organizations of Latin America and the Caribbean was established in 1988 with the participation of all project countries, to ensure continuity in NDT activities in the future.

9) Thirteen project countries were confirmed as members of the international Committee for NDT, out of a total of 47 members, which indicates that these countries have reached technical competence at the international level.

10) Specialists from project countries co-operated in training activities in Africa and Asia and other regions followed the project methodology.

300. In 1991 a follow-up project on NDT in quality control programmes was initiated in order to introduce the concept of quality control and quality assurance as an integral part of industrial production and construction activities. This concept was realized using NDT methods. The new three-year project is financed by Germany and the Agency and is being used to establish a future project on quality management and quality control that will enhance the existing regional infrastructure as related to the adoption of quality systems, processes and standards.

Other Regional Activities

301. During the five years under review, activities on quality control of in-vivo procedures in nuclear medicine came to an end. The project was implemented with the collaboration of WHO and the Asociación Latinoamericana de Sociedades de Biología y Medicina Nuclear (ALASBIMN) and included a co-ordinated research programme. One regional and several national workshops were held in the eleven participating countries. A report (TECDOC-317 - Quality Control of Nuclear Medicine Instruments) published by the Agency, served as the basic training and operational manual. Test sources and phantoms were supplied to users involved in routine procedures to test and validate instruments.

302. The main achievements under the project can be summarized as follows: international standards of quality control procedures are being followed by participating institutions based on TECDOC-317; dose calibrators, scanners and a number of gamma cameras have routine quality control operations; national intercomparison programmes on quality control and recommendation for corrections have started and are proceeding towards central control and certification procedures.

303. A project on nuclear power planning started in 1991 to foster the exchange of information and experience on all aspects of nuclear power programmes among the four countries in the region that have these programmes. The Agency has sponsored workshops and the implementation of regional expert missions as well as the participation of some staff to provide guidance in the workshops. In this way the Agency facilitates development of co-operation between the nuclear power programmes in the region. In the same year, a new project on environmental studies using nuclear techniques was initiated with the participation of five countries and with funds from Germany and the Agency. The project supports the use of nuclear analytical techniques in environmental pollution studies. In two countries the studies refer to air pollution and in the other three to water pollution.

304. In 1989 a regional project on manpower development was initiated to fund fellowships and scientific visits. In this way advanced training is provided to Member States according to the needs of their nuclear development programmes but for which no allocation has been made in a current national technical co-operation project.

305. The regular training programme has offered courses on radiation

protection, nuclear fuel cycle and waste management, human health, food and agriculture, environment, physical and chemical sciences. The course on medical scintigraphy and another on safety and regulation of radiation sources were repeated because of the important need for training in these subjects.

306. For the coming years it is foreseen that new regional projects will be initiated on quality assurance in nuclear medicine, utilization of tracer techniques in dam leakage, and legal framework for radiation protection programmes.

IV. PROJECTS CONCLUDED DURING 1992: ACHIEVEMENTS

In the following pages, brief accomplishment summaries are given for projects - excluding training courses - which were "operationally" completed during 1992. For the project cancelled during this period, the reasons leading to its cancellation are given.

A project is "operationally completed" when all experts have completed 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 depends on actions by the national authorities and counterparts and 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/2/007 X-RAY FLUORESCENCE ANALYSIS

COMPLETED: **92-12-30** TOTAL COST: **$73,053**

TO CONSOLIDATE THE USE OF X-RAY FLUORESCENCE TECHNIQUES, ESPECIALLY FOR TRACE ANALYSIS OF HEAVY ELEMENTS.

The Agency supported the project, which was initiated in 1988, by the provision of new equipment, including a Si(Li) detector and a computer system, as well as repair of the existing X-radiation detector and the Ge(Li) detector. One fellowship was awarded and two experts provided training in sample preparation. As a result of the project, the use of X-ray fluorescence techniques at the Institute of Nuclear Physics, Tirana, has been consolidated.

ALGERIA

ALG/1/005 SECONDARY STANDARDS DOSIMETRY LABORATORY

COMPLETED: **92-12-30** TOTAL COST: **$290,171**

TO ESTABLISH AN SSDL IN SUPPORT OF MEDICAL APPLICATIONS.

The Agency has been assisting the Government of Algeria since 1981 in establishing a secondary standards dosimetry laboratory (SSDL) at the Centre for Radiation Protection and Safety, Algiers, for calibration and certification of radiation equipment used in research, radiation processing and nuclear medicine. Through training six staff abroad and provision of equipment and expert services, the SSDL in Algiers is now capable of providing a wide range of dosimetry services to various users of radiation equipment throughout the country. The services have adequately met the radiation protection regulations for users and include dose calibration and certification of radiation instruments as well as the design of relevant dosimetry methods for standardizing industrial application and dose quality control of radiotherapy equipment. The laboratory has also developed and routinely provides a training programme for radiation workers and radioisotope users in dosimetry and calibration which mainly benefits the health care sector. All radiotherapy equipment is routinely calibrated and controlled by this laboratory. The Government has shown a firm commitment to the project by providing for the construction of the premises and the purchase of major pieces of equipment. It is expected that the laboratory will continue to promote more accurate and reliable radiation dosimetry for radiation protection and to support industrial radiation processing activities in Algeria.

ALG/5/010 ESTABLISHMENT OF A MICROBIOLOGY LABORATORY

COMPLETED: **92-07-13** TOTAL COST: **$46,153**

TO ESTABLISH A MICROBIOLOGICAL LABORATORY FOR QUALITY CONTROL OF FOODSTUFFS IN SUPPORT OF A FOOD IRRADIATION PROGRAMME.

The project provided equipment and expert services which led to the establishment of a microbiological laboratory. This is now fully operational and is being used for quality control of foodstuffs (onions, potatoes, dates, spices) irradiated in the pilot irradiator facility in Algeria. This laboratory will play a key role in the national food irradiation programme as the authorities have decided to acquire an industrial food irradiator.

ALG/5/011 PESTICIDE RESIDUES

COMPLETED: **92-05-14** TOTAL COST: **$183,785**

TO STRENGTHEN THE CAPABILITY OF THE CENTRE FOR DEVELOPMENT OF NUCLEAR TECHNIQUES FOR THE APPLICATION OF RADIOTRACER TECHNIQUES TO STUDY TRANSLOCATION, MOBILITY AND DEGRADATION OF PESTICIDE RESIDUES IN THE FOOD CHAIN.

The project was initiated in order to tackle problems related to the use of pesticides in Algeria. Equipment was provided to the Centre for Development of Nuclear Techniques for radiotracer techniques (automatic liquid scintillation counter, sample oxidizer, fume hood, high performance liquid chromatograph, glassware, chemicals) together with expert services and fellowship training abroad for two scientists. Studies were carried out, using radiotracers, to determine the fate, behaviour and degradation mechanisms of pesticides such as malathion residues in stored wheat, C-14 maneb in lettuce, tomatoes and lindane (used for locust control). To date, the programme has led to five scientific manuscripts either published or in preparation. The group of scientists concerned has now assumed the task of monitoring pesticide residues in food and environment in Algeria, and the data are being used by the competent authorities to review environmental policy making.

ARGENTINA

ARG/4/078 NUCLEAR ENGINEERING, PHASE II

COMPLETED: **92-12-23** TOTAL COST: **$239,742**

TO COMPLETE THE PROMOTION OF RESEARCH AND DEVELOPMENT ACTIVITIES IN NUCLEAR ENGINEERING AT THE BARILOCHE ATOMIC CENTRE.

The project was a continuation of the activities that had started under phase I which ended in 1989. The second phase completed the various research activities at the Bariloche Atomic Centre and consolidated the infrastructure for the nuclear engineering programme at the Cuyo National University. To this effect, eight expert missions were carried out, and ten scientific visits were financed in specialized institutions in France, Germany, Italy, Spain and the United States. In addition, equipment was provided to suit the needs of three research areas. Twenty additional nuclear engineers were granted degrees making it a total of 138 since 1981 and eight doctoral thesis were presented.

BANGLADESH

BGD/0/003 DATABASE DEVELOPMENT

COMPLETED: **92-12-30** TOTAL COST: **$20,799**

TO ADVISE ON AND PLAN A PROJECT FOR THE DESIGN, DEVELOPMENT AND IMPLEMENTATION OF A DATABASE FOR NUCLEAR INFORMATION.

This project, approved in 1983, was originally intended to provide expert services and advice on nuclear information and to supply equipment and software to assist the development of a database. An Agency expert undertook a mission to evaluate the requirements and recommended the use of ISIS software, available free of charge from UNESCO. Two further expert missions were undertaken to assist with the installation and implementation of the DOS version of CDS/ISIS. The experts conducted a training course on the use of several software packages and demonstrated the online features of CDS/ISIS and certain instructions on applications of the package. Three project-related fellowships were awarded for training in the use of the software. At a later stage, with the development of new optical technologies, the Agency provided a CD-ROM player with the software necessary to retrieve information

from INIS compact disks. The information services established are being used by scientists and engineers in support of their R&D work on nuclear science and technology.

BGD/1/010 TRACE ANALYTICAL LABORATORY

COMPLETED: **92-12-30** TOTAL COST: **$141,087**

TO STRENGTHEN THE LOCAL CAPABILITY FOR RAPID AND PRECISE ELEMENTAL ANALYSIS REQUIRED BY VARIOUS SECTORS OF THE NATIONAL ECONOMY.

The Atomic Energy Centre (AEC), Dhaka, provides a wide range of analytical services to the Bangladesh Atomic Energy Commission (BAEC) and other institutions and industries in the country. The Agency provided a tube-excited X-ray generator, a Si(Li) detector, a PIXE vacuum chamber, an atomic absorption spectrometer, a heated graphite furnace, a high purity germanium coaxial detector and a desktop computer. Four Agency experts undertook four missions to provide training and to assist in the installation of the tube-excited X-ray system. As a result of the Agency's systematic assistance to the nuclear analytical laboratory, the BAEC now has a reasonably equipped and adequately staffed laboratory for advanced techniques including tube-excited X-ray analysis, X-ray fluorescence analysis, proton-induced X-ray emission techniques (PIXE), and atomic absorption spectrometry. Electrochemical methods for analysis of certain samples have also been introduced. The Van de Graaf accelerator of the AEC, previously used in nuclear structure studies, is now almost entirely devoted to the PIXE activities. The laboratories have developed intensive co-operation with a number of government institutions. Analysis of medical, biological and mineral samples Is performed routinely and analytical services are offered to private enterprises on a contractual basis. A number of studies have been carried out on the optimization and improvement of nuclear analytical techniques, comparison of these techniques with classical methods, and their application to specific problems. The project has resulted in an adequate number of well trained staff. The Agency's provision of training, both individual and through training courses, complemented initial training received in the home laboratory.

BGD/5/013 NUCLEAR TECHNIQUES IN AGRICULTURE

COMPLETED: **92-12-30** TOTAL COST: **$140,329**

TO STRENGTHEN RESEARCH AND DEVELOPMENT ACTIVITIES IN THE FIELD OF AGRICULTURE THROUGH THE APPLICATION OF RADIOISOTOPES AND RADIATION TECHNOLOGY.

The project covers two major areas of study: (a) soil fertility and crop production, and (b) plant breeding. The primary objectives of the soils component was to find ways, through isotope-aided research, to increase grain legume production, and develop inoculum technology. The plant breeding activities aimed to establish a tissue culture laboratory. After a programming mission by two Agency staff members, the project was approved in 1988 with footnote-a status, and was mainly funded through an extrabudgetary contribution by the United Kingdom. The project was implemented at the Bangladesh Institute of Nuclear Agriculture (BINA), Mymensingh. Two experts undertook four missions to provide training in soil microbiology and plant tissue culture. The experts also assisted in the design

of field experiments to measure nitrogen fixation in chickpeas, lentils and groundnuts using the N-15 method as well as in doubled haploid methods by in-vitro culture of anthers of rice mutation breeding. Two Agency technical staff members visited the project and assisted in planning and assessing the achievements of the project. Equipment provided included a liquid scintillation counter, a table-top nuclear magnetic resonance spectrometer, an analytical balance, a laminar flow hood, radiolabelled fertilizers and certain laboratory supplies. One project-related fellowship was awarded for 12 months in the United Kingdom. Under this project, field studies resulted in the identification of elite strains of rhizobia which, in combination with appropriate host legumes, have fixed greater amounts of nitrogen than the low yielding cultivars. By this method the yield of chickpeas has been boosted by 30%-40% and that of groundnuts by 30%-50%. Farmers have responded enthusiastically because of the enormous cost-benefit advantage of adopting this method.

BGD/6/009 NUCLEAR MEDICINE (PHASE II)

COMPLETED: **92-12-30** TOTAL COST: **$94,385**

TO UPGRADE AND MODERNIZE FACILITIES AT THREE NUCLEAR MEDICINE CENTRES.

During the last two decades, the Agency has provided Bangladesh with substantial assistance in nuclear medicine. In 1989, the Bangladesh Atomic Energy Commission (BAEC) sought Agency assistance to upgrade and modernize facilities at various centres. Under this project, the main beneficiary was the Nuclear Medicine Centre in Chittagong, which serves the population in south-east Bangladesh. Equipment provided to the Centre included a radioimmunoassay system (gamma counter and data processor), an in-vivo probe detector system for dynamic functional studies in patients, and a radioisotope calibrator for measuring radiopharmaceutical doses before administering them to patients. Five fellowships were awarded for training abroad, two of which were funded by India. As a result of the project, nuclear medicine services have been strengthened and extended to provide a wider range of investigation. The Chittagong Centre is now able to provide nuclear cardiology services for the first time in Bangladesh.

BGD/8/004 TRACERS IN SEDIMENTOLOGY

COMPLETED: **92-12-30** TOTAL COST: **$145,914**

TO DETERMINE THE DIRECTION AND RATE OF SHORE SAND MOVEMENT PREVAILING ON EITHER SIDE OF THE KARNAFULI OUTFALL (CHITTAGONG) AND TO IDENTIFY A SUITABLE DUMPING SITE FOR THE DREDGED MATERIALS.

Chittagong is the most important seaport in Bangladesh but it has a sedimentation problem. Despite extensive efforts by the port authorities to dredge the Karnafuli River bed and harbours, the dredged areas become silted up within a year or two. In 1984, the Government sought Agency assistance in establishing a laboratory for the Bangladesh Atomic Energy Commission (BAEC) to investigate bottom sediment transport, using radioactive scandium (Sc-46) glass as tracer. An Agency expert undertook three missions to assist in planning and implementing the project. The Agency provided specialized counting systems for oceanographic use, a tracer injection system,

scandium labelled glass, sampling equipment (vibro-corer) and a computer system. The scandium glass was irradiated at the BAEC nuclear reactor at Savar. The BAEC, in co-operation with the harbour authorities, provided the boat and positioning equipment for the experimental work. Two tracer injections were performed in April 1990 at Chittagong port, and several tracking campaigns were carried out by a counterpart during the next few months. The results obtained were satisfactory and provided information on the movement of the sediment in the zone under investigation. One fellowship was awarded for practical training abroad and one national consultant mission was arranged for the main counterpart to visit Malaysia during the presence of the Agency expert to present and discuss the results obtained during tracking campaigns after the Chittagong experiment. It is considered that the technology transferred and the level of information acquired by the staff of the counterpart institute will allow them to conduct future tracing experiments successfully.

BGD/8/009 RADIATION INDUCED VULCANIZATION OF NATURAL RUBBER LATEX

COMPLETED: **92-12-30** TOTAL COST: **$74,152**

TO ESTABLISH A RESEARCH LABORATORY FOR RADIATION VULCANIZATION OF NATURAL LATEX.

The project was approved in 1990 to transfer technology for radiation vulcanization of natural rubber latex (RVNRL). This technology had been developed through a UNDP/IAEA/RCA regional project. The present project is intended to complement the regional project and to establish the necessary infrastructure. Basic equipment provided for preparation of specimens and testing product quality included a centrifuge machine, thickness gauge, viscometer, gear ageing oven, compact circulation thermostat and a universal ball mill. An Agency expert advised on setting up the laboratory and on the research programme. One staff member was awarded a scientific visit to a radiation chemistry research establishment in Japan. As a result of the project, the Institute of Nuclear Science and Technology, Dhaka, is now well prepared to carry out research to transfer the technology to local industry.

BGD/9/006 OCCUPATIONAL RADIATION MONITORING

COMPLETED: **92-12-30** TOTAL COST: **$136,340**

TO INTRODUCE AN ENVIRONMENTAL MONITORING PROGRAMME AND THE TECHNIQUES NEEDED FOR MEASURING LOW-LEVEL RADIATION; TO ESTABLISH A WHOLE-BODY COUNTER SYSTEM TO MEASURE BODY BURDENS AND THE DISPERSION OF RADIONUCLIDES IN THE BODY.

This project, initiated in 1989, was the result of a RAPAT and a WAMAP mission to Bangladesh. The Bangladesh Atomic Energy Commission (BAEC) sought Agency assistance in strengthening occupational radiation protection to fill the gaps in the country's efforts to establish a radiation protection programme that would provide personal monitoring for all radiation workers, with particular emphasis on personnel involved in the peaceful uses of ionizing radiation. Equipment provided by the Agency included a thermoluminescence dosimetry system, personal dosimeters, survey meters and portable X-ray and surface contamination monitors. One of the counterpart staff received long-term

training abroad and one expert gave on-the-job training. The expert helped the Nuclear Safety and Radiation Protection Division to prepare a document on the basic principles of radiation protection in medicine as well as instructions for carrying out area and personal monitoring. The expert also assisted in drafting and implementing the radiation protection infrastructure. As a result of the project, the radiation protection infrastructure in Bangladesh has been strengthened.

BOLIVIA

BOL/0/005 NUCLEAR CENTRE INFRASTRUCTURE

COMPLETED: **92-11-18** TOTAL COST: **$111,328**

TO DEVELOP PHYSICAL SCIENCES AT THE NUCLEAR RESEARCH CENTRE, VIACHA.

As a result of the project, the X-ray fluorescence laboratory and the neutron generator facility of the Nuclear Research Centre were upgraded and the technical capacity in physical sciences of the professionals of the Centre improved. This part of the project was financed by the USA. Following the recommendation of a field mission, the Agency financed the infrastructure of sewage and electricity at the Centre. Unfortunately, owing to economic and administrative constraints, the laboratories are practically unused as most of the trained staff have left the Institute.

BOL/2/008 X-RAY FLUORESCENCE

COMPLETED: **92-09-08** TOTAL COST: **$193,876**

TO EXTEND THE CAPACITY OF IBTEN'S NUCLEAR ANALYTICAL LABORATORY FOR APPLICATIONS IN NUCLEAR AND REACTOR PHYSICS AS WELL AS IN MINING AND AGRICULTURE.

Since 1981 the Agency has been assisting the Bolivian Institute for Nuclear Science and Technology (IBTEN) in establishing a nuclear analytical laboratory. The Agency supplied expert advice and long-term training (30 months) of local staff. Expansion of the research and analytical capability of the nuclear analytical laboratory was accomplished by the application of X-ray fluorescence and nuclear activation analysis techniques. Equipment supplied under the project included a data processing system, a neutron and tritium monitor, a liquid nitrogen production plant, and the necessary spare parts. Owing to economic and administrative constraints, the laboratories are, unfortunately, practically empty as most of the trained staff are no longer working for IBTEN.

BOL/4/005 NUCLEAR ELECTRONICS

COMPLETED: **92-09-15** TOTAL COST: **$51,998**

TO SET UP A LABORATORY WITH QUALIFIED STAFF TO PROVIDE MAINTENANCE AND REPAIR SERVICE TO ALL NUCLEAR INSTRUMENT USERS; TO ASSIST IN THE DESIGN AND DEVELOPMENT OF SPECIFIC NON-COMMERCIAL SPARE PARTS.

Under this project, initiated in 1988, the Agency provided expert advice, training and equipment. On completion of the project a laboratory was established at the Bolivian Institute for Nuclear Science and Technology, La Paz, with qualified staff to ensure correct operation and regular maintenance of nuclear electronic equipment and to design and develop specific non-commercial spare parts. Unfortunately, this achievement has not been sustained since, owing to economic and administrative problems, almost all trained staff left the Institute.

BOL/5/004 RADIOISOTOPES IN AGRICULTURE

COMPLETED: **92-09-08** TOTAL COST: **$549,849**

TO STUDY SOIL AND FERTILIZER AVAILABILITY IN ORDER TO INCREASE CROP PRODUCTION.

From 1981 to 1987 the Agency assisted the Bolivian Institute for Nuclear Science and Technology (IBTEN), the Bolivian Institute of Agriculture, and other research institutes in the use of nuclear techniques in agriculture in an effort to increase agricultural productivity in the Bolivian highlands. As a result of this large-scale project, two laboratories were created, one to study soil fertility problems and soil-plant relationship in wheat and potatoes, and the other, financed by the United Kingdom, for tissue culture to initiate activities related to the cultivation of new varieties of lupin, quinoa and maize resistant to cold, drought and salinity. Expert missions and equipment for the two laboratories were provided, and a large training programme of 34 months was implemented. Unfortunately, owing to economic and administrative constraints, the laboratories are practically unused as most of the trained staff are no longer working for the project. In addition, one of the main objectives, to co-ordinate activities with the Ministry of Agriculture and other research institutions, was not fully accomplished.

BOL/5/005 NUCLEAR TECHNIQUES IN SOIL-SCIENCE STUDIES

COMPLETED: **92-09-08** TOTAL COST: **$94,158**

TO DEVELOP NUCLEAR TECHNIQUES SUITED TO THE ANDEAN REGION WITH A VIEW TO ACHIEVING INCREASED AGRICULTURAL OUTPUT AT THE LOWEST POSSIBLE COST.

In the Bolivian highlands, traditional land management practices and serious edapho-climatic problems - such as soil salinity, low soil fertility, water shortages for the major part of the year, and frosts that can occur in any season - are responsible for low yields and poor crop quality. The main crops affected are potatoes, quinoa, barley and wheat. This project, initiated in

1988 to increase agricultural output, assisted the Bolivian Institute for Nuclear Science and Technology (IBTEN) in the design and evaluation of experiments related to the efficient use of fertilizer and water management for the highlands. Expert services, laboratory equipment and labelled fertilizers were provided under the project. Co-operation with the Ministry of Agriculture and the Faculties of Agronomy at Cochabamba and Oruro, which was foreseen as a way to extend the use of nuclear techniques, did not fully materialize owing to economic constraints on the part of IBTEN.

BOL/6/011 RADIOIMMUNOASSAY

COMPLETED: **92-05-14** TOTAL COST: **$153,858**

TO EXPAND AND SUPPLEMENT THE RADIOIMMUNOASSAY PROGRAMME (PLASMATIC DETERMINATIONS AND ELECTROPHORESIS FOR DETECTION OF HORMONAL ALTERATIONS).

The Agency supplied the equipment to upgrade two laboratories and create two new ones. Expert advice and training In connection with proteins and steroid hormone radioimmunoassay (RIA) helped to create a Centre for Radioimmunoassay in La Paz. By 1987 the La Paz RIA Laboratory had become the focal point for training and transfer of technology through co-ordination, production and distribution of reagents at the national level. As a result of the project, a national network of RIA laboratories has been established in Bolivia, with the participation of four hospitals of the Ministry of Social Welfare and Public Health, in La Paz, Sucre, Cochabamba and Santa Cruz. Bolivia is now self-sufficient in this field.

BOL/6/012 COMPUTER GAMMA CAMERA STUDIES

COMPLETED: **92-09-08** TOTAL COST: **$39,416**

TO IMPROVE THE CAPACITY FOR DIAGNOSING MINERS, PATIENTS LIVING AT HIGH ALTITUDES AND/OR WITH CONGENITAL HEART DISEASES.

The project was approved in 1983 and funded by the USA to improve respiratory and cardiac function studies, using nuclear techniques, with a view to developing diagnostic methods for silicosis and other circulatory and respiratory diseases associated with high altitudes. As a result of the project, the technical staff of the Nuclear Medicine Centre, La Paz, have been trained in the use, repair and quality control of a computer gamma-camera system, thus improving diagnosis of patients living at high altitudes and those with congenital heart diseases. The Agency supplied expert services, equipment and spare parts as well as equipment and training for an adequate radiation safety programme. Technetium-99m generators were also provided for a short period.

BOL/6/013 NUCLEAR MEDICINE CENTRE UPGRADING

COMPLETED: **92-05-14** TOTAL COST: **$88,609**

TO EXPAND THE RANGE OF NUCLEAR MEDICINE SERVICES AVAILABLE; TO ESTABLISH FACILITIES FOR MAINTENANCE AND REPAIR OF ELECTRONIC EQUIPMENT.

In 1983 the Ministry of Social Welfare and Public Health assumed responsibility for the Nuclear Medicine Centre, La Paz, mainly in order to strengthen the infrastructure for expansion of nuclear medicine services available in Bolivia. To support this development, the Government requested Agency assistance. As a result of the project, initiated in 1984, the Nuclear Medicine Centre was upgraded and the diagnostic services for low-income patients improved. The Centre also now serves as a teaching institution for advanced medical students. A maintenance and repair capability was established for the existing medicine equipment and for future laboratory instruments. The Agency supplied electronic equipment, spare parts and expert advice.

BOL/6/014 NUCLEAR MEDICINE CENTRE

COMPLETED: **92-09-09** TOTAL COST: **$236,795**

TO UPGRADE EQUIPMENT IN ORDER TO MAKE NUCLEAR MEDICINE DIAGNOSTIC TESTS AVAILABLE TO A LARGER NUMBER OF PATIENTS, SPECIALLY THOSE AFFECTED BY MYOCARDIOPATHY, CHAGAS, GOITRE DISEASES AND SILICOTUBERCULOSIS.

The National Institute for Nuclear Medicine (INAMEN), La Paz, which was opened in 1982, is the only nuclear medicine centre in Bolivia and serves all income groups. However, its equipment was obsolete and spare parts were no longer available. As a result of this project, complemented by the extrabudgetary project BOL/6/015 funded by France, a new gamma camera was installed and diagnostic procedures were improved and made available to low-income patients. The equipment will be used eventually to determine human cardiocirculatory and pulmonary parameters of endemic diseases in the Bolivian highlands.

BOL/9/005 RADIATION PROTECTION

COMPLETED: **92-12-30** TOTAL COST: **$125,583**

TO ESTABLISH RADIATION PROTECTION PROCEDURES, PARTICULARLY IN OCCUPATIONAL MONITORING AND RADIATION SAFETY INSPECTION PROGRAMMES.

This project, approved in 1980 with footnote-a status, was upgraded in 1983 and funded by the Agency's TACF. It was intended to strengthen the basic radiation protection capability of the Bolivian Institute for Nuclear Science and Technology (IBTEN), as a continuation of two previous projects. Expert services on regulation, monitoring and radiation dosimetry for a total of about 6.5 man-months were provided. An IBTEN staff member was awarded a fellowship for training in radiation protection. A thermoluminescence dosimeter (TLD) and accessories, monitoring equipment, a gamma irradiator and an alpha- beta nuclear spectrometer were also provided. As a result of the project, radiation

safety in practices involving the use of ionizing radiation was improved by the introduction and establishment of adequate radiation protection procedures, through the strengthening of technical capabilities and through the provision of radiation monitoring and calibration equipment. An operational personnel dosimetry service was established for monitoring occupational radiation exposure from external radiation on a regular basis, making use of TLD equipment. Updated radiation protection regulations were prepared for promulgation by the national authorities, and IBTEN achieved the capability to carry out inspections for radiation safety purposes.

BRAZIL

BRA/1/030 STRENGTHENING OF DOSIMETRY

COMPLETED: **92-11-18** TOTAL COST: **$121,644**

TO SET UP AN ABSOLUTE COUNTING SYSTEM TO MEASURE NUCLIDES WITH COMPLEX DECAY SCHEMES; TO SET UP QUALITY CONTROL FOR RADIOACTIVE STANDARDS.

The project was approved in 1989 for three years in order to increase the capability of the Institute for Radiation Protection and Dosimetry, IRD/CNEN, Rio de Janeiro, in response to the need for radioactivity standards in Brazil. Initially, the Agency provided an expert to develop an implementation plan to establish a primary laboratory for radionuclide metrology. It was determined that no additional expert missions would be required and the resources thus made available were used for fellowships and the equipment needed to provide routine service for standardization and quality control in radioisotope production, environmental radioactivity measurements, radiotherapy and radiodiagnosis. Three fellowships were awarded for training abroad. The absolute activity measuring system set up as a result of the project reduced the uncertainty in the standardization of many of the radionuclides supplied to users and increased the number of radionuclides that can be standardized in the laboratory. These improvements will benefit the overall nuclear programme in Brazil, in particular the areas of environmental monitoring control, nuclear medicine and scientific research.

BRA/9/034 MEDICAL AND ENVIRONMENTAL ASPECTS OF THE GOIANIA ACCIDENT

COMPLETED: **92-12-30** TOTAL COST: **$276,380**

TO EVALUATE Cs-137 DISPERSION IN THE ENVIRONMENT AND CARRY OUT BIO-ASSAY STUDIES ON INDIVIDUALS INVOLVED IN THE GOIANIA ACCIDENT.

As a result of the Goiania accident in 1987, the environment was contaminated with a large amount of Cs-137. Brazil requested Agency assistance to enable the Institute for Radiation Protection and Dosimetry (IRD/CNEN) to carry out a complete study of the environmental impact of the Cs-137 dispersion in the environment. Although several similar studies have been carried out in Europe and the USA, such data cannot be applied in a tropical environment. As a result of the project, important conclusions were reached on the basis of studies conducted on caesium resuspension in urban areas, uptake from the soil by chickens, external contamination and uptake by leafy vegetables and the mobilization of caesium in water. The project was initiated in 1989, and a

large number of samples were collected and analysed. The results were used in the development of an urban radioecological model describing the behaviour of radionuclides under tropical conditions. On the medical side, studies were conducted directly on individuals, and the findings indicated the presence of caesium in scar tissue. Further studies were undertaken to define the distribution of caesium in other individuals showing activity where no scar tissue was present. Bio-assay studies were carried out to evaluate the internal and external doses received following the accident through analysis of Cs-137 activity in excreta, evaluation of doses by chromosomal analyses, and mathematical metabolic modelling for internal dose estimation. The Agency provided experts, a large amount of equipment, seven fellowships and eight scientific visits. Most of the training was carried out in specialized institutions in Canada, France, Germany, italy and the USA. These activities led to several publications and to papers presented at international conferences.

BULGARIA

BUL/9/011 OSART MISSIONS TO KOZLODUY AND BELENE NPP'S

COMPLETED: **92-12-30** TOTAL COST: **$41,114**

TO REVIEW THE OPERATIONAL SAFETY OF KOZLODUY AND BELENE NUCLEAR POWER PLANTS.

This Reserve Fund project was approved in 1991 to continue the assistance provided to Bulgaria under project BUL/9/010 relating to the operational safety of Kozloduy Nuclear Power Plant (NPP). In 1991 an OSART mission to Kozloduy Unit 5 took place and a subsequent follow-up visit was undertaken to advise the regulatory body on the following: the restart of Unit 3; plans based on a safety review mission and OSART recommendations; and the progress of regulatory assistance. Two Agency experts undertook a further visit to review the evaluation of the readiness for restarting Kozloduy Unit 4. A seminar on Assessment of Safety Significant Events (ASSET) methodology was held in 1992 to provide training in ASSET techniques for assessing plant operational safety performance. The 28 participants were drawn from the operating organization, the regulatory body, and research and nuclear energy institutions. This was the second in a series of four ASSET missions requested by the Bulgarian Government to deal with the management of safety significant incidents at the four WWER 440/230 type units at the Kozloduy NPP: to review operational safety performance in November 1990; to train operators and regulators in March 1992; to assist plant management in implementing the ASSET recommendations in June 1992; and to assess progress made in the prevention of incidents in September 1993. Four inspectors from the regulatory body attended a workshop in Trnava, Czechoslovakia, on safety inspection during nuclear power plant operation. Three Bulgarian scientists participated as observers in OSART missions to the Koeberg NPP, South Africa, the Grafenrheinfeld NPP, Germany, and the Fessenheim NPP, France. Further safety-related missions are planned under Project BUL/9/015 during 1993-94. In view of the suspension of work on the Belene NPP, that part of the project was not implemented.

CHILE

CHI/4/016 REPAIR AND UPGRADING OF MASS SPECTROMETER

COMPLETED: **92-09-15** TOTAL COST: **$52,036**

TO REPAIR AND UPGRADE THE MASS SPECTROMETER.

The original objective of this project, approved in 1989, was the repair and upgrading of an old mass spectrometer of the Chilean Nuclear Energy Commission (CChEN). This new equipment is now being used to measure stable isotope ratios of light elements such as H-1, H-2, O-16, O-18, C-13 and C-14. Certain items of equipment had to be replaced, and a PC was supplied by the Agency and adapted for automation of the data acquisition system and for automatic control of the high tension unit. Expert and consultant services to assess the required repair and upgrading and for training in the use of the mass spectrometer were also provided. The repair and upgrading of the instrument will enable CChEN to undertake new research programmes involving the measurement of stable isotopes in water samples. Owing to the special climatic and orographic conditions of the country, such isotopes are powerful tools for tackling many local hydrological problems, such as investigation of water resources, the study of leakage problems in natural and man-made lakes, and investigation of relationships between surface water bodies (river and lakes) and aquifers located in flat areas.

CHI/5/014 NUCLEAR TECHNIQUES IN AGRICULTURE

COMPLETED: **92-11-02** TOTAL COST: **$255,204**

TO UNDERTAKE ISOTOPE-AIDED STUDIES ON SOIL-WATER-FERTILIZER-PLANT RELATIONSHIPS IN VOLCANIC SOILS WITH A VIEW TO IMPROVING SOIL, WATER AND FERTILIZER MANAGEMENT PRACTICES FOR INCREASING CROP PRODUCTION.

Chile imports significant quantities of phosphate fertilizer for agricultural purposes. Crop response to phosphorus in volcanic soils varies according to the type of nitrogen fertilizer used and soil-water availability. The project was originally approved in 1988 to develop improved methods of fertilizer management and cultivation, and further funds were made available under the 1989-90 Programme. Expert services provided by the Agency included assistance in soil fertility and water balance studies, biological nitrogen fixation by grain legumes, and fertilization of apple trees, as well as analysis of N-15 by emission spectrometry. Major items of equipment provided included a N-15 analyser with a supply of labelled fertilizer, a liquid scintillation counter and a neutron moisture probe. A major achievement of this project has been the establishment of firm linkage between the two counterpart institutions, the Chilean Nuclear Energy Commission (CChEN) and the National Research Institute for Agriculture and Livestock (INIA), for the application of nuclear techniques under field conditions in a network of experimental stations. Several scientists from both institutions have been trained under the project. The Agency provided the equipment necessary to establish analytical facilities for processing and analysing samples for stable isotopes (N-15) and radioisotopes (P-32). As a result of project activities and of the co-operative and interdisciplinary research work, both laboratories are now fully operational, and the applications of nuclear techniques in soil/plant studies have been disseminated at the national level. Specifically, the project assisted

in evaluating the relative efficiency of various fertilizer nitrogen sources for commercial wheat cultivars in different agricultural regions using isotope techniques. Quantification of direct and residual effects of phosphorus fertilization with local rock phosphates and imported triple superphosphates was performed for various cropping systems in three agricultural regions. Furthermore, the rate and time of nitrogen application for fruit trees (a major export of the country) was adjusted, on the basis of the results of studies with N-15 related to nitrogen uptake patterns of peaches.

CHI/8/018 TRACER STUDIES OF FLOW IN GEOLOGICAL FORMATIONS

COMPLETED: **92-09-08** TOTAL COST: **$87,017**

TO USE TRACER TECHNIQUES TO STUDY THE FLOW OF WATER OR LEACHING SOLUTIONS THROUGH POROUS MEDIA AND TO DETERMINE THE TRANSPORT OF CONTAMINANTS TO FACILITATE THE DEVELOPMENT OF SUITABLE MODELS FOR SPECIFIC CASES.

The project was approved under the Agency's 1988-90 Programme for assistance to the Chilean Nuclear Energy Commission (CChEN). The first requirement was the reorganization of CChEN's tracer laboratory. With Agency assistance in the form of equipment and expert services, this was achieved in 1990, and with newly recruited staff the laboratory was able to embark on the proposed studies. Training abroad was provided to three counterparts; an Agency expert carried out three missions; and two scientific visits were awarded. Geological prospecting equipment as well as submersible pumps and sampling items were supplied under the project. The Copper Corporation of Chile (CODELCO) contributed operational funds for field experiments and, most importantly, continued to fund the services of the project's chief counterpart who was no longer a staff member of CChEN. CODELCO is also the main beneficiary of project achievements, since copper dumps at its Chuquicamata mine can now be handled most efficiently thanks to a mathematical model for power optimization based on the application of nuclear tracer techniques. The modelling technique for tracer transport through porous media is now also being applied to other Chilean residue dumping grounds and will contribute to the improvement of the country's environmental protection activities.

CAMEROON

CMR/1/003 TRAINING IN NUCLEAR PHYSICS

COMPLETED: **92-12-30** TOTAL COST: **$153,126**

TO INTRODUCE NUCLEAR PHYSICS INTO THE CURRICULUM OF THE UNIVERSITY OF YAOUNDE.

The University of Yaoundé sought Agency assistance to introduce nuclear physics into the curriculum of the Department of Physics through the provision of laboratory equipment and expert services. Under this project, which was approved in 1987, the Agency supplied teaching equipment including a gamma spectrometer, an alpha spectrometer, a low-level counting system, a desktop computer system for automated data acquisition and analysis, equipment for electronic measurement and radiation protection, books and

scientific publications. The installation of equipment and training in the use of personal computers, low-level counting, radiation detection and protection, as well as training in nuclear physics experiments, were undertaken during five missions by four experts. The laboratory is now fully operational and its staff has acquired the basic knowledge and capacity to provide academic training in nuclear physics.

CMR/5/005 IMPROVEMENT OF RUBBER TREE (HEVEA) PRODUCTIVITY

COMPLETED: **92-07-13** TOTAL COST: **$8,187**

TO INVESTIGATE THE POSSIBILITY OF APPLYING NUCLEAR TECHNIQUES IN THE PRODUCTIVITY OF HEVEA AND OTHER CROPS OF NATIONAL INTEREST.

This project was initiated in 1987 with the limited objective of training a local scientist to enable him to elaborate a more comprehensive project proposal on the application of nuclear techniques to the productivity of hevea (rubber tree) and other crops of national interest. No provision was made for the supply of equipment. An expert undertook a four-day mission and made several recommendations, including provision of appropriate equipment for a follow-up project. One local scientist received a three-month fellowship at the Rubber Research Institute, Côte d'Ivoire. Although the major training objective of the project was achieved, the Research Institute of Agronomy, Yaoundé, has not yet followed up with a new request.

COLOMBIA

COL/2/009 X-RAY FLUORESCENCE LABORATORY

COMPLETED: **92-12-18** TOTAL COST: **$152,220**

TO ESTABLISH AN X-RAY FLUORESCENCE CAPABILITY FOR THE ANALYSIS OF A WIDE RANGE OF MINERAL ORES IN SUPPORT OF NATURAL RESOURCE DEVELOPMENT PROGRAMMES.

This project was approved in 1985 and was further extended in 1988 and 1989. Its objective was to set up an X-ray fluorescence laboratory at the Institute of Nuclear Affairs (IAN), Bogotá, with a range of analytical capabilities. The Agency provided major items of laboratory equipment, including an X-ray fluorescence spectrometer with a total reflection module, a multichannel analyser and a Si(Li) detector. Expert services for installation and training in the use of X-ray equipment were provided as well as a national training course on radiochemistry. Project counterparts received additional training through two fellowships. As a result of the project, IAN now possesses a well equipped X-ray fluorescence laboratory which is being used in such fields as environmental pollution (identification of heavy metals in air and water), sedimentology and intercalibration of analytical techniques (with neutron activation analysis and atomic absorption).

COL/4/009 UPGRADING OF RESEARCH REACTOR INSTRUMENTATION

COMPLETED: **92-12-18** TOTAL COST: **$347,803**

TO IMPLEMENT A PREVENTIVE MAINTENANCE PLAN; TO DESIGN ELECTRONIC CIRCUITS, BOTH ANALOG AND DIGITAL; TO UPGRADE EXISTING ELECTRONIC CONTROL AND OPERATION SYSTEMS.

This project for assistance to the Institute of Nuclear Affairs (IAN), Bogotá, was approved in 1989 with footnote-a status. It was subsequently upgraded through a major contribution from the USA and received a funds-in-trust contribution from Colombia as well as supplementary TC funds. The project was part of a long-term effort to modernize and upgrade IAN's 30 kW research reactor and was particularly concerned with upgrading the reactor's electronic control and operation systems while initiating work on the safety analysis report. The contribution from the USA was used for acquiring modern reactor control and data processing equipment, culminating in the installation of a new reactor console and training of IAN's reactor staff by the supplier. Funds-in-trust were used for the purchase of generators, amplifiers and detectors, while regular funds supplemented reactor control equipment items as well as safety system monitoring equipment. The Agency also provided expert services for the preparation of a safety analysis report. Under this project, the reactor IAN-R1 was provided with a modernized and computerized reactor control system. Meanwhile, the follow-up project COL/4/011, approved under the 1991-92 Programme, is providing additional inputs related to control and safety rod mechanisms, reactor maintenance, and monitoring the reactor area. Eventually, Project COL/4/012, approved under the 1993-94 Programme, will assist IAN in converting the reactor core to low-enriched uranium and pave the way for later power upgrading.

COL/6/005 APPLICATION OF DNA PROBES FOR DIAGNOSIS OF MALARIA

COMPLETED: **92-12-18** TOTAL COST: **$109,694**

TO DEVELOP FACILITIES AND EXPERTISE FOR THE ROUTINE APPLICATION OF DNA PROBES.

This project was approved in 1990 to assist the Universidad de Valle's Microbiology Department in Cali. The Agency provided major instrumentation including a centrifuge, freezer and chromatographic equipment. Two long-term fellowships were awarded for training in developing and labelling DNA probes for malaria diagnosis and research. While expert services had also been foreseen under the project, they were actually provided from bilateral sources, thereby facilitating an extension of training activities. With support from the Pan-American Health Organization, the Microbiology Department also hosted two regional training courses in 1990 and 1991 on the use of DNA probes. The project established immunoradiometric assays and DNA probe technology, enabling the Department to study malaria transmission in Western Colombia. Identification of the exophillic mosquito Anopheles neval as the principal vector in the region led to the termination of indoor spraying with insecticide since transmission occurs outdoors, and thus allowed the funds earmarked for spraying to be used for prophylactic drugs. Collaboration with several institutes in Europe on testing the efficacy of candidate vaccines was established and will be continued.

COL/8/015 EVALUATION OF THE SAN ANDRES AQUIFERS

COMPLETED: **92-12-18** TOTAL COST: **$54,042**

TO DETERMINE THE HYDRODYNAMIC CHARACTERISTICS OF THE AQUIFERS ON SAN ANDRES ISLAND AND TO EVALUATE UNDERGROUND WATER RESOURCES.

This project was approved in 1989 with counterparts at the Hydrology Section of the Institute of Nuclear Affairs (IAN), Bogotá, in close collaboration with EMPOISLAS, a state institution charged with identifying drinking water resources in the Colombian islands. In spite of the interest generated by the touristic development of San Andres Island, it was not possible to fully attain the objectives of identifying the characteristics of the island's aquifers and evaluating its underground water resources. This was largely due to co-ordination and funding problems at the local level, which did not permit sufficient samplings. The Agency provided expert services in karstic hydrology and stable isotope measurements together with spare parts for IAN's mass spectrometer and logging equipment. Although the original objectives were not achieved, the project did contribute to greater knowledge of the problems involved in the study of karstic aquifers.

COL/9/003 RADIATION PROTECTION MONITORING

COMPLETED: **92-12-18** TOTAL COST: **$83,880**

TO IMPROVE RADIATION MONITORING AT THE R-1 RESEARCH REACTOR.

This project, which was approved in 1989 and extended in 1991, was intended to improve radiation monitoring at the R-1 research reactor of the Institute of Nuclear Affairs (IAN), Bogotá. The expert services for nuclear safety and for the design of a more comprehensive project were closely co-ordinated with the reactor modernization projects COL/4/009 and COL/4/011. Equipment provided included radiation detectors, dosimeters and other monitoring items, as well as some reactor spare parts. Radiation safety at the research reactor was considerably improved by means of the following: conditioning the shielding of the decontamination room and the reactor control room to reduce external radiation levels; renewal of area radiation monitors and ancillary equipment together with an increase in their number; and preparation of procedural manuals for reactor area control. Training abroad and on site was given. Assistance was also provided under Project COL/4/011 for updating the reactor's Safety Analysis Report. This project contributed to a major improvement of safety installations around the reactor and assisted in laying the basis for the 1993-94 project COL/9/004 on a national programme of radiation protection.

CHINA

CPR/1/003 SECONDARY STANDARDS DOSIMETRY LABORATORY

COMPLETED: **92-12-30** TOTAL COST: **$411,594**

TO MODERNIZE THE SSDL IN SHANGHAI.

The project was first approved in 1986 as hardcore and the request for continuation was approved in 1987 with footnote-a status which was subsequently upgraded with an extrabudgetary contribution from Germany in 1987. Under this project, the Agency has provided the Secondary Standards Dosimetry Laboratory (SSDL), Shanghai, with measuring and calibration equipment, including a multipurpose irradiator OB85, a panoramic gamma irradiator OB84, a digital current integrator, measuring carts, a remote control filter changer, an automatic half value layer (HVL) measuring device, a laser alignment system, and an indoor camera. In addition to the equipment supplied to the Shanghai Laboratory, the Agency provided the Beijing SSDL with a microprocessor controlled X-ray system MG324, a digital current integrator, a remote control filter changer and an automatic HVL measuring device. Three Agency experts undertook five missions to advise and assist the counterparts on the upgrading of the SSDL facilities, in setting up the laboratories, on calibrating ionizing radiation, and on radiation dosimetry. One staff member was awarded a long-term fellowship and one was awarded a scientific visit under the Agency's manpower development programme. Two other fellows were offered scientific visits under the type II fellowship programme of the donor country. The Government contributed generously to the cost of the laboratory buildings and equipment manufactured locally. As a result of the project, two well equipped SSDLs have been set up in Shanghai and Beijing which now provide calibration services to all the radiotherapy departments in the two regions, covering a total population of 300 million. The Shanghai SSDL has formulated five national verifications of calibration and several working dosimetry procedures. By 1991, four secondary standards set up in the Beijing SSDL had obtained authorization for calibration services from the State Bureau of Metrology. Since 1985, the Beijing SSDL has organized 50 hospitals in China to participate in the IAEA/WHO international postal-dose intercomparison, and the results were presented at the 1987 Symposium on Dosimetry in Radiotherapy in Vienna. Calibration of output for cobalt-60 teletherapy units and medical accelerators has been undertaken in seven provinces, with a total population of about 200 million. Nationwide calibration and intercomparison experiments are also being carried out to check the instruments used for medical X-ray monitoring and for quality assurance of radiation therapy dosimetry. The project has led to a number of publications at home and abroad. The project is expected to contribute significantly to improving the accuracy of radiation dosimetry and to promoting safe application of ionizing radiation in medicine.

CPR/2/003 NUCLEAR TECHNIQUES FOR IN-SITU COAL ANALYSIS

COMPLETED: **92-12-30** TOTAL COST: **$65,609**

TO SET UP A NEUTRON CAPTURE/GAMMA RAY LOGGING SYSTEM WITH HIGH RESOLUTION FOR IN-SITU DETERMINATION OF THE DEPTH, THICKNESS AND QUALITY OF COAL SEAMS.

Coal remains an important energy source in China, and in view of environmental and health considerations, the Institute of Atomic Energy, Beijing, undertook to develop an effective and rapid method of coal assessment by employing a nuclear spectral logging technique for in-situ coal analysis. Such analysis provides data not only on the depth and thickness of the coal seam, but also on the quality of the coal, e.g. the sulphur, carbon and ash content and the calorific value. Under this project, approved in 1988, the Agency has provided some equipment and components for setting up a neutron capture/gamma ray logging system and a desktop computer, while the

Government provided a californium-252 neutron source and other equipment. An Agency expert advised on the design and fabrication of a high purity germanium borehole logging probe and its use for in-situ studies. As a result of the project, the counterpart has fabricated a neutron capture/gamma ray spectral well logging system consisting of a downhole probe and uphole instruments and has developed expertise in the multielement well logging technique. The first field test was carried out in 1991 in the coalfield of Shan Dong Province, in co-operation with the Zhejiang Coalfield Geological Prospecting Corporation, and five production boreholes were dealt with in 1992. The system developed proved useful for accurate evaluation of the coal seams and the main elements of the rock formation. The project has also contributed to the publication of a number of scientific papers.

CPR/4/004 NUCLEAR FUEL ASSEMBLY FABRICATION

COMPLETED: **92-12-30** TOTAL COST: **$62,323**

TO PROMOTE GREATER OPERATIONAL SAFETY AT THE QINSHAN NUCLEAR POWER PLANT THROUGH THE ESTABLISHMENT OF A QUALITY CONTROL/QUALITY ASSURANCE PROGRAMME FOR FUEL ASSEMBLIES TO BE SUPPLIED TO THE PLANT.

The Yibin Nuclear Fuel Element Plant, under the Ministry of Energy Resources, fabricates fuel assemblies for the Qinshan Nuclear Power Plant. A fuel fabrication facility was commissioned in 1987 by the Government. Agency assistance was requested in establishing a quality assurance (QA) and quality control (QC) system and to introduce advanced management methods. Under this project, initiated in 1987, the Agency provided a surface area analyser and a testing device for spacer grid spring force. Five Agency experts advised on the following: QA/QC for nuclear fuel assembly and associated core components fabrication and their management procedures; fabrication of uranium oxide pellets and the adaptability of rotary press to ex-ADU powder; fabrication of spacer grids; and the handling, transport and assembly of fuel assemblies. Four counterpart staff were awarded scientific visits under the regional fellowship programme. As a result of the project, the Yibin Nuclear Fuel Element plant has set up a complete QA/QC system and has improved management practices. The quality of fuel assemblies manufactured by the plant has been assured so that the safe operation of the nuclear power plants in China could be guaranteed. In October 1990, the first fuel assemblies manufactured by the plant were delivered to the Qinshan Nuclear Power Plant, which became operational in December 1991.

CPR/5/004 USE OF RADIATION AND ISOTOPES IN FOOD AND AGRICULTURE

COMPLETED: **92-12-31** TOTAL COST: **$412,897**

TO UPGRADE UNDERGRADUATE AND GRADUATE EDUCATION IN THE APPLICATION OF ISOTOPE AND RADIATION TECHNIQUES IN SOIL FERTILITY AND PLANT NUTRITION, CROP BREEDING AND FOOD PRESERVATION, AND TO INITIATE DEVELOPMENT-ORIENTED RESEARCH PROJECTS IN THESE FIELDS.

The project was approved by the UNDP in 1987 with the IAEA as the executing agency. Under the project, the Agency has provided the Southwestern Agricultural University (SAU), Chongqing, Sichuan Province, with several items of equipment, including an N-15 analyser, two beta-gamma counters, a

sample oxidizer, a refrigerated centrifuge, a climatic chamber, an electronic balance, and a surveillance system. Two Agency experts advised on soil/plant nutrition and mutation breeding. The experts also gave seminars on the application of isotopes in agricultural research and on the use of radiation and chemicals and the role of in-vitro culture techniques and genetic engineering in mutation breeding. The first seminar was attended by 45 participants and the second by 50 participants of which 20 were from 11 agricultural institutions in other provinces. The Agency also organized a national training course on the commercialization of food irradiation in Nanjing in 1990 at which two Agency experts delivered lectures. The course was attended by about 40 participants from all over China of which seven were from the SAU. Seven teachers/researchers from the SAU were awarded long-term fellowship training abroad and six other senior staff members were awarded scientific visits. As a result of the project, the original isotope laboratory of the SAU has been upgraded to become the Laboratory of Atomic Energy Applications in Agricultural Sciences, 18 research projects in soil science/plant nutrition, mutation breeding and food preservation have been undertaken, three textbooks for undergraduate studies have been written, experimental work for undergraduate and graduate students has been substantially increased, and 14 graduate students have already received Masters degrees. By 1991, 24 research publications had been produced. In addition to providing advanced education and training to its own staff, the laboratory is now capable of organizing regional and inter-regional training courses on the applications of nuclear energy in agriculture.

CPR/7/003 RADIONUCLIDES IN FOOD AND ENVIRONMENTAL SAMPLES

COMPLETED: **92-12-30** TOTAL COST: **$95,392**

TO ORGANIZE A NATIONAL TRAINING COURSE ON THE DETERMINATION OF RADIONUCLIDES IN FOOD AND ENVIRONMENTAL SAMPLES.

The Government of China has undertaken the construction of a number of nuclear power plants for the generation of electricity. To ensure environmental safety in the area surrounding such plants, surveys of released radioactivity must be carried out correctly. The Institute of Nuclear Energy Technology of Tsinghua University, Beijing, intended to organize a training course to provide guidance on correct survey methodology and on accurate determination of radionuclides in food and environmental samples under accident conditions. The project was approved in 1991 with footnote-a status, which was subsequently upgraded with extrabudgetary funds from Germany. The Agency supplied equipment including a liquid scintillation counter, an alpha spectrometer and a contamination monitor. A national training course on the determination of radionuclides in food and environmental samples was successfully organized at the Institute in 1991 at which four Agency experts delivered lectures and 14 participants from nuclear power plants, radioactivity monitoring centres and other relevant institutes participated. As a result of the project, environmental surveillance in the area surrounding nuclear power plants is expected to improve.

CPR/9/017 NUCLEAR POWER PLANT SAFETY

COMPLETED: **92-12-30** TOTAL COST: **$25,242**

TO DEVELOP EXPERTISE FOR MODIFICATION AND IMPROVEMENT OF DESIGN AND SAFETY FEATURES OF THE QINSHAN NUCLEAR POWER PLANT.

The 300 MW(e) nuclear power plant at Qinshan, designed by China, was due to begin operation in 1991. Before commissioning, the Agency was requested to provide some expert assistance on a number of safety issues. The project was approved in 1991 from the Reserve Fund, and four Agency experts advised the Shanghai Nuclear Engineering and Design Institute on the safety parameter display system, anticipated transients without scram, transient analysis for establishing setpoints, and severe accident management. As a result of the project, the Institute has developed expertise in various aspects of nuclear safety, and the Qinshan nuclear power plant was successfully commissioned in December 1991.

CUBA

CUB/0/004 EXTENSION OF THE APPLICATION OF NUCLEAR TECHNIQUES

COMPLETED: **92-12-30** TOTAL COST: **$610,628**

TO IMPROVE MEDICAL RESEARCH AND DIAGNOSTIC CAPACITY SO THAT HIGHER QUALITY MEDICAL SERVICES CAN BE PROVIDED. TO STRENGTHEN THE TEACHING INFRASTRUCTURE FOR TRAINING IN NUCLEAR SUBJECTS.

This UNDP project was executed by IAEA as a continuation of a previous project that provided the technical basis for the development of the application of nuclear techniques in different areas of the national economy. As the budget approved by UNDP was insufficient, IAEA agreed to finance most fellowships and some expert missions. Experts gave advice on various aspects of nuclear medicine including the utilization of the gamma camera provided to the National Institute of Oncology and Radiobiology (INOR), and on activities related to the several laboratories of the Advanced Institute of Sciences and Nuclear Technology (ISCTN) in support of the teaching of nuclear subjects. In addition to the gamma camera and ancillary equipment, other equipment was supplied to complete the laboratories at ISCTN. Fellowships and scientific visits were granted to sixteen staff members of the two implementing institutions. As a result of the project, Cuba has now an adequate nuclear medicine infrastructure for diagnosis not only in Havana but in all provinces as well. New mathematical methods were adopted for the acquisition, analysis and processing of functional tomographic and gammagraphic images in several pathologies, different diagnostic tests were automated, and new physiological parameters were incorporated in medical practice. As far as the teaching infrastructure is concerned, several laboratories are now available for teaching and research. The number of postgraduate courses increased substantially and a greater variety of degrees in nuclear subjects can now be earned.

CUB/6/009 PREPARATION OF REAGENTS FOR TUMOUR MARKING

COMPLETED: **92-11-18** TOTAL COST: **$118,423**

TO FURTHER DEVELOP TECHNIQUES FOR THE PREPARATION OF RADIOLABELLED COMPOUNDS INCLUDING QUALITY CONTROL PROCEDURES FOR THE DIAGNOSIS OF TUMOURS.

The project was approved in 1989 as a continuation of activities initiated previously under a UNDP-financed and IAEA-executed project, in an effort to assist Cuba to reduce the morbidity and mortality caused by common diseases among which are malignant neoplasms. An expert was financed to advise on radioimmunoassay (RIA) and related procedures, and equipment was provided for automated analysis and sample counting. Three fellowships were granted on subjects related to the preparation of radiolabelled compounds. As a result of the project a laboratory was established for obtaining tumour markers and other related biological reagents. An RIA technique was developed to determine the beta chain of human chorionic gonadotropin, thus avoiding the need to import commercial reagents. The purification of human synthetic calcitonin was also achieved. The reagents produced are being distributed to laboratories at the national level and the laboratory is being used as a training centre.

CUB/8/009 NUCLEAR TECHNIQUES IN SEDIMENTATION STUDIES

COMPLETED: **92-12-18** TOTAL COST: **$119,628**

TO INVESTIGATE THE ORIGIN AND LITHOLOGICAL COMPOSITION OF SEDIMENTS AND TO MEASURE THE DENSITY AND RATE OF DEPOSITION OF SEDIMENTS IN DAMS USED FOR IRRIGATION.

The studies conducted under this project centered on the La Juventud reservoir. The Cuban Institute of Hydroeconomy (now the National Institute of Hydraulic Resources) was the counterpart institution, but several other Cuban institutions collaborated in implementing the project. The Agency provided all equipment necessary to carry out the studies, including an echo sounder and two gamma backscattering density gauges. Two experts advised on measuring layers of deposited sediments in reservoirs and assisted in setting up the tritium calibration system related to activities supported under a regional project. Two fellowships were awarded for training abroad. As a result of the project, the Institute is now capable of performing studies on sediments by means of tracers; several such studies have already been conducted at the La Juventud dam. Technology based on the use of gamma backscattering gauges has been transferred, making it possible to determine the density and thickness of deposited layers of bottom sediments in lakes and reservoirs. Analysis of sediment samples using X-ray fluorescence and neutron activation techniques have provided information on the origin of the sediments deposited at the reservoir.

CUB/9/007 ENVIRONMENTAL RADIATION MONITORING

COMPLETED: **92-11-18** TOTAL COST: **$78,506**

TO SET UP A NATIONAL ENVIRONMENTAL RADIATION MONITORING SYSTEM.

The project was initiated in 1989 to enable the Centre for Hygiene and Radiation Protection, Havana, to monitor environmental background radiation at the national level. Equipment supplied under the project consisted of a thermoluminescence system and equipment for aerosol sampling and data processing. Training was provided under several regional activities. As part of the national system established under the project, three laboratories now have the capability to monitor the radioactivity of aerosol; ionization chambers measure gamma doses daily throughout the country; and measurements of fallout in 30 sites are reported monthly.

CYPRUS

CYP/8/003 ISOTOPES IN HYDROLOGY

COMPLETED: **92-12-30** TOTAL COST: **$187,596**

TO COLLECT AND ANALYSE HYDROLOGICAL SAMPLES USING ENVIRONMENTAL ISOTOPE TECHNIQUES WITH A VIEW TO ASSESSING WATER RESOURCES.

Cyprus has very few water resources, and the Government has given high priority to their exploitation, particularly with regard to the management of reservoirs, which consist of dams and aquifers, in order to meet the needs of households, industry and agriculture. Most of the dams are located on or near sedimentary rocks and have therefore suffered serious leakage. Through this project, initiated in 1982 as a continuation of Project CYP/8/002, which was initiated in 1979, water leakage investigations were carried out on reservoirs, using isotope hydrology techniques. Variations in deuterium and O-18 content of the groundwater of the Kouris dam, the Akhna reservoir, the Akrotiri aquifer and the Euretou dam were studied in order to identify their recharge rates from local rivers and rainfall. The distribution of environmental tritium in the reservoirs was also studied to obtain information about the groundwater flow regimes. The isotopic analyses were performed at the Agency's Isotope Hydrology Laboratory in Vienna. Equipment and supplies, including computer systems and software, a hydrometer, a spectrophotometer, a fluorometer and an underwater sensor, were supplied to the Water Development Department of the Ministry of Agriculture and Natural Resources, Nicosia. Agency staff members undertook missions to advise the counterparts on work plans, sampling procedures and the interpretation of results. Three counterpart staff members were awarded fellowships for training abroad and the principal counterparts undertook a scientific visit to the Agency's Isotope Hydrology Section in Vienna to review results. The project has enabled the counterparts to obtain detailed information on residence times in the reservoirs, on seepage from rivers to the reservoirs and on the amount of direct recharge via precipitation, thus enabling the authorities to institute measures towards rational water management on the island.

CZECH & SLOVAK FEDERAL REPUBLIC

CZE/9/005 TEST OF NOISE THERMOMETRY IN WWER-440 REACTORS

COMPLETED: **92-12-30** TOTAL COST: **$68,523**

TO INVESTIGATE THE APPLICABILITY OF NOISE THERMOMETRY IN WWER-440 REACTORS UNDER OPERATIONAL CONDITIONS.

This project, approved in 1991, provided assistance to the Nuclear Power Plant Research Institute (VUJE), Trnava, in developing applications of noise thermometry for operational WWER-type reactors. The Institute for Applied Materials Research at the Nuclear Research Centre (KfA), Jülich, Germany, had been collaborating with VUJE in this area prior to the Agency's approval of the project. KfA continued to provide specialized assistance to the Institute, and on two occasions received three engineers from VUJE for on-the-job training. The Agency provided a computer system and purpose-designed thermocouple sensors for operation in WWER-440/213 reactors, and made possible the leasing of the main components of the noise-thermometry equipment from KfA. Experts from KfA conducted several missions connected with the initial design and, later, the installation and testing of the noise-thermometry system at Bohunice nuclear power plant. The acquisition of this system and its successful operation in 1992 in Bohunice Unit 2 demonstrated an accurate means of verifying the reactor coolant temperatures. Conventional devices used in these reactors have temperature coefficients which can change as a result of ageing and environment, thereby reducing the accuracy of temperature measurements in the reactor and its components. The new system has enabled in-situ recalibration of the standard reactor temperature sensors under actual operating conditions, without the need for complicated disassembly and removal of these devices to the laboratory for this purpose. The introduction of this advanced technology as a result of the project can contribute to improved operational safety of WWER-type reactors in the former Czech and Slovak Federal Republic.

CZE/9/006 FOLLOW-UP OSART TO TEMELIN-1 AND 2 NUCLEAR POWER PLANTS

COMPLETED: **92-12-30** TOTAL COST: **$9,615**

TO REVIEW THE OPERATIONAL SAFETY OF TEMELIN-1 AND 2 NUCLEAR POWER PLANTS.

The project was approved in 1991 at the request of the Czechoslovak Government for continuing assistance related to operational safety at nuclear power plants (NPP), and following previous OSART missions under Project CZE/9/003 to Units 1 and 2 of Temelin NPP. In 1992 a follow-up OSART mission to Temelin NPP was therefore carried out. A training seminar on Assessment of Safety Significant Events (ASSET) methodology was arranged for 29 participants representing Bohunice, Dukovany and Temelin NPPs, the national regulatory body and the Nuclear Power Plants Research Institute (VUJE), Trnava. In addition to the standard ASSET programme, workshops on International Nuclear Event Scale (INES) rating techniques and root cause analysis methodology for investigation of local operating events at Bohunice and Dukovany were organized. A Czechoslovak scientist participated as an observer in an OSART mission to Grand Gulf NPP, USA. Further missions are planned under CZE/9/010 during 1993-94.

CZE/9/008 QUALITY ASSURANCE AND SITE SAFETY OF NPP'S

COMPLETED: **92-12-30** TOTAL COST: **$28,160**

TO ASSIST IN THE PREPARATION OF A QUALITY ASSURANCE PROGRAMME FOR THE TEMELIN NPP AND IN THE IMPLEMENTATION OF THE RECOMMENDATIONS OF THE AGENCY'S SITE SAFETY REVIEW MISSION.

This Reserve Fund project was Initiated in 1991 at the request of the former Czech and Slovak Federal Republic to assist in the preparation of a quality assurance programme for the Temelin nuclear power plant and in implementing the recommendations of an Agency-sponsored site safety review mission carried out in 1990. Six expert missions were undertaken, principally to review the implementation of site safety recommendations and to study seismic and meteorology-related analyses, modelling and monitoring, relevant to plant safety and siting. A workshop on aspects of quality assurance related to siting and design was held in Prague. A training course on quality assurance during nuclear power plant construction was held in Temelin, attended by 20 senior management personnel from the nuclear utility.

DOMINICAN REPUBLIC

DOM/1/004 NUCLEAR ANALYTICAL TECHNIQUES

COMPLETED: **92-05-14** TOTAL COST: **$241,483**

TO EXTEND THE USE OF AN ELECTRON MICROSCOPE FOR RESEARCH.

The project was approved in 1984 as part of an effort to establish a laboratory for the application of nuclear analytical techniques to teaching and research. The expert services and basic equipment needed for initiating studies in isotope-excited X-ray fluorescence for analysis of trace metals and a Moessbauer spectroscopy system were provided. The equipment was widely used in the analysis of clays for ceramic purposes and of archaeological items. The project also supported the acquisition of a nitrogen liquifier to ensure the availability of liquid nitrogen for operating the detectors. Three fellows received training in these techniques and their work contributed to the establishment of a laboratory offering services to both the Government and the private sector. The project also served as a basis for launching a research programme in pollution studies related to the mining industries. This work will continue under Project DOM/2/002.

DEMOCRATIC PEOPLE'S REPUBLIC OF KOREA

DRK/1/003 SECONDARY STANDARDS DOSIMETRY LABORATORY

COMPLETED: **92-12-30** TOTAL COST: **$458,291**

TO ESTABLISH A NATIONAL SSDL IN THE FIELD OF RADIATION PROTECTION FOR PROVIDING UNIFORM AND CONSISTENT DOSIMETRY STANDARDS AND MEASUREMENTS.

A secondary standards dosimetry laboratory (SSDL) has been established at the

Institute of Radiation Protection (IRP) of the Ministry of Atomic Energy, Pyongyang, to provide radiation dosimetry and calibration services for the entire country in compliance with international standards. The Agency has supported the activity under this project since 1983 through provision of a gamma irradiator, dosimeters, an X-ray machine, radiotherapy equipment and a radiochromic reader. Expert services were also provided to assist in installation and calibration of equipment and to train staff in dose calibration and high-level radiation dosimetry. Three IRP staff members were awarded fellowships and trained abroad. The IRP provided irradiation bunkers and associated laboratory equipment, and recruited more staff to operate the laboratory, which is now fully operational and adequately staffed with trained personnel. At present, they calibrate 50-60 dosimeters annually, using secondary standard dosimeters provided by the Agency. The laboratory also provides regular calibration services to radiotherapy units and users of radiography equipment. It is also responsible for calibrating thermoluminescence dosimeters for the personnel dosimetry monitoring system, which serves 2000 radiation workers. The SSDL has also helped to provide training to a number of radiation workers and radioisotope users in radiation dosimetry and calibration. It is expected that the project will continue to promote more accurate and reliable radiation dosimetry for radiation protection and for the support of radiation application activities, particularly in medicine and industry.

DRK/4/002 CYCLOTRON FACILITY

COMPLETED: **92-12-30** TOTAL COST: **$1,874,220**

TO ESTABLISH A CYCLOTRON FACILITY FOR THE PRODUCTION OF RADIOISOTOPES, FOR USE PARTICULARLY IN NUCLEAR MEDICINE.

The project was intended to establish a cyclotron facility to produce radioisotopes for use in nuclear medicine and to provide charged particle activation analysis services to industry and research establishments. This project, approved in 1983, has been supported under a cost-sharing scheme by the Agency, the USA and the Government. The Government furnished the balance required for its purchase, and a 20 MeV cyclotron, model MGC-20, was ordered from the USSR in 1985. Agency experts advised on the engineering design of the cyclotron and the building requirements and on the technical parameters of a cyclotron facility for radioisotope production and other applications. Five staff members were awarded scientific visits to cyclotrons in several European countries, and another was granted a fellowship for training abroad. In 1985, the Government established the Institute of Atomic Energy (IAE) to take over from the Institute of Nuclear Physics the responsibility for installation and operation of the cyclotron and related research activities. In 1987, construction of the cyclotron building began at Mongyongdae District in Pyongyang where the IAE is located. Construction of the building was completed in July 1990 and the main parts and units of the cyclotron facility were delivered during 1989-90. The facility was installed and successfully commissioned in 1992. Studies for charged particle activation analysis are being conducted under Project DRK/4/004. With the establishment of the cyclotron facility, the local production of radioisotopes for use in nuclear medicine will be undertaken under Project DRK/4/005 approved for the 1993-94 Programme.

DRK/5/003 NITROGEN FIXATION

COMPLETED: **92-12-18** TOTAL COST: **$109,650**

TO PRODUCE A HIGH YIELD VARIETY OF SOYBEAN SUITABLE FOR LOCAL CONDITIONS AND WITH A HIGH CAPACITY TO FIX ATMOSPHERIC NITROGEN.

The Institute of Plant Cultivation of the Academy of Agricultural Sciences, Pyongyang, sought Agency assistance in improving the nitrogen fixing capacity and the yield of soybean varieties suitable for cultivation in the country. Under this project, initiated in 1989, equipment including laminar flow hood, fermenter, centrifuge, microscope, spectrophotometer, as well as N-15 labelled fertilizer, was supplied to the Institute. An Agency expert assisted the counterpart in the design and initiation of N-15 experiments and introduced rhizobium technology during a first mission. During a follow-up mission, he advised the counterpart on the analysis and interpretation of data obtained from previous experiments. The expert also introduced ureide assay technique for screening soybeans for high nitrogen fixation potential. Two scientists of the Institute were granted fellowships, one training in N-15 techniques in biological nitrogen fixation and the other in N-15 analytical techniques. After greenhouse and field experiments, three rhizobium strains were selected for their high nitrogen fixation capacity. Experiments in inoculating two high yielding local soybean varieties with selected strains have produced promising results. In particular, the soybean yields increased from 13% to 27% by the use of new soybean varieties. An adequately equipped isotope laboratory has been established, with a group of scientists and technicians capable of conducting biological nitrogen fixation studies which will be continued under Project DRK/5/004. It is expected that wide dissemination of selected soybean seeds and strains of rhizobium for large-scale production of rhizobium inocula will in the near future provide the country with additional urgently needed protein while at the same time reducing dependence on expensive commercial fertilizers.

DRK/9/002 ENVIRONMENTAL RADIOACTIVITY MONITORING

COMPLETED: **92-12-30** TOTAL COST: **$176,804**

TO STRENGTHEN NATIONAL CAPABILITY FOR MONITORING ENVIRONMENTAL RADIOACTIVITY.

The Institute of Radiation Protection (IRP), Pyongyang, is responsible for radiation protection throughout the country. As an important step towards establishing a national monitoring system, the IRP sought Agency assistance in setting up a centre for measuring environmental radioactivity. Under this project, initiated in 1988, the Agency provided equipment, including a multichannel analyser with data processing system, a hyperpure semiconductor detector, an automatic liquid scintillation counter, a low-level radioactivity measurement system, and ancillary items. An Agency expert assisted in setting up the radioactivity measurement systems and in training local staff. Following recommendations of a RAPAT mission in 1989, a Workshop on National Infrastructure for Radiation Safety was held in 1991, with 20 local participants from various nuclear institutions. During the workshop, three Agency experts lectured, conducted practical sessions and organized discussions on the national radiation safety programme. An IRP staff member was granted an Agency fellowship and trained in low-level radioactivity measurement under

a regional manpower development project. With Agency assistance, an appropriately equipped central laboratory for monitoring environmental radioactivity has been established at the IRP. A group of counterpart staff is now capable of monitoring environmental radioactivity, and they have measured environmental samples such as soil, food, air and fallout, leaves and water samples. The IRP plans to establish monitoring stations in other parts of the country. The central laboratory at the IRP is expected to become the focal point for assistance and advice in a national radiation monitoring system intended to improve radiation protection in the country.

ECUADOR

ECU/1/004 APPLIED NUCLEAR PHYSICS

COMPLETED: **92-05-14** TOTAL COST: **$305,291**

TO INTRODUCE APPLIED NUCLEAR PHYSICS TECHNIQUES IN THE FIELDS OF MATERIALS RESEARCH, RADIOLOGY, RADIOCHEMISTRY AND MEDICINE.

The Ecuadorian Atomic Energy Commission operates a number of laboratories for applied studies and intends to introduce advanced nuclear analytical techniques into the national economy. As a first step, suitable analytical laboratories were established at the Commission itself to serve as training centres and reference laboratories. This project was designed to assist in three areas: (a) X-ray analysis and Moessbauer spectroscopy, (b) a new dimension in the analysis of trace and minor elements, and (c) structural studies. Instruction in the correct use of desktop computers in nuclear laboratories improved the operation of all the Commission's laboratories. The project succeeded in its major objectives, and the techniques, which are being used for the first time in Ecuador, are producing valuable results in analyses and training. The assignment of experts stimulated rapid progress. Less effective was the training of local staff as several members of the nuclear analytical laboratories who received extensive training abroad did not return to their laboratories. However, those who attended the IAEA training courses continue to participate in the activities of the laboratory.

ECU/8/011 INDUSTRIAL APPLICATIONS

COMPLETED: **92-09-08** TOTAL COST: **$70,316**

TO INTRODUCE NON-DESTRUCTIVE TESTING TECHNIQUES FOR QUALITY ASSURANCE AND QUALITY CONTROL OF EQUIPMENT BUILT BY THE NATIONAL METAL-MECHANICAL INDUSTRY.

The project was upgraded in 1988 from footnote-a status and financed by an extrabudgetary contribution from Germany. Non-destructive testing (NDT) equipment provided to the Ecuadorian Atomic Energy Commission (CEEA) were a radiography unit (Co-60) and a double frequency eddy current instrument type TMT-ECT MAD2 with accessories. Two national training courses were carried out by an expert from the donor country (15 days each) on eddy current techniques (levels 1 and 2), each with 11 participants from other institutions. The project was implemented as programmed and the objectives accomplished. National technicians using NDT techniques are providing services to the metal-mechanical industry and assisting in inspections needed

in the aeronautical industry, using eddy current techniques.

EGYPT

EGY/4/030 CONSTRUCTION AND USE OF SPECTROMETRIC CALIBRATION PADS

COMPLETED: **92-09-09** TOTAL COST: **$80,693**

TO ESTABLISH STANDARDS AND PROCEDURES FOR THE DESIGN, CONSTRUCTION AND USE OF CALIBRATION PADS FOR THE NUCLEAR RAW MATERIALS DEVELOPMENT PROGRAMME.

The project was initiated in answer to the need to convert all qualitative ground and airborne spectrometric measurements to quantitative measurements easily comprehensible to geologists. The project provided expert services, equipment (portable gamma spectrometers, calibration sources and equipment) and training which enabled the Nuclear Materials Corporation to design and construct four sets of gamma-ray spectrometer calibration pads and to optimize the use of sophisticated software packages for processing airborne gamma-ray data. The calibration concrete pads are being used for calibrating portable equipment at various uranium field camps in Egypt. Expert advice was also given on how this data could be used for establishing background radioactivity maps, which are invaluable for uranium exploration.

EGY/5/018 RADIOIMMUNOASSAY IN ANIMAL SCIENCE

COMPLETED: **92-12-30** TOTAL COST: **$107,259**

TO USE RADIO- AND ENZYME-IMMUNOASSAYS FOR DIAGNOSIS OF VIRAL AND BACTERIAL INFECTIONS OF LIVESTOCK.

The Animal Health Research Institute (AHRI), Dokki, Cairo, is Egypt's primary institute for the diagnosis of animal diseases. This project was initiated in 1986 through an extrabudgetary contribution from the USA with the aim of strengthening AHRI's diagnostic capabilities and extending them to a wide range of viral and bacterial infections in livestock by introducing centralized radioimmunoassay (RIA) and enzyme-linked immunosorbent assay (ELISA) techniques. Several expert missions were undertaken to train the counterpart staff and to establish diagnosis procedures for poultry diseases and for brucellosis and rinderpest in cattle with special reference to ELISA-related RIA techniques. Equipment provided included an ELISA reader, a computer system with adequate software, a distillation apparatus, a refrigerated centrifuge and various items of laboratory equipment and supplies. The project has been relatively successful in introducing nuclear and related techniques for diagnosing diseases affecting livestock and poultry. The AHRI can now carry out surveys and promote control programmes for rinderpest, infectious bovine rhinotracheitis and poultry diseases such as Newcastle disease and Gunboro.

EGY/6/004 INTRACAVITARY RADIATION THERAPY FOR CANCER

COMPLETED: **92-12-31** TOTAL COST: **$985,798**

TO INVESTIGATE THE APPLICATION OF THE AFTERLOADING TECHNIQUE WITH SEALED RADIOACTIVE SOURCES FOR THE TREATMENT OF UTERINE-CERVICAL CANCER.

Uterine-cervical cancer is one of the most common forms of malignancy affecting women in developing countries. This large-scale IAEA/WHO project was initiated in 1983 at the Radiation Oncology and Nuclear Medicine Centre of the Faculty of Medicine, Cairo University (NEMROCK), through an extrabudgetary contribution from Italy, to investigate the feasibility of using the afterloading technique with sealed radioactive sources as a relatively simple and inexpensive method of treatment which would be of particular interest to small hospitals lacking teletherapy equipment. From its beginning, the project was guided by an advisory committee including senior radiotherapists and representatives of IAEA and WHO. An annual three-week brachytherapy training course was developed, involving 109 specialists from Egypt and 20 from other African countries. The achievements of the project have been reported to about eight international conferences. Equipment provided under the project included brachytherapy sources, computer systems, X-radiography equipment, radiation monitors and various cytology laboratory items and teaching materials. Two project-funded fellowships were awarded for training abroad and several expert missions were undertaken to support project activities. The project has contributed to increasing the awareness in Egypt and other developing countries of uterine-cervical cancer and to investigating possible approaches to its management. The work performed under the project has strengthened the position of NEMROCK as a centre for training and policy making in the field of brachytherapy and has demonstrated the potential and applicability of the technique for treating uterine cancer in the early stages. The project has enabled NEMROCK to develop suitable programmes for cancer registries, epidemiology, follow-up of patients and dose calculations. The experience gained has significantly extended the range of the Agency's TC programme in radiotherapy and helped In the formulation of related projects in seven developing countries.

EGY/9/014 NUCLEAR SAFETY

COMPLETED: **92-07-13** TOTAL COST: **$311,214**

TO ASSIST THE NUCLEAR SAFETY COMMISSION IN REGULATORY MATTERS, TO PROVIDE TRAINING IN NUCLEAR SAFETY, WORKSHOPS ON METHODOLOGY, AND TO REVIEW AND EVALUATE SAFETY ANALYSIS REPORTS.

The project was initiated in answer to the need to prepare the regulatory staff to perform a safety analysis review and license the planned nuclear power plant. Thanks to extrabudgetary funds from the USA, equipment (computer systems and accessories, software), expert services and training were provided. The assistance focussed mainly on nuclear safety and on methodology and technical considerations for review and evaluation of safety analysis reports of nuclear power plants and other nuclear installations. Seven workshops on various aspects of nuclear safety were organized and eight staff members of the Regulatory Body were trained abroad. Experts also gave advice on commissioning procedures, particularly on safety analysis of fuel behaviour, quality assurance programme review and auditing requirements, as well as

surveillance of testing and commissioning activities. Regulatory aspects of commissioning and operation were also covered and existing regulations improved. As a result of the project, the professional capabilities of the regulatory staff have been substantially increased, thereby enabling the Regulatory Body to carry out its responsibilities in safety analysis assessment and licensing in respect of nuclear power plants, fuel cycle facilities and nuclear installations.

EGY/9/025 COMPUTERIZED SAFETY LOGIC SYSTEM

COMPLETED: **92-12-30** TOTAL COST: **$123,850**

TO IMPROVE THE OPERATIONAL SAFETY OF THE ETRR-1 RESEARCH REACTOR; TO PROVIDE A RELIABLE COMPUTERIZED LOGIC SYSTEM TO CONTROL THE SAFETY ROD OPERATION, GUARANTEEING FAST AND ACCURATE RESPONSE.

The Nuclear Research Centre, Inshas, Cairo, is equipped with a research reactor which reached criticality in 1961. In recent years, the Agency provided assistance based on RAPAT missions and recommendations of nuclear safety experts to improve the safety operation of the reactor. Previous assistance included the provision and installation of new radiation monitoring instruments and new process control instrumentation. Under this project, initiated in 1991, the Agency supplied a computerized safety logic system to replace the old system, which did not respond to the requirements of the modernized control and measuring instruments already installed at the reactor. The project has contributed towards modernizing Egypt's only research reactor.

ETHIOPIA

ETH/5/007 ANIMAL SCIENCE

COMPLETED: **92-09-08** TOTAL COST: **$249,854**

TO IMPROVE THE PRODUCTIVITY OF LOCAL BREEDS OF CATTLE THROUGH IMPROVED NUTRITIONAL AND REPRODUCTIVE MANAGEMENT.

The project started in 1984 and has included studies in animal nutrition, reproduction and disease diagnosis. Much of the work has been supported by related FAO/IAEA research contracts under a number of co-ordinated research programmes and is continuing thanks to the same support and to IAEA Project ETH/5/009. Radioimmunoassay (RIA) techniques for the measurement of progesterone were introduced under the project at the Institute of Pathobiology, Addis Ababa, and the Faculty of Veterinary Medicine, Debre Zeit. RIA techniques were used for studies on the constraints reducing productivity of indigenous breeds of cattle, sheep and goats and subsequently on the effectiveness of measures used to alleviate these constraints. At the Institute of Agricultural Research, Holetta, research on evaluation of locally available feeds and agricultural by-products was carried out using a variety of in-vitro and in-vivo techniques introduced under this project. As a result counterpart staff are now better able to advise farmers on feed rations and the use of agricultural by-products for supplementary feeding. Studies were supported at the Institute of Pathobiology on the use of radioisotopic techniques for the development and utilization of irradiated vaccines against sheep lungworm and liver fluke. Although not successful in producing a viable

vaccine, these studies provided valuable information on immunity mechanisms and the problems of using such vaccines in the field. Linked closely with an FAO/IAEA SIDA-funded research contract, support was provided for the introduction and use of an ELISA-based system for sero-monitoring the national rinderpest vaccination campaign. This work was carried out at the National Veterinary Institute, Debre Zeit, and to date some 20 000 sera have been tested.

ETH/6/003 RADIOISOTOPES IN MEDICINE

COMPLETED: **92-07-13** TOTAL COST: **$512,026**

TO INCREASE THE DIAGNOSTIC IMPACT OF NUCLEAR MEDICINE SERVICES.

The primary objectives of this project were to introduce nuclear medicine as a means of diagnosing endemic diseases and to create a referral centre in Ethiopia. These objectives have been achieved by the introduction of both in-vivo organ imaging and in-vitro radioimmunoassay (RIA) techniques through the mechanisms of equipment and reagent supply, provision of expert services and local manpower development. The provision of equipment started in 1982 with the supply of a rectilinear scanner, isotope calibrator, a double probe uptake measurement system, and a thyroid phantom. The equipment capability of the laboratory was constantly upgraded through the supply of numerous other items such as a lyophyliser, a laminar air flow cabinet, a refrigerated centrifuge, a large capacity refrigerator, a second isotope calibrator, and RIA pipettes. A reconditioned gamma camera was supplied in 1990. The establishment of diagnostic tests was further supported by the supply of reagents for both the in-vivo and in-vitro laboratories. Initially, ready-made commercial kits were supplied for RIA. However, in 1990, following a regional training course held in Ethiopia, the laboratory started to use bulk reagent methodology. Expert services, totalling about 16 man-months, contributed appreciably towards the establishment and upgrading of both in-vivo and in-vitro nuclear medicine activities and towards the installation and operation of the gamma camera. Training of the local staff has been carried out through twelve project-related fellowships, nine of which were of one year's duration, and three short scientific visits. The essential objectives of the project have been realised in that a nuclear medicine laboratory, with both in-vivo and in-vitro equipment and trained staff capable of providing a clinical diagnostic service, has been established at the Black Lion Hospital in Addis Ababa. The laboratory is a viable concern and continues to be further supported and upgraded by the Agency under a follow-up project (ETH/6/005).

GABON

GAB/3/002 GEOLOGICAL DATA BANK

COMPLETED: **92-12-30** TOTAL COST: **$65,502**

TO STRENGTHEN THE CAPABILITY FOR LOCAL TREATMENT AND INTERPRETATION OF RADIOMETRIC, GEOPHYSICAL AND GEOLOGICAL DATA AND TO FACILITATE ASSESSMENT OF THE NATURAL RAW MATERIALS RESOURCE POTENTIAL THROUGH THE ESTABLISHMENT OF A COMPUTERIZED DATABASE TO BE USED FOR THE PRODUCTION OF MAPS.

The initial objectives of this project were two-fold: to create a database system for geological information and to establish a fluorimetric laboratory for uranium analysis. Since the part of the project dealing with the database was achieved through bilateral assistance, the Agency focussed its assistance primarily on the fluorimetric laboratory. A complete fluorimetric analysis system was supplied and an expert, during two missions totalling nearly ten weeks, helped to install the equipment and train the local staff in its operation. From the installation of the fluorimeter in April 1990 up to the second visit of the expert, in November 1991, about 1200 geochemical and geological samples had been analysed by the local staff. The fluorimetric laboratory is now fully operational.

GHANA

GHA/5/011 ERADICATION OF RIVERINE TSETSE FLY

COMPLETED: **92-07-13** TOTAL COST: **$254,556**

TO CONTROL AND POSSIBLY ERADICATE RIVERINE SPECIES OF TSETSE FLY BY MEANS OF THE STERILE INSECT TECHNIQUE.

The main objective of the project was to apply the sterile insect technique (SIT) and other environmentally safe techniques for the eradication of Glossina palpalis palpalis and G. tachinoides from selected cattle-rearing areas in the northern and upper regions of Ghana and consequently to control trypanosomiasis. With Agency assistance, a well equipped laboratory has been set up for tsetse rearing and research on SIT. The second FAO/IAEA regional training course on integrated control of tsetse flies, with emphasis on SIT, was held In this laboratory in 1990. Through Agency training programmes, four fellowships, totalling about 28 months, were awarded. Relevant training was also provided by attendance at IAEA-sponsored training courses, raising the number of trained personnel to nine scientists and four technicians. Five expert missions assisted the project for a total duration of over seven months. A colony of G. palpalis has now been established in the laboratory and useful reproductive data collected. The staff have gained sufficient experience to undertake mass rearing and sterilization of flies for field releases, which will begin under Phase II of the project. The ecological, entomological and epidemiological baseline data have been sufficiently updated to be used to design strategies for releases and monitoring of the flies.

GHA/6/007 NUCLEAR MEDICINE

COMPLETED: **92-05-14** TOTAL COST: **$274,545**

TO EXPAND THE ACTIVITIES OF A NUCLEAR MEDICINE UNIT AND TO DEVELOP SELF-SUFFICIENCY IN THE PREPARATION OF KITS FOR RADIOISOTOPE IMAGING AND RADIOIMMUNOASSAYS.

The Agency's support to the University of Ghana's Medical School dates back to a project initiated in 1974. Under the present project, initiated in 1982, the Nuclear Medicine Unit has been supplied with major equipment for in-vivo studies including a rectilinear scanner, a renography system and a radioisotope dose calibrator, as well as expendable items such as radioisotopes and chemical reagents. A complete radioimmunoassay (RIA) system was provided for thyroid-related hormones. One physician and two technologists were awarded fellowships. A radiopharmacy laboratory was set up with expert assistance from the Agency and the provision of important items of equipment including a horizontal laminar flow unit, a medium capacity freeze drying machine, automatic pipettes, a hand and foot monitor, and an isotope dose calibrator. During an expert mission, a few trial batches of Tc-99m phytase injection were prepared and relevant aspects of preparation and purification of I-125 labelled T-3 and T-4 and their antisera for use in RIA work were discussed in detail. With the inputs from the Agency, the Nuclear Medicine Unit of the Medical School has built an infrastructure capable of performing in-vivo and in-vitro nuclear medicine investigations. An average of 2400 nuclear medical studies are carried out annually in the unit, including scintigraphy of the brain, thyroid, liver, spleen and kidney. About 20% of the workload concerns the RIA of thyroid hormones. The unit is now capable of switching over to the use of imported bulk reagents from ready-to-use RIA kits, which will reduce the cost of each assay while maintaining the quality. The nuclear medicine infrastructure has been developed to such a level that the next phase of the project, GHA/6/008, can now be embarked upon.

GREECE

GRE/4/008 RESEARCH REACTOR MODERNIZATION

COMPLETED: **92-07-13** TOTAL COST: **$128,075**

TO ESTABLISH A RADIATION MONITORING SYSTEM AT A RESEARCH REACTOR AND IN ITS VICINITY.

As the research reactor at the Demokritos Nuclear Research Center (NRC), is very close to the residential area it became necessary to modernize the monitoring system around the reactor. The objectives of the project were achieved in two steps. First a meteorological tower was built and equipped, and then a stack monitor was built, installed and put into operation. The 84 metre high meteorological tower was constructed by the NRC, and the Agency provided the equipment and advised on its installation. The stack monitor was then designed and constructed under the project at the Agency's Laboratory at Seibersdorf for monitoring gaseous components discharged from the reactor area (noble gases, aerosols and volatiles). The stack monitor was installed and put into operation with the assistance of an Agency expert. The reactor monitoring system has now been upgraded to the required level.

GUATEMALA

GUA/6/008 NUCLEAR MEDICINE LABORATORY (IN VITRO)

COMPLETED: **92-12-30** TOTAL COST: **$56,090**

TO STRENGTHEN THE CAPABILITY OF THE NUCLEAR MEDICINE UNIT TO PRODUCE RADIOIMMUNOASSAY KITS FOR HYPOTHALAMIC PITUITARY THYROID AND HYPOTHALAMIC PITUITARY GONADAL AXES USING LOCALLY PRODUCED REAGENTS.

The project was approved in 1989 to continue activities carried out under Project GUA/6/007 at the San Juan de Dios General Hospital and the National Directorate of Nuclear Energy (DGEN), Guatemala City. The laboratory made good progress in the production of primary reagents for radioimmunoassay (RIA). All the reagents needed for assays of thyroid hormones, T-3 and T-4, are now being produced and a national programme of neonatal hypothyroid screening has been designed. Two fellowships were financed by the United Kingdom and Brazil for training in RIA technology, and scientific visits were granted to two physicians on related topics and nuclear medicine in general. Equipment was provided to complete the laboratory and for the repair of the gamma camera. The project resulted in a great improvement of the services provided to the low-income population and laid the foundation for the establishment of nuclear medicine centres throughout Guatemala, which will be initiated under Project GUA/6/011.

HAITI

HAI/8/003 ISOTOPE HYDROLOGY

COMPLETED: **92-09-08** TOTAL COST: **$115,851**

TO APPLY ISOTOPE-AIDED TECHNIQUES IN THE STUDY OF THE LEOGANA, GONAIVES, ARTIBONITE AND CAYES AQUIFERS AND TO IMPLEMENT PERIODIC ISOTOPE MONITORING PROGRAMMES.

The present project was preceded by a UNDP-funded project (HAI/8/002) supporting the Haitian Water Resources Survey (SNRE), initiated in 1984, studying the groundwater resources of the Cul-de-Sac Plain, which is the main water supply for Port-au-Prince. This study was undertaken in parallel with the present project. The use of nuclear techniques in solving water resource problems was extended to several aquifer systems under the present project, which was intended to apply isotope-aided techniques in the study of some Haitian aquifers and to implement periodic isotope monitoring programmes. The Agency provided expert and consultant services for planning and installing a laboratory and for hydrochemistry and isotope studies. Equipment provided included an atomic absorption spectrophotometer, a vehicle, some isotopes, as well as analytical services and various laboratory items and supplies. The areas investigated were those where the UNDP-SNRE project had planned a drilling campaign for water supply: mainly in the northern peninsula (Arbre Plain, Plaine du Nord, Le Borgne) and Cayes Plain, on the southern peninsula. Isotope-aided studies were initiated and monitoring was carried out at regular intervals. The report of the studies undertaken under the UNDP-funded project was included in the final report of that project and is a unique document on the status of the country's water resources. (It was of great value in the present project.) Two fellowships were awarded for training on the application of

isotope techniques in hydrology. As a result of the project, the SNRE has set up a well equipped hydrochemistry laboratory.

HONG KONG

HOK/1/004 CALIBRATION FACILITIES FOR DOSIMETRY

COMPLETED: **92-11-18** TOTAL COST: **$51,008**

TO ESTABLISH CALIBRATION FACILITIES FOR RADIATION MONITORING AND RADIOLOGICAL PROTECTION IN HONG KONG.

The project was approved following the recommendation of an Agency pre-project mission in early 1988 in order to establish calibration facilities at the Royal Observatory, Radiation Monitoring Division, Hong Kong. The Agency provided the reference class dosimetric system with a calibration certificate from the Agency's Dosimetry Laboratory at Seibersdorf as well as a Cs-137 source. One expert mission to establish calibration facilities for dosimetry was carried out in 1989. The set-up was then ready for routine calibration. A two-week scientific visit and a three-month fellowship training for counterpart staff were awarded in 1989. A final review mission was carried out by an Agency staff member in 1992 to assess the project's achievements. IAEA reference materials and intercomparison samples have been used successfully to upgrade the national environmental monitoring programme.

HUNGARY

HUN/1/008 STRENGTHENING OF AN ADVANCED AUTOMATED RADIATION LABORATORY

COMPLETED: **92-06-19** TOTAL COST: **$26,940**

TO ESTABLISH A NATIONAL CAPABILITY FOR USING PULSE RADIOLYSIS IN CONNECTION WITH FUNDAMENTAL AND APPLIED RESEARCH IN BIOLOGY AND RADIATION TREATMENT OF FOOD, SPICES AND NATURAL POLYMERS.

This UNDP-financed project started in 1986 and was executed by the Agency through provision of equipment, expert services and scientific visits. The equipment included two high frequency digital storage oscilloscopes. The main laboratory (the Radiation Chemistry Department) responsible for implementing the project at the Institute of Isotopes of the Hungarian Academy of Sciences had already been established under the UNDP Project HUN/82/002, where an up-to-date system had been developed on the basis of a computerized 4 MeV LINAC electron pulse accelerator. The present project enabled the laboratory to improve the efficiency and performance of the accelerator and to complete the construction of a pulse radiolysis facility for fundamental and applied research. Investigations can now be carried out on chemical reactions to determine decomposition, ageing and transformation of biologically important compounds. The results may be applied in the development of radiation treatment of food, spices, drugs and natural polymers. The laboratory and its facilities, in collaboration with other Hungarian institutions, are also available to developing countries for training or advice.

HUN/5/012 RADIOACTIVE CONTAMINATION AND FOOD CONTROL

COMPLETED: **92-12-30** TOTAL COST: **$120,296**

TO ESTABLISH A SERVICE OF RADIOACTIVE CONTAMINATION CONTROL IN FOODSTUFFS.

Since 1960, the Veterinary and Food Control Service of the Ministry of Agriculture has operated a nationwide network for environmental radiation monitoring and determination of radioactive contamination of foodstuffs. The project was financed by France and initiated in 1989 to upgrade the existing network and thereby improve the level of service offered. At first the network consisted of a single regional monitoring station and 23 local stations. The Agency provided a portable gamma spectroscope and laboratory-based alpha and gamma spectroscopy systems, with the result that more accurate and more efficient methods for measurement of radioactive contamination were introduced. Expert services were provided in gamma spectroscopy and to advise the Hungarian authorities in planning the upgraded monitoring network. Two scientific visits on environmental monitoring were sponsored by France in 1991.

HUN/9/012 OSART FOLLOW-UP VISIT TO PAKS NUCLEAR POWER PLANT

COMPLETED: **92-12-30** TOTAL COST: **$48,214**

TO CARRY OUT AN OSART FOLLOW-UP VISIT TO THE PAKS NUCLEAR POWER PLANT.

The project was approved in 1991 at the request of the Hungarian Government for advisory missions to the Paks Nuclear Power Plant (NPP). Three Agency experts visited the plant under the OSART programme in 1991, making recommendations to the plant operators and management to help strengthen overall operational safety. In 1992, an Assessment of Safety Significant Events (ASSET) training seminar was held for 22 participants from Hungarian nuclear organizations, including representatives from uranium mining, public health and medical services. As well as covering the standard ASSET programme, the seminar concentrated on two major aspects: familiarization of operators from all types of nuclear facility with the International Nuclear Event Scale (INES) information system; and ASSET methodology and computer codes for root cause analysis. A team of five Agency personnel, six external experts and one cost-free expert from Japan also carried out an ASSET review mission on the past operating experience of the four WWER 440/213 units at the Paks NPP and offered recommendations for prevention of incidents. One Hungarian scientist participated as an observer in an OSART mission to the Koeberg NPP, South Africa, to study operational safety review procedures and methods.

INDONESIA

INS/0/010 NUCLEAR INFORMATION SYSTEM

COMPLETED: **92-12-30** TOTAL COST: **$31,743**

TO SET UP A COMPUTERIZED SCIENTIFIC INFORMATION SYSTEM FOR R&D ACTIVITIES AT SERPONG.

The National Atomic Energy Agency has established a large multidisciplinary nuclear research complex at Serpong, West Java, in addition to those already existing at Jakarta, Bandung and Yogyakarta. The project was approved in 1989 to equip the Informatics Development Centre, Serpong, in order to improve the nuclear information services available to scientists and researchers in Indonesia. Equipment and materials essential to an information centre, including a personal computer, were provided. A CD-ROM player was also supplied, so that the Centre could offer information retrieval services using the INIS CD-ROM database. Two counterpart staff were awarded scientific visits and another staff member participated in Agency group fellowship training. As a result of the project, the Centre has automated its library functions through the creation of local databases and linked this local system with their existing mainframe computer. The Centre can now perform computerized searches for bibliographic references in the INIS CD-ROM database and is now able to provide improved general nuclear information services.

INS/4/026 NEUTRON TRANSMUTATION DOPING OF SILICON

COMPLETED: **92-12-30** TOTAL COST: **$68,993**

TO GAIN EXPERTISE IN MATERIALS RESEARCH USING NEUTRON IRRADIATION FROM THE HIGH FLUX MULTIPURPOSE RESEARCH REACTOR AT SERPONG.

As a part of the plans for utilizing the high flux 30 MW(th) multipurpose research reactor at Serpong, the Siwabessy Multipurpose Reactor Centre, Serpong, undertook the construction of a neutron transmutation doping (NTD) facility for the controlled irradiation of semiconductor materials, with the aim of doping semiconductor-grade silicon for use in the electronics and associated industries. Under the project, approved in 1989 on the basis of a pre-project mission, the Agency provided some items of equipment and supplies, Including an automatic resistivity measuring instrument for silicon wafers, silicon ingots and broad spectrum foil kits. An Agency expert undertook two missions to advise on the installation of the irradiation facility provided by the Government, on calibration of the NTD system, and on neutron flux and spectrum measurement for NTD silicon. Two counterpart staff were awarded scientific visits. As a result of the project, the counterparts can now independently carry out further R&D work on silicon NTD, which is expected to be of eventual economic benefit.

INS/6/007 QUALITY CONTROL AND MAINTENANCE OF NUCLEAR MEDICAL EQUIPMENT

COMPLETED: **92-12-30** TOTAL COST: **$87,417**

TO ESTABLISH A WELL EQUIPPED LABORATORY FOR QUALITY CONTROL AND MAINTENANCE OF NUCLEAR MEDICINE EQUIPMENT.

Many items of nuclear medical equipment, including gamma cameras/SPECT and cobalt-60 teletherapy machines, have been installed in various hospitals in Indonesia. However, owing to the lack of technical support from manufacturers, as a result of which much vital and very expensive equipment suffers severely from long down-time and poor quality, it became necessary to establish local service capability for maintenance and quality control of such equipment. Under this project, approved in 1989, the Agency provided various test instruments, phantoms and electronic spare parts. Two Agency experts gave advice on trouble shooting and preventive maintenance protocol and conducted two national training courses on quality control and maintenance of nuclear medical equipment. Three counterpart staff received long-term fellowship training. As a result of the project, the Nuclear Instrumentation Division of the Yogyakarta Nuclear Research Centre now has the capacity to carry out routine repair/maintenance and quality control of nuclear medical equipment and is already providing these services to seven government hospitals in eastern Indonesia. A national training course for users and operators of gamma camera/SPECT on the quality control and maintenance of nuclear medical equipment has been planned for 1993, to be conducted by the project counterpart.

INS/9/014 RESEARCH REACTOR SAFETY

COMPLETED: **92-12-30** TOTAL COST: **$66,773**

TO ACQUIRE EXPERTISE IN THE THERMOHYDRAULICS OF REACTOR SAFETY FOR THE MPR-30.

A 30 MW(th) multipurpose research reactor was commissioned in 1987 in Serpong, West Java. Commissioning of the integrated facilities was the responsibility of the National Atomic Energy Agency. To study the safety aspects of reactor operation and to evaluate the thermohydraulic data derived during commissioning, it was necessary to determine accurately the reactor's thermohydraulic parameters by means of measurements and calculations, using computer codes. The project was approved in 1989 with footnote-a status and was upgraded in 1990. Germany also made additional extrabudgetary contributions for the provision of an expert. The Agency supplied equipment, including a computer system. Three Agency experts carried out four missions and advised on thermohydraulic assessment of the reactor, accident analysis, safety analysis calculations, and development of computer codes for flow distribution calculations. Two counterpart staff were awarded long-term fellowship training. As a result of the project, the counterpart at the Siwabessy Multipurpose Reactor Centre, Serpong, has developed expertise in the thermohydraulics of reactor safety.

INTERREGIONAL

INT/1/028 EQUIPMENT MAINTENANCE TRAINING

COMPLETED: **92-12-30** TOTAL COST: **$87,007**

TO INSTALL A LIQUID NITROGEN PRODUCTION FACILITY FOR TRAINING PURPOSES.

It was originally envisaged to install a USSR-made nitrogen liquifying plant at the Agency's Laboratory at Seibersdorf to provide training in its operation and maintenance to personnel from countries which had requested such facilities, with the intention to transfer the equipment to a developing country at a later stage. However, it was agreed that the cost of setting up the facility at Seibersdorf was not warranted, and the decision was taken to transfer the equipment to Damascus where it was installed in the laboratories of the Syrian Atomic Energy Commission.

INT/1/039 NUCLEAR MEASUREMENT TECHNIQUES

COMPLETED: **92-03-30** TOTAL COST: **$312,158**

TO SET UP SPECIFIC MEASUREMENT CAPABILITIES FOR LABORATORIES IN DEVELOPING MEMBER STATES IN APPLIED NUCLEAR MEASUREMENTS AND TO PROMOTE CO-OPERATION/CO-ORDINATION AMONG PARTICIPATING INSTITUTES.

The project was Initiated in 1987 as a follow-up of an earlier interregional project on nuclear data techniques and instrumentation (INT/1/018) which assisted laboratories to establish a capability for performing nuclear measurements. The scope of the current project was broadened to a more general emphasis on quantitative nuclear measurements. Two sets of intercomparison exercises were to be carried out under the programme, in which 41 laboratories volunteered to participate. Of the 54 laboratories to which an announcement was sent, 41 submitted participation programmes to the Agency, and samples for analysis were sent to them. Of these, 23 reported measurement results while 12 indicated their Intention to carry out the measurements but did not do so. Measurements for the second set of exercises were carried out by only three of a total of 14. Results from the first exercise disclosed important inconsistencies in the quality of reported measurements by all except one or two laboratories. Some measurements were well within acceptable limits while others showed large discrepancies. The major contributing factors were inappropriate sample preparation techniques, improper calculations of correction factors for the 'matrix effect', and use of incorrect reference materials. These inadequacies indicated a need to continue efforts to Improve the capability of nuclear laboratories in developing countries to carry out the accurate, reliable and reproducible nuclear measurements needed for most application programmes. The scope of the approach should, however, be narrowed and should concentrate on integral training in all steps involved from sample preparation, use of reference materials, operation of equipment, collection, processing and analysis of data. It was concluded that this training could best be conducted for Africa. A regional project, X-Ray Fluorescence Laboratory Network in Africa (RAF/8/015), was therefore approved for implementation from 1992.

INT/9/054 SITING OF NUCLEAR INSTALLATIONS

COMPLETED: **92-07-13** TOTAL COST: **$349,823**

TO SUPPORT CO-ORDINATED ACTIVITIES IN CONNECTION WITH THE SITING OF NUCLEAR FACILITIES IN DEVELOPING MEMBER STATES.

The project was approved In 1984 to provide developing countries with experts whose knowledge of the whole site selection process, both theoretical and practical, would provide the technical expertise required for planning the siting of nuclear facilities. During the period 1984-90, twelve experts undertook many missions and four lectured at a seminar on site selection in Vienna in 1985, which was attended by 21 participants from seven countries. Direct results of the project were: the preparation of checklists to be used in site safety review missions; the preparation and dissemination of computer codes related to siting and hazards (used in particular as training tools); and the publication of an Agency TecDoc, leading to a Safety Guide on earthquake-resistant design of nuclear facilities with a limited radioactive inventory. Many siting missions were organized and, in most cases, followed up by national projects for more sustained and systematic assistance, e.g. in Albania, Brazil, Iraq, Iran, Morocco, Portugal, Tunisia, Turkey and Yugoslavia.

IRAN, ISLAMIC REPUBLIC OF

IRA/0/005 PROCUREMENT ASSISTANCE

COMPLETED: **92-07-13** TOTAL COST: **$312,694**

TO PROVIDE ASSISTANCE THROUGH PROCUREMENT OF EQUIPMENT.

The objectives of the project, namely to assist the Iranian Government by using funds-in-trust to procure equipment or spare parts not provided under an Agency or UNDP programme, has been achieved. The project assisted in upgrading nuclear equipment and facilities in Iran. The major items of equipment procured were reactor control devices, a gamma irradiator cell and source for the Tehran and Isfahan Nuclear Research Centres, supplementing UNDP Project IRA/82/003 and Agency Project IRA/4/016. In addition, advice was provided on suitable suppliers of material such as natural uranium fuel for the Iranian subcritical reactor at the Isfahan Nuclear Research Centre, necessary for Project IRA/4/016, and purchased directly from China on a bilateral basis.

IRA/1/007 CALIBRATION FACILITIES FOR DOSIMETRY

COMPLETED: **92-12-30** TOTAL COST: **$23,482**

TO IMPROVE SAFETY RELATED TO THE APPLICATION OF SOURCES OF IONIZING RADIATION THROUGH THE ESTABLISHMENT OF A SECONDARY STANDARDS DOSIMETRY LABORATORY THAT WILL ASSUME RESPONSIBILITY FOR THE CALIBRATION OF ALL SOURCES OF IONIZING RADIATION IN THE COUNTRY.

A national calibration laboratory for ionizing radiation was successfully established at the Nuclear Research Centre for Medicine and Agriculture,

Karedj. Back-up for the personnel monitoring services and calibration of all radiation protection Instrumentation was also provided by the Agency. The project contributed to a large extent to the safe application of ionizing radiation in Iran.

COTE D'IVOIRE

IVC/5/015 NUCLEAR METHODS IN NUTRITIONAL ANALYSIS

COMPLETED: **92-09-09** TOTAL COST: **$127,415**

TO ASSESS THE NUTRITIVE VALUE OF RUMINANT FEEDS.

This project was initiated by the Government to assess the nutritive value of animal feedstuffs, many of them in the form of by-products from the food and agriculture industries. The project helped to address the problem by providing equipment for studies on in-vitro digestibility, together with expert advice and fellowship training. Several by-product foodstuffs (e.g. palm sludge, coffee hulls, chocolate waste products, etc.) were studied and their effectiveness compared with that of forage. Practical treatments appropriate to commercial exploitation were elaborated. The interactions between nutrition and reproduction were also investigated. In addition to on-the-job training, two scientists received training abroad. The Central Animal Nutrition Laboratory, Abidjan, now provides analytical services to other countries in the region (Ghana, Burkina Faso).

IVC/5/017 FOOD PRESERVATION

COMPLETED: **92-07-13** TOTAL COST: **$45,344**

TO PROMOTE PILOT-SCALE FOOD IRRADIATION IN ORDER TO COMMERCIALIZE FOOD PRODUCTS.

The project was Initiated by the Government to assess the techno-economic feasibility of food irradiation. The project provided expert advice and training in various aspects of food irradiation technology. Four scientists received training abroad. During implementation of the project the Government decided to acquire a commercial food irradiator for preservation of various commodities and for research and development. The project assisted this undertaking by providing expert advice for elaboration of a national programme on food irradiation, including the appropriate legislation, and for safe operation of the irradiator.

JAMAICA

JAM/2/004 **NUCLEAR ANALYTICAL LABORATORY**

COMPLETED: **92-12-30** TOTAL COST: **$78,086**

TO EXPAND THE USE OF ENERGY-DISPERSIVE X-RAY FLUORESCENCE AND NEUTRON ACTIVATION ANALYSIS FOR DETERMINING ELEMENTAL CONCENTRATIONS IN A WIDE VARIETY OF SAMPLES OF GEOLOGICAL AND BIOLOGICAL ORIGIN.

The Centre for Nuclear Sciences, Kingston, established, constructed and operated by the University of the West Indies, is the focal point for nuclear activities in Jamaica. A SLOWPOKE research reactor was acquired with the sole objective of conducting advanced analytical studies using neutron activation analysis. This project was approved in 1988 in order to introduce X-ray fluorescence analysis to complement the use of neutron activation analysis and to support some of the auxiliary services in radiation monitoring and nuclear instrumentation by providing auxiliary analytical equipment. The project was operational for four years (1988/91) and yielded excellent results. Activities included a systematic study of Jamaican ores and soils in order to create a complete geological map of the country, numerous studies of biological materials important to the economy, and radiation area and personnel monitoring services. The Centre plays an important role in advanced academic studies: several faculties participate in its programme or use its services. Several scientists of the Centre received training from an Agency expert and from training courses, and have reached the level at which they can serve as experts or training course instructors. Co-operation between the University and the Agency continues.

JORDAN

JOR/0/004 **RADIATION AND RADIOISOTOPE LABORATORY**

COMPLETED: **92-12-30** TOTAL COST: **$311,845**

TO ESTABLISH A RADIATION PROTECTION SERVICE TO BE USED BY THE NATIONAL AUTHORITY.

The principal aim of the project, initiated in 1985, was the performance of low-level gamma spectrometry measurements and personnel and environmental thermoluminescence dosimetry (TLD), at the Radiation Protection Laboratory (RPL) of the Royal Scientific Society (RSS), Amman. The Agency provided a TLD system and cards, an isotope calibrator and sources, a spectroscopy system, a computer system, a high-purity germanium detector, and dose rate and survey meters. Eight Agency experts, including three staff members, visited Jordan to train and advise the counterparts on personnel monitoring, calibration of the monitoring equipment, low-level counting techniques and other analytical, radiotracing and radiogauging methods. One counterpart staff member received group fellowship training on nuclear instrumentation, to enable him to maintain equipment provided under the project. Counterparts are now able to routinely monitor about 1000 radiation workers and others from 91 centres in Jordan, including hospitals, research laboratories and industries. Staff of the RPL are also engaged in post-Chernobyl measurements of radiocaesium in various foodstuffs imported into or exported from the country. An environmental monitoring programme has

been successfully established, and low-level counting is performed on samples collected from 30 stations, including the phosphate mines and mills. The counterparts are now able to continue with routine programmes for personnel, food and environmental monitoring and to enforce radiation protection regulations which were drafted and promulgated with the Agency's assistance.

JOR/3/002 URANIUM RECOVERY FROM PHOSPHORIC ACID

COMPLETED: **92-12-30** TOTAL COST: **$68,322**

TO ASSESS THE FEASIBILITY OF EXTRACTING URANIUM FROM PHOSPHORIC ACID WITH A VIEW TO ESTABLISHING A PILOT PLANT.

The Fertilizer Unit of the Jordan Phosphate Mines Company (JPMC) had previously carried out a feasibility study on the extraction of uranium from the phosphoric acid produced at its Aqaba complex in collaboration with a German firm, with a view to commercializing the extraction of uranium from the JPMC mines which contain about 60 to 100 parts per million of uranium in the phosphatic rocks. Under the present project, initiated in 1988, the Agency provided a micro-plant facility, spare parts, chemicals and a spectrophotometer for experimental recovery of yellow cake uranium from the phosphoric acid. The facility is attached to the Fertilizer Unit of the JPMC, near Amman, where adequate analytical equipment has been made available to carry out tests on uranium extraction. Four expert missions were organised to train and advise the counterpart staff on the operation of the micro-plant and to evaluate and assist in the analyses. In view of the present depressed world market price of uranium, the project would not have continued to the pilot-plant stage, since the investment required is substantial. However, JPMC is continuing detailed investigations of uranium recovery from phosphoric acid by solvent extraction techniques.

JOR/3/003 URANIUM EXPLORATION

COMPLETED: **92-12-30** TOTAL COST: **$245,633**

TO STRENGTHEN THE FLUORIMETRIC LABORATORY'S CAPABILITY FOR URANIUM ANALYSIS WITH A VIEW TO COLLECTING DETAILED INFORMATION ON URANIUM RESOURCES NEEDED IN DETERMINING THE NATIONAL RADIOACTIVE MINERAL POTENTIAL.

The Natural Resources Authority (NRA), under the Ministry of Energy and Mineral Resources, is responsible for basic geological studies and investigations into mineral resources in Jordan. Under this project, initiated in 1988, the Agency supplied the NRA with laboratory equipment and material, including a fluorometer, a multichannel analyser, calibration blocks and a scintillation detector, which were used in evaluating the national radioactive mineral potential. Previous airborne investigations had indicated a moderate to good potential for uranium, other than those associated with phosphate deposits. The Geology, Geophysics and Laboratories Departments of the NRA participated in the exploration. Counterparts in each department were trained in the methodologies of applying hydrogeochemical, geochemical, geophysical and mineralogical techniques in the exploration programme. One expert, a uranium exploration geologist, undertook a year-long mission to Jordan to work with the counterparts on the project and was instrumental in

detailing the national uranium potentialities; he did not, however, uncover any bodies of economically interesting deposits. Eight other experts spent periods from one week to two months advising the counterparts, chiefly on the geochemical analysis of field samples. Six staff members were awarded fellowship training and scientific visits in advanced laboratories, where they were exposed to current techniques in uranium exploration and geochemical analysis. The project has led to the establishment of a capable core of local staff, who are steadily continuing to investigate Jordan's uranium potential.

JOR/5/004 FOOD IRRADIATION

COMPLETED: **92-12-30** TOTAL COST: **$4,991**

TO IMPROVE THE STORAGE OF LOCALLY PRODUCED FOOD CROPS IN JORDAN THROUGH GAMMA IRRADIATION.

The project was approved in 1989 to initiate a techno-economic pre-feasibility study of food irradiation in Jordan. A local pre-project study had indicated that the lack of adequate storage facilities, coupled with high temperatures, led to spoilage of stored agricultural products by microorganisms and insects, creating high post-harvest losses. The report also indicated that reliance on insecticides and fumigants to control infestations and spoilage has become unacceptable owing to frequent adverse side effects. The Agency was requested to provide a cobalt-60 irradiation facility, but in view of the inadequate infrastructure and lack of trained personnel, an expert first undertook a one-month pre-feasibility study funded by an extrabudgetary contribution from France. A French expert advised the counterparts and reviewed pilot-scale studies on selected crops and foods, marketing tests and development of regulations for trading in irradiated food products. The expert visited many food processing plants and institutions in Jordan and reviewed the feasibility of introducing food irradiation technology. His recommendations included the establishment of necessary infrastructures, legislation, laboratories and training in food irradiation and other preservation techniques. A continuation project on food irradiation has been approved for the 1993-94 Programme, mainly to supply a 10 kilo-curie experimental irradiator for research and training.

JOR/6/007 RADIOTHERAPY

COMPLETED: **92-12-30** TOTAL COST: **$62,582**

TO PROVIDE QUALITY ASSURANCE AND ACHIEVE HIGH STANDARDS IN RADIOTHERAPY TREATMENT PLANNING AND DELIVERY PROCEDURES.

To improve the general level of teletherapy and radiation protection at the Medical Physics Section of the Jordan Cancer Centre, located at the Al-Bashir Hospital, Amman, Agency assistance was requested to establish a quality assurance programme, particularly in the area of radiotherapy. The request was approved in 1989 to provide expert assistance as well as equipment, which included a computerized treatment planning system, quality assurance test tools, dosimeters, a phantom, ionization chambers and accessories for the major equipment. An Agency staff member advised on the activities and defined the specifications of equipment ordered for the project. Two staff members were awarded project-related scientific visits to advanced hospital

facilities in the United Kingdom. The project has contributed significantly to the improvement of patient treatment planning at the Cancer Centre, where higher cure rates in patient treatment are being achieved.

JOR/8/003 ISOTOPES IN HYDROLOGY

COMPLETED: **92-12-30** TOTAL COST: **$233,176**

TO ESTABLISH AN ISOTOPE HYDROLOGY LABORATORY; TO TRAIN LOCAL STAFF IN THE USE OF ISOTOPE METHODS FOR SOLVING PROBLEMS RELATING TO THE HYDROLOGY OF FOUR BASINS.

Water is a scarce commodity In Jordan and detailed information on the characteristics of the main underground basins needs to be mapped out. Through this project, initiated in 1983 as a continuation of an earlier project, JOR/8/002, the Agency assisted the Water Research and Isotope Laboratory (WRIL) of the Water Authority in Amman to establish an isotope hydrology laboratory. As the WRIL was the analytical centre for all water samples collected from the Member States participating in a related regional project, RER/8/002, the Agency provided a substantial amount of equipment in support of the analytical activities. The main items of equipment comprised spare parts to service a mass spectrometer and a liquid scintillation counter (LSC). Other laboratory equipment provided included an oscilloscope, a computer system and peripheral material. More than eight expert missions were organized to train the counterparts on calibration procedures for the LSC in tritium and carbon-14 counting, field sampling methodology, interpretation of hydrogeological data and on arid zone hydrological techniques. Agency experts also provided training in analytical techniques and advised on results concerning the size and recharge rates of aquifers and the interconnections between surface and groundwater. In related workshops and co-ordination meetings, held under the umbrella of the regional project, the counterparts attended lectures and reviewed case studies on the use of isotope techniques in hydrology, many of which were taken from work performed in and around Jordan. The counterparts are routinely using the techniques gained under the project in isotope hydrology evaluations of groundwater resources and in other hydrogeological investigations as part of the regional programme of activities for the Middle East.

KENYA

KEN/5/009 TSETSE FLY CONTROL

COMPLETED: **92-07-13** TOTAL COST: **$110,462**

TO SURVEY IN DETAIL THE FEASIBILITY OF THE STERILE INSECT TECHNIQUE FOR TSETSE CONTROL; TO PREPARE A PROPOSAL FOR A LARGE-SCALE FOUR-YEAR PROJECT WITH POSSIBLE SIDA FINANCING.

The project was established in 1984 in response to a request by the Government for an Agency expert mission to review the tsetse and trypanosomiasis situation in the Lambwe valley and to assist in the formulation of a project to address the control and eradication of Glossina pallidipes through an integrated approach, with the sterile insect technique (SIT) as the main component. Four experts, financed by an extrabudgetary contribution

from SIDA, visited Kenya, carried out the review and assisted in the preparation of the project document. R&D activities financed by an extrabudgetary contribution from Belgium were carried out at the Agency's laboratories at Seibersdorf. A programme was also initiated by Seibersdorf for collaboration with the Tropical Institute, Antwerp, to study the vectorial capacity of G. pallidipes. Under the project, a colony of the target species was set up at Seibersdorf, where two Kenyan counterparts received training in mass rearing techniques. As a result of this project a large-scale project proposal for tsetse fly eradication in the Lambwe valley (KEN/5/014) was approved under the 1991-92 Programme for five years with footnote-a status. The project still awaits financing. The R&D carried out at Seibersdorf and the training of counterparts have laid the necessary technical foundation for implementing the large-scale project should funds be made available.

KEN/5/012 FATE OF TRYPANOCIDAL DRUGS IN CATTLE

COMPLETED: **92-05-21** TOTAL COST: **$64,008**

TO DETERMINE THE METABOLIC FATE OF TRYPANOCIDE DRUGS IN CATTLE INFECTED WITH TRYPANOSOMES BY MEANS OF ISOTOPICALLY LABELLED DRUGS IN ORDER TO IMPROVE DRUG FORMULATION IN COLLABORATION WITH PHARMACEUTICAL COMPANIES.

The project was initiated in 1983 with extrabudgetary funding from Italy until 1990 and from UNDP for part of 1991. The main achievement was the construction and commissioning of laboratories and ancillary facilities for studies of the pharmacokinetics of trypanocidal drugs, using radioisotope techniques. Professional and support staff were trained. Research programmes in both field and laboratory were established which extended beyond pharmacokinetics to include drug sensitivity studies, drug testing in culture systems and cattle, testing controlled-release formulations, improvements in a diagnostic technique for trypanosomiasis and improvements in the analysis of trypanocidal drugs.

LIBYAN ARAB JAMAHIRIYA

LIB/1/003 ACTIVATION ANALYSIS

COMPLETED: **92-05-14** TOTAL COST: **$59,591**

TO STRENGTHEN THE ANALYTICAL CHEMISTRY CAPABILITY OF THE CHEMISTRY DEPARTMENT, TAJOURA NUCLEAR RESEARCH CENTRE, FOR NEUTRON ACTIVATION ANALYSIS AS RELATED TO THE QUALITY CONTROL OF DRINKING AND SEA WATER.

Following a pre-project assistance mission in 1977, the project was initiated in 1988 for an expected duration of two years. Initially no provision was made for the supply of equipment, and only some reference materials could be provided. However, an expert undertook a one-month mission to provide on-the-job training in connection with the neutron activation analysis of natural waters and aquatic samples. Two fellows, including the project counterpart, received training abroad for a total of nearly one year. Although the reactor at the Tajoura Nuclear Research Centre, Tripoli, was supposed to be used for this project, a satisfactory schedule could not be worked out. Activation was therefore largely restricted to a neutron generator. Nonetheless, neutron

activation analysis was used to determine the level of cadmium in sea and surface water. Some short-lived radionuclides were produced with the neutron generator, and the determination of Cs-137 in foodstuffs was carried out by absolute low level counting.

LIB/5/003 ERADICATION OF MEDITERRANEAN FRUIT FLY

COMPLETED: **92-12-30** TOTAL COST: **$242,785**

TO PROMOTE THE USE OF THE STERILE INSECT TECHNIQUE FOR ERADICATING THE MEDFLY BY DEVELOPING MASS REARING TECHNIQUES AND INITIATING ECOLOGICAL FIELD STUDIES.

The project was approved in 1985 and has been supported since 1988 by additional funds-in-trust from the country itself. Expert services assisted in conducting field surveys of medfly and in developing mass rearing techniques at the Tajoura Nuclear Research Centre. The necessary equipment was provided. Seven short-term fellowships were awarded for training abroad on the sterile insect technique. Under the project, a laboratory was designed, constructed and put into operation in 1986 to rear local medfly strains. The project led directly to the Libyan Ministry of Agriculture becoming involved in the regional project RAF/5/013.

LIB/9/006 RADIATION PROTECTION

COMPLETED: **92-03-30** TOTAL COST: **$57,438**

TO ESTABLISH A RADIATION PROTECTION SERVICE FOR DIAGNOSTIC RADIOLOGY, QUALITY ASSURANCE OF X-RAY MACHINES AND DETERMINATION OF RADIATION DOSES.

This project, initiated in 1989, focussed on radiation protection in diagnostic radiology. Under the project, a one-month split expert mission followed a RAPAT mission and partly coincided with a WAMAP mission. A thermoluminescence dosimeter and an X-ray unit quality assurance test system were supplied. At present, personnel monitoring services are being provided to about 800 radiation workers at the Tajoura Nuclear Research Centre, Tripoli, 400 medical radiation workers in some 15 government hospitals in the Tripoli area, and a few industrial radiation users. Quality assurance tests are being carried out in several hospitals using an RMI kit supplied by the Agency. Although the radiation monitoring services in the country have been upgraded with the assistance of the Agency, there is still scope to extend these services to the other 40-50 hospitals and to supply film badges at three-monthly rather than monthly intervals.

MALAYSIA

MAL/1/009 NEUTRON ACTIVATION ANALYSIS

COMPLETED: **92-12-30** TOTAL COST: **$170,826**

TO STRENGTHEN THE CAPABILITY OF THE ANALYTICAL SERVICES GROUP FOR APPLICATION OF NUCLEAR TECHNIQUES; TO FACILITATE THE ESTABLISHMENT OF AN EFFICIENT ANALYSIS LABORATORY.

The Government of Malaysia sought Agency assistance to strengthen the Analytical Services Group at the Nuclear Energy Unit (UTN) and to establish an efficient analysis laboratory in order to provide regular reliable analytical services to Government agencies, universities and industry. Under this project, initiated in 1987, the Agency provided equipment including a microanalytical balance, a peristaltic pump, a fraction collector, an NaI detector and a computer system. The Agency also provided an automatic sample changer and the services of an expert in instrumental and radiochemical neutron activation analysis (NAA) for geological and environmental samples. This enabled the UTN to initiate automated NAA in order to improve analytical accuracy, sensibility and sample throughput. The Agency also provided an anti-Compton gamma spectrometry system together with the services of an expert and fellowship training to enable the UTN to determine trace elements in plant materials and soils, elemental composition of geological materials (for the Geological Survey of Malaysia) and to analyse high purity materials (such as silicon wafers, petroleum and its products) for industry. Analysis of environmental samples is now available from the UTN. A functional, well equipped NAA laboratory with trained personnel can now provide elemental analysis for a wide variety of samples to the public and private sectors in Malaysia.

MAL/6/011 RADIOIMMUNOASSAY IN MEDICINE

COMPLETED: **92-12-30** TOTAL COST: **$115,420**

TO IMPROVE RADIOIMMUNOASSAY METHODS FOR THYROID-RELATED HORMONES.

This project, first approved in 1985, was intended to reduce the costs and upgrade the quality of radioimmunoassay (RIA) methods for thyroid-related hormones by introducing bulk reagent (as opposed to commercial kit) techniques and stimulating good RIA practice, particularly quality control. Three experts undertook four missions to assist in developing in-house RIA reagents for steroids and thyroid hormones and to establish quality control procedures. Two local staff members were trained in the production of RIA reagents for a total of six months. The Agency supplied a liquid scintillation counter, a fraction collector, RIA reagents, and radioactive tracers and chemicals. Financial assistance was provided under the regional (RCA) project RAS/6/011, in which the Department of Medicine, National University of Malaysia, Kuala Lumpur, participated. Reagent supplies and computer equipment were provided under the regional project, and workers from the laboratory participated in a series of regional training courses held between 1987 and 1991. The project has achieved its initial aims and the Department of Medicine is well on the way to self- sufficiency in the production of primary reagents for thyroid hormone assays. The laboratory has now extended this activity to the field of steroid and pituitary glycoprotein hormones and has

developed an indigenous assay for several such compounds using I-125 as tracers for the steroid hormones. All the methods developed have been validated and are in routine use. The laboratory is now a major clinical, research and training centre and is particularly active in neonatal hypothyroid and hepatitis B screening.

MAL/8/005 TRACERS IN SEDIMENTOLOGY

COMPLETED: **92-12-30** TOTAL COST: **$183,820**

TO UNDERTAKE SEDIMENT TRANSPORT INVESTIGATIONS.

In 1984, the Malaysian Government sought Agency assistance to establish a laboratory at the Tun Ismail Atomic Research Centre (UTN) to investigate sediment transport using radioactive tracers in harbour areas with serious sedimentation problems. The project was initiated in 1985. The Agency provided a unit for sedimentological analysis and a scintillation detector. One expert undertook six missions to advise on different types of tracer studies and to review them. With the help of the Agency expert, various tracer studies were conducted, including experimental campaigns at the ports of Kelang and Bintuiu, and pollution dispersion studies at Port Penang where field studies were also conducted to determine the directions and concentrations of the effluent discharged from Perai Industrial Estate. A national consultant's visit was awarded to the main counterpart to participate in a regional workshop in Jakarta on the use of nuclear techniques for sedimentological studies. The project has accomplished the transfer of technology in the field of radiotracer applications in sedimentation and environmental problems which will allow the tracer group at UTN to conduct successful investigations on sediment transport (both suspended and bottom sediments), using radioactive tracers, in estuarine and harbour areas without assistance from external experts.

MEXICO

MEX/2/011 PARTICLE-INDUCED X-RAY EMISSION TECHNIQUES

COMPLETED: **92-09-08** TOTAL COST: **$91,342**

TO STRENGTHEN THE LOCAL CAPABILITY FOR PARTICLE-INDUCED X-RAY EMISSION TECHNIQUES USED IN AEROSOL ATMOSPHERIC CONTAMINANT ANALYSIS.

The project was funded by extrabudgetary contributions from the United Kingdom in 1988 and 1990. A complete particle-induced X-ray emission (PIXE) facility has been installed at the National Institute for Nuclear Research, Mexico City, and the PIXE analytical technique has been introduced, using the Institute's accelerator proton beam. The Agency contributed expert services and staff training and supplied an X-ray spectrometer and ancillary equipment. The facility is being used to obtain data on atmospheric contamination in Mexico City and selected industrial sites required by government institutions such as the Department for Urban Development and Ecology and the Mexican Petroleum Institute.

MEX/4/037 NEW CORE CONFIGURATION FOR RESEARCH REACTOR

COMPLETED: **92-09-08** TOTAL COST: **$55,461**

TO USE FLIP TYPE 70% ENRICHED FUEL ELEMENTS TOGETHER WITH 20% ENRICHED FUEL IN NEW CORE CONFIGURATIONS AT THE ININ RESEARCH REACTOR AND TO PERFORM THERMOHYDRAULIC CALCULATIONS TO DETERMINE THE POSSIBLE RISKS OF CONTINUOUS OPERATION.

This project was approved in 1988 to assist the National Institute for Nuclear Research (ININ), Mexico City, in the study of a new core configuration for the ININ TRIGA research reactor. The Agency awarded one fellowship and one scientific visit as well as providing expert services on stability analysis, reactor physics, thermohydraulics calculations and the application of the WIMD-4 code to reactor physics analysis. The project has contributed to the buildup of a local capacity for core calculations and thermohydraulics analysis which will be used by ININ to design mixed cores for its research reactor.

MEX/4/041 SPENT FUEL

CANCELLED: **92-09-08**

TO ASSIST IN EVALUATING THE VARIOUS ALTERNATIVES FOR THE INTERIM AND FINAL DISPOSAL OF SPENT FUEL FROM THE LAGUNA VERDE NUCLEAR POWER PLANT.

The project was approved in 1991 but, in the meantime, the Laguna Verde Nuclear Power Plant has completed the enlargement of the in-site spent fuel storage capacity which can now receive for long-term interim disposal the spent fuel produced during approximately 40 years of commercial operation. The Mexican Government has therefore requested cancellation of this project and strengthening of the activities undertaken under Project MEX/9/035 (Nuclear Waste Management).

MEX/5/013 PLANT MUTATION BREEDING

COMPLETED: **92-12-30** TOTAL COST: **$199,512**

TO INCREASE THE CROP YIELD OF SORGHUM AND TO INCREASE FUNGUS RESISTANCE IN BEANS.

Sorghum and kidney beans are economically very important crops in the Bajio region of Mexico. Kidney bean yields are severely hampered by the bean rust fungus disease. In 1984, the School of Agronomy and Animal Husbandry of the Autonomous University of Guanajuato initiated sorghum and kidney bean mutation breeding programmes with the assistance of the Agency. This project, approved with footnote-a status for 1984, was upgraded the same year with funds from the TACF and an extrabudgetary contribution from the USA for provision of some laboratory equipment. In 1987 and 1990 the project received important additional extrabudgetary contributions from the United Kingdom. With Agency assistance, five expert missions guided the project and two fellowships and one scientific visit were awarded for project-related scientists. A fully equipped tissue culture laboratory was established to allow the application of in-vitro culture techniques to ongoing mutation breeding

activities. The project generated sorghum mutants which mature significantly earlier than locally grown varieties and are shorter in stature, two characters very important to the success of local sorghum improvement programmes. These mutants consistently yield as well as or better than commercially available hybrid cultivars and warrant commercialization. A white-seeded mutant was produced, a character of importance when developing sorghum for human consumption. Kidney bean mutation breeding activities focussed on the generation of rust and virus resistance in the otherwise acceptable germ plasm and on the creation of light seed coloured mutants in the disease-resistant variety, Karlikobaya 17, using seed irradiation, combined with in-vitro culture. Protocols were established for callus initiation and plant regeneration. This programme is still in progress. Additional activities were initiated in mutation breeding and in-vitro culture of garlic and wheat anther culture.

MEX/5/014 REPRODUCTIVE PHYSIOLOGY OF CATTLE IN TROPICAL AREAS

COMPLETED: **92-09-08** TOTAL COST: **$77,197**

TO STUDY WITH RADIOIMMUNOASSAY TECHNIQUES THE EFFECTS OF VARIOUS NUTRITIONAL AND MANAGEMENT PRACTICES ON THE APPEARANCE OF PUBERTY, POST-PARTUM OVARIAN ACTIVITY, MANIFESTATIONS OF SYNCHRONIZING OESTRUS AND ARTIFICIAL INSEMINATION.

This project, approved in 1989, was aimed at the identification of low-cost management and nutritional inputs to increase the productive efficiency of livestock. The recipient institution was the Department of Animal Reproduction, Faculty of Veterinary Medicine of the Autonomous National University of Mexico (UNAM), and the field activities were carried out at the Centre for Research on Tropical Livestock in the Vera Cruz State, in order to facilitate suitable contacts with the small farmers for the future transfer of available technology. This aspect will be followed up in Project MEX/5/016 in the 1993-94 Programme. Expert services, a scientific visit as well as veterinary ultrasonic diagnostic equipment, radioactivity counters and monitors, a computer system and ancillary equipment, were provided by the Agency under this project. Valuable information on post-partum reproductive performance, hormone profiles, oestrus synchronization and oestrus behaviour in cattle and hair sheep under tropical conditions has been obtained and published in international scientific journals. Members of the research team in charge of the project have undertaken Agency expert missions in the region and UNAM has been the host institution for Agency trainees in the field of radioimmunoassay of reproductive hormones.

MEX/5/015 USE OF NITROGEN FERTILIZERS IN CROP PRODUCTION

COMPLETED: **92-12-30** TOTAL COST: **$134,660**

TO EVALUATE THE RELATIVE EFFECTIVENESS OF DIFFERENT NITROGEN FERTILIZERS IN THE SORGHUM AND WHEAT CROPS; TO EVALUATE AND OPTIMIZE BIOLOGICAL NITROGEN FIXATION IN REGIONAL LEGUME CROPS.

The Guanajuatan Bajio is one of the most heavily fertilized regions in Mexico, receiving approximately 86 000 tonnes of nitrogen per year, mainly for the sorghum and wheat crops. The project, initiated in 1989, was intended to

minimize nitrogen fertilizer losses which, according to preliminary studies, exceed 50% of the applied nitrogen, mainly owing to denitrification. The Centre for Research and Advanced Studies of the National Polytechnic Institute (CINVESTAV-IPN), Irapuato, with Agency assistance, initiated field experiments in order to understand the mechanisms of nitrogen loss under farmers' practices of fertilizer use. Expert services on soil nitrogen balances, isotope techniques in biological nitrogen fixation, and N-15 determination were provided under the project. A fellowship was awarded for training in nitrogen isotopic analysis. The Agency supplied an emission spectrometer with ancillary equipment in order to establish a laboratory for N-15 determination. CINVESTAV-IPN has achieved a good analytical capability to use N-15 techniques in its research efforts to improve fertilizer practices. Field experiments, initiated under the guidance of Agency experts, are in progress to evaluate the relative effectiveness and fate of different forms of applied nitrogen fertilizers. It is expected that the increased knowledge of nitrogen loss mechanisms gained through the project will lead to an improvement in fertilizer management in the Bajio region.

MEX/8/017 CHARACTERIZATION OF GEOTHERMAL RESOURCES

COMPLETED: **92-12-18** TOTAL COST: **$154,961**

TO INCREASE THE CAPABILITY OF THE FEDERAL ELECTRICITY COMMISSION TO USE GEOCHEMICAL AND ISOTOPIC TECHNIQUES TO CHARACTERIZE AND ASSESS GEOTHERMAL RESOURCES.

The evaluation, management and operation of geothermal projects for the production of electricity requires complete and accurate characterization of the geothermal fields before exploitation and during the operational phase. Through this project, started in 1989 and funded by an extrabudgetary contribution from the USA, the Federal Electricity Commission intended to improve understanding of the geothermal parameters by using isotope techniques in characterizing the fields. The Agency provided expert services on the application of isotope techniques and to assist in reinjection experiments. Chromatographic equipment and a carbon dioxide-water equilibration system to speed up O-16 determination were provided, together with spare parts for mass and atomic absorption spectrometers. As a result of the project, conceptual models have been derived from isotopic data for the geothermal fields of Cerro Prieto, Los Azufres and Los Humeros which form the basis for numerical models. The technical staff of the Commission is now familiar with the potential of isotope and geochemical techniques in geothermal exploration and exploitation and can apply the methods. Plans have been formulated for the use of tracers in geothermal fluid reinjection experiments.

MEX/9/027 QUALITY CERTIFICATION

COMPLETED: **92-11-18** TOTAL COST: **$247,575**

TO IMPROVE QUALIFICATION SERVICES FOR SAFETY-RELATED NUCLEAR EQUIPMENT AND COMPONENTS.

This project, approved in 1984, was intended to develop a capability for qualification of safety-related equipment and components at the National Institute for Nuclear Research (ININ), Mexico City. In the field of environmental

qualification, the objectives were fully achieved through the design, construction and operation of a complete facility for qualification tests. ININ funds were used for construction of the laboratory, and the Agency provided the training and expertise necessary to design the laboratory, prepare test procedures and analyse the results. Complementary items of equipment were also provided. In the field of seismic qualifications (earthquake acceleration) success was less complete owing to lack of sufficient funds at ININ to acquire a large shaking table to simulate earthquake effects. This part of the project was therefore restricted to training personnel and to prototype tests involving less sophisticated equipment. Two workshops on quality assurance for Mexican industry and a workshop on technical support for operations at the Laguna Verde Nuclear Project were organized with the assistance of Agency experts.

MEX/9/028 ECOLOGICAL MODELLING

COMPLETED: **92-09-08** TOTAL COST: **$132,068**

TO DESIGN APPROPRIATE MATHEMATICAL MODELS FOR EVALUATION OF HYDROTHERMAL AND RADIOACTIVE RELEASES.

The project was approved in 1984 to assist Mexico in evaluating the thermal and radioactive effluent impact of the Laguna Verde Nuclear Power Plant. Expert services, a scientific visit and oceanographic equipment were provided by the Agency and from funds-in-trust from the Mexican Government. A mathematical numerical simulation of hydrothermal flows and radionuclide dispersion was developed at the Institute for Electrical Research and applied to studying the discharge effluent distribution at the power station.

MEX/9/031 PROBABILISTIC RISK ANALYSIS

COMPLETED: **92-12-18** TOTAL COST: **$55,114**

TO EVALUATE THE RELIABILITY OF VARIOUS SYSTEM COMPONENTS AT THE LAGUNA VERDE NUCLEAR POWER PLANT USING PROBABILISTIC RISK ANALYSIS TECHNIQUES.

In preparation for commissioning the Laguna Verde Nuclear Power Plant (LVNPP), which will be the first in Mexico, the Government requested Agency assistance in establishing a probabilistic safety assessment (PSA) programme for evaluation of various components and systems of the plant. This project, approved in 1985, involved the Federal Electricity Commission and the Institute for Electrical Research. The National Commission for Nuclear Safety and Safeguards monitored the development of the project and reviewed some of its results. The Agency provided expert services for an initial PSA workshop for development of level 1 PSA and assisted in areas such as human factor modelling. Expert missions reviewed plans for the application of results, for developing a level 2 PSA, and for modelling external events. Local staff received training through Agency fellowships and a scientific visit. As a result of the project, Mexico has developed good local capability in PSA and had utilized project results in practical applications at LVNPP. A new project, MEX/9/039, is in progress, aiming at PSA level 2.

MEX/9/032 COMMISSIONING OF THE LAGUNA VERDE NUCLEAR POWER PLANT

COMPLETED: **92-09-08** TOTAL COST: **$399,337**

TO REVIEW AND EVALUATE PROCEDURES FOR STARTUP AND OPERATIONAL TESTING OF THE LAGUNA VERDE NUCLEAR POWER PLANT.

This project, approved in 1985, was designed to support the National Commission for Nuclear Safety and Safeguards (CNSNS) during the commissioning of Unit 1 of the Laguna Verde Nuclear Power Plant (LVNPP). When approved, the operation was scheduled to start in 1986, and therefore only limited assistance was foreseen. However, owing to delays in commissioning, the project was extended and additional assistance made available, a total of 60 months of expert services being provided. Two long-term expert missions were undertaken to co-ordinate the work of the CNSNS during commissioning. The experts assisted in defining CNSNS activities, preparing inspection procedures and reviewing the commissioning programme and testing procedures. Thirteen short-term missions addressed more specific fields. The staff training provided by the experts was complemented by three fellowships and three scientific visits, totalling over 11 months. The objectives of the project were fully achieved. CNSNS had a constant presence on site during pre-operational and power-ascension tests. It has reviewed almost all testing procedures and witnessed all important tests, particularly those considered relevant to safety. The test results were reviewed and partial permits issued which allowed complete control of the commissioning programme. LVNPP had a very smooth, if atypically long, commissioning period, which led, however, to LVNPP breaking the BWR record for continuous operation during first cycle.

MEX/9/036 EMERGENCY PLANNING AND PREPAREDNESS

COMPLETED: **92-09-08** TOTAL COST: **$28,414**

TO TRAIN STAFF OF THE NATIONAL INSTITUTE FOR NUCLEAR RESEARCH TO IMPLEMENT AN EMERGENCY PLAN FOR THE INSTITUTE'S NUCLEAR INSTALLATIONS AND TO DEFINE POSSIBLE PARTICIPATION IN THE OVERALL EMERGENCY PLAN FOR LAGUNA VERDE NUCLEAR POWER PLANT.

Under this project, approved in 1989, the overall emergency plan for the National Institute for Nuclear Research (ININ) was updated with the assistance of an Agency expert. The plan for external radiological emergency of the Laguna Verde Nuclear Power Plant was also revised to determine the possible support of ININ. The Agency provided expert services and awarded two fellowships and a scientific visit to strengthen the training of local staff in emergency planning and procedures.

MALI

MLI/3/006 URANIUM DATA BANK

COMPLETED: **92-12-30** TOTAL COST: **$69,889**

TO FACILITATE THE COLLECTION, MANAGEMENT AND INTERPRETATION OF URANIUM PROSPECTING DATA AND TO STIMULATE USE OF INFORMATION AVAILABLE FOR FUTURE PLANNING.

Extensive uranium exploration programmes carried out in Mali by various foreign companies have generated considerable geological and geochemical data on uranium favourability. This project was initiated in 1991 to facilitate the collection, management and interpretation of available uranium prospecting data and to develop a microcomputer data management system. The Agency provided equipment including a microcomputer system with basic software, a plotter and a digitizer, as well as experts who advised on the use of software and trained the counterpart staff on data acquisition and management, using the available computer facility. Three counterpart staff have been trained abroad on data acquisition and management. The information produced also serves as baseline information for the evaluation and assessment of other mineral resources. The staff of the National Directorate for Geology and Mines, Bamako, is now capable of managing a computerized databank for uranium exploration and will be prepared to use this information in future planning.

MLI/5/011 IMPROVEMENT OF ANIMAL DIAGNOSTIC CAPABILITIES

COMPLETED: **92-11-18** TOTAL COST: **$127,382**

TO IMPROVE DIAGNOSTICS OF MAJOR ANIMAL DISEASES BY MEANS OF NUCLEAR AND RELATED TECHNIQUES.

Successful planning of animal health strategies in Mali is hampered by the absence of an efficient and systematic control of various endemic diseases that affect livestock, and by the lack of adequate means for the production of vaccines locally. To remove these constraints, the project has focussed on strengthening the infrastructure of the Central Veterinary Laboratory, Bamako, by providing equipment that includes a spectrophotometer, centrifuges, a computer system, ELISA equipment, blood sampling equipment and glassware, together with expert services and the training abroad of two counterpart staff. Agency experts gave advice on the use of ELISA techniques for diagnosis of various diseases such as Rift Valley fever, infectious bovine rhinotracheitis and trypanosomiasis, and assisted in the computerization of epidemiological studies. The experts also introduced quality control and validation of vaccines produced locally. Several national campaigns have been performed and the data collected properly interpreted and compiled. Research on a thermostable rinderpest vaccine has also been carried out. Mass sero-surveys and monitoring of post-vaccination immune status of major diseases are routinely performed.

MLI/6/003 NUCLEIC ACID PROBES IN MALARIA DIAGNOSIS

COMPLETED: **92-11-18** TOTAL COST: **$143,704**

TO FACILITATE THE DETERMINATION OF DATA ON THE PREVALENCE OF MALARIA AND THE EFFICACY OF CONTROL MEASURES.

This project was initiated in 1991 to answer an acute need to establish a molecular biology laboratory at the School of Medicine and Pharmacy, Bamako, where DNA probes would be used for malaria vector identification and for rapid detection of drug and pesticide resistance. Under the project, the Agency provided equipment including a liquid scintillation counter with accessories, refrigerated centrifuges, a laminar flow hood, an optical microscope, a computer system and supplies, together with expert services and the training abroad of one counterpart staff member. The National Institute of Health (NIH), USA, provided technical backstopping as well as a cost-free expert. Agency experts assisted in the use of a rapid test for chloroquine resistance developed by the NIH, and the results were compared with in-vitro and in-vivo testing methods for chloroquine resistance. The tests were performed on 678 specimens and demonstrated that chloroquine resistance is present in Mali and that its prevalence is markedly influenced by the use of chloroquine. On the basis of this conclusion, the experts assisted in elaborating a national strategy to monitor the evolution of resistance and to guide national health policy. Bilateral and other multilateral assistance has also contributed towards the implementation of this national strategy.

MONGOLIA

MON/5/004 SOIL SCIENCE AND PLANT NUTRITION

COMPLETED: **92-09-08** TOTAL COST: **$91,914**

TO CONDUCT STUDIES OF THE SOIL-PLANT-FERTILIZER RELATIONSHIPS USING ISOTOPE TECHNIQUES WITH A VIEW TO DEVELOPING EFFICIENT FERTILIZER MANAGEMENT PRACTICES.

In Mongolia the nitrogen fertility of the soil is poor and in areas suitable for agriculture the annual precipitation is very low. Agricultural land is limited and the growing season is reduced to three or four months annually. The Scientific Research Institute for Plant Breeding and Agriculture, Darhan, requested Agency assistance in conducting studies to find ways of increasing crop production. One Agency technical staff member visited Mongolia in 1988 and on the basis of his recommendations the project was reformulated. Two experts undertook two missions to assist the counterpart in developing research programmes aimed at maximizing nitrogen fertilizer use efficiency, using the N-15 isotope as a tracer, and increasing water use efficiency for crops by means of the neutron probe method. The crops studied were wheat and barley, the most important cereals in Mongolia. Equipment supplied included a liquid scintillation counter and a neutron moisture gauge with accessories. An N-15 labelled fertilizer was also supplied. Analytical services for determining N-15 in soil samples were supported. One project-funded and one project-related fellowship were granted for training abroad. The project resulted in the establishment of an isotope laboratory and the use of isotope and nuclear-related techniques in soil fertility and crop production for the first

time in Mongolia. Field and greenhouse experiments, especially those using the N-15 isotope, have already shown interesting results. In addition, the counterpart has acquired the necessary skills to undertake future follow-up studies on isotope and nuclear techniques in soil fertility and crop production.

MOROCCO

MOR/0/005 INIS DATA BASE ACCESS

COMPLETED: **92-12-30** TOTAL COST: **$27,207**

TO ESTABLISH ON-LINE ACCESS TO THE AGENCY'S INIS DATABASE IN ORDER TO PROVIDE TECHNICAL INFORMATION TO A LARGER NUMBER OF INSTITUTIONS.

This project was initiated in 1990 to establish on-line access to INIS and to assist the National Centre for Nuclear Techniques, Science and Energy, Rabat, in the management and dissemination of nuclear information. The Agency provided a data acquisition and processing facility consisting of a computer system and software, a laser printer and a microfiche device, together with expert services. Owing to developments in information technology, the Centre is able to use the INIS database locally, using the CD-ROM version of the database and can thus provide a more immediate and effective service. Training abroad for the counterpart staff was secured under other projects. The Agency experts assisted in the installation of the facility and gave on-the-job training in input preparation and retrieval. As a result of the project, several Moroccan institutions are now receiving monthly INIS services and are also contributing to the INIS database. These services are expected to lead to a wider circulation of nuclear information and to make research more readily available to scientists and engineers.

MOR/1/006 TRAINING AND RESEARCH IN NUCLEAR SCIENCE

COMPLETED: **92-07-13** TOTAL COST: **$157,063**

TO STRENGTHEN THE NUCLEAR PHYSICS LABORATORY BY PROVIDING ADDITIONAL ASSISTANCE IN INSTRUMENTATION, MAINTENANCE OF ELECTRONIC EQUIPMENT AND SPARE PARTS AND BY TRAINING LOCAL STAFF IN THESE TECHNIQUES.

The project was initiated by the Government of Morocco in answer to the need to upgrade the facilities established under a large UNDP project; it has provided equipment, spare parts and training abroad for six researchers. This assistance permitted the laboratory to develop additional practical demonstrations and to introduce new analytical techniques such as neutron activation analysis and total reflection X-ray fluorescence. It has also enabled the laboratory to perform more analyses of mineral samples for the mining industry. Equipment provided included radiation detectors, a computer, a multichannel analyser, radioactive sources, electronic components and spare parts. Maintenance and repair activities are routinely performed by the staff trained under the project.

MOR/3/007 RAW MATERIALS

COMPLETED: **92-07-13** TOTAL COST: **$242,539**

TO INCREASE THE CAPABILITY OF THE LABORATORY FOR URANIUM ANALYSIS.

In Morocco, much of the area of the Anti-Atlas has been prospected for uranium mineralization, which has generated considerable data on uranium favourability. The project was initiated in answer to the need to compile, organize and verify these data and to define the regions of favourable prospection. The project has provided equipment for data acquisition and treatment, expert services and training. This assistance enabled the Directorate for Geology, Rabat, to set up a computerized geological and mining databank for radioactive materials and to define favourable regions for further prospection. With the functional infrastructure established, activities were initiated to gather basic information on uranium and other mineral resources, and the data have been compiled in a form which has made possible the determination of areas worthy of further field prospection.

MOR/6/008 NUCLEAR MEDICINE

COMPLETED: **92-12-16** TOTAL COST: **$170,277**

TO STRENGTHEN THE ACTIVITIES OF THE NUCLEAR MEDICINE DEPARTMENT AT AVICENNE HOSPITAL.

Since 1983, the Agency has been assisting the Government of Morocco in establishing the only nuclear medicine service in the country where in-vitro and in-vivo investigations can be performed. Through training local medical doctors and technicians as well as provision of equipment and supplies, the nuclear medicine service at the Ibn Sina Hospital, Avicenne, is now capable of routinely performing nuclear medicine diagnostic tests of major organs such as kidney, liver, brain and thyroid and of providing radioimmunoassay services for hormonal studies. All patients are now referred to this service for medical investigations. Expert services provided recently under 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. Continuity of the studies on local preparation of bulk reagents is being secured under the AFRA projects from which Morocco benefits.

MYANMAR

MYA/5/005 RADIOISOTOPES IN AGRICULTURE

COMPLETED: **92-12-17** TOTAL COST: **$108,155**

TO STUDY RADIATION-INDUCED GENETIC CHANGES FOR DEVELOPING IMPROVED VARIETIES OF CERTAIN CROP PLANTS.

The project was approved in 1981 as an extension of activities under an earlier FAO/IAEA/UNDP project MYA/5/004 (UNDP-BUR/74/005) to study radiation-induced

genetic changes which develop improved varieties of certain crop plants such as jute, sugar cane and sesame. Under this multi-year project, five expert missions were carried out for a total duration of five months to advise counterpart staff at the Seed Division, Myanmar Agriculture Service, on mutation breeding and radiation dosimetry. Owing to the disturbances during 1988, most of the equipment was lost, except for the gamma irradiator and a microscope. The project was reactivated successfully with the help of an Agency expert in 1990, and the gamma irradiator is in good condition. Consequently, nine crop species have been integrated into the mutation breeding programme, and two early maturing mutant varieties of rice were successfully released. The technology transferred under the project will help further studies to initiate plant breeding programmes on other crops of interest.

NIGER

NER/0/003 RADIOISOTOPE LABORATORY

COMPLETED: **92-09-15** TOTAL COST: **$467,952**

TO ESTABLISH A NATIONAL RADIOISOTOPE LABORATORY.

The major constraint on the introduction of nuclear physics in the University of Niamey's curriculum was the lack of a nuclear physics laboratory where practicals could be performed and research activities carried out. The project assisted the University in establishing a nuclear science laboratory as a first step. During the first years the project focussed on strengthening the teaching capability of the University through the provision of equipment for the practicals and a resident expert for two years to teach nuclear science. In 1984, the laboratory was upgraded to be able to undertake analysis of geological and biological samples of value to the national economy. The principal technique introduced was X-ray fluorescence analysis. Equipment provided by the Agency included an X-ray fluorescence system with accessories, a liquid nitrogen plant, and a multichannel analyser with a computer and radioactive sources. This technique is now used routinely for analysis of samples referred to the laboratory from national institutions.

NER/5/005 NUCLEAR TECHNIQUES IN ANIMAL PRODUCTION

COMPLETED: **92-07-13** TOTAL COST: **$169,180**

TO INCREASE THE FERTILITY AND PRODUCTION OF SHEEP.

In temperate regions of Niger the reproductive potential of the Peulh ewes is limited to some extent by seasonal anoestrus. The project was initiated in answer to the need to elucidate the annual variations in sexual activity and in the endocrine balances which govern follicular maturation and ovulation. The project provided a viable radioimmunoassay laboratory together with expert services and training abroad. The research carried out demonstrated that two types of disturbances in ovarian function are limiting the fertility of ewes in semi-arid environment: persistent corpora lutea which occurs in 14% of animals, and seasonal anoestrus which is observed in 67%. These ovarian anomalies were associated with a weak endogenous rhythm of LH secretion. The results obtained suggest that both types of ovarian dysfunction may reflect poorer adaptation of the Peulh ewes to the semi-arid climate. Further studies

are under way to confirm these findings.

NER/5/007 **LABORATORY FOR SERO-EPIDEMIOLOGY**

COMPLETED: **92-09-09** TOTAL COST: **$115,891**

TO CARRY OUT SERO-EPIDEMIOLOGICAL STUDIES ON THE MAJOR EPIZOOTICS AND TO DEVELOP TESTS FOR LOCAL USE.

The major constraint in planning animal health strategies in Niger is the absence of adequate data on the prevalence and economic impact of major livestock diseases. This project has therefore provided for the establishment of a functional laboratory for ELISA serology together with expert services and training of two scientists abroad. The established infrastructure is currently performing mass sero-surveys and monitoring post-vaccination immune status of rinderpest, peste de petits ruminants (PPR), sheep pox and contagious bovine pleuro-pneumonia. With Agency assistance, several national campaigns have been undertaken and the data collected has been processed. Research on a thermostable rinderpest vaccine and a combined rinderpest/CBPP vaccine has also been carried out and both types were assayed in 1991. A computerized database has also been installed.

NICARAGUA

NIC/3/003 **URANIUM EXPLORATION**

COMPLETED: **92-12-30** TOTAL COST: **$131,080**

TO STRENGTHEN THE LOCAL ANALYTICAL CAPABILITY, PARTICULARLY FOR DETERMINATION OF URANIUM IN GEOLOGICAL SAMPLES.

In 1987 the Nicaraguan Institute of Mining (INMINE) of the Directorate of Geology, Managua, sought Agency assistance to strengthen the local analytical capability for determination of uranium in geological samples In connection with the production of a metallogenic map and assessment of the natural raw material resources potential. Under the project, a fluorimetric laboratory was established for low-level uranium analysis of geological and environmental samples; personnel of the Central Laboratory received training on its operation, and the technical staff of the Geological Department of INMINE received practical training on the use of portable gamma-ray spectrometers in geological research and mineral exploration, particularly gold.

NIGERIA

NIR/1/003 **NUCLEAR PHYSICS**

COMPLETED: **92-12-30** TOTAL COST: **$372,123**

TO ESTABLISH TEACHING AND TRAINING FACILITIES IN NUCLEAR PHYSICS AND NEUTRON ACTIVATION ANALYSIS.

The project was initiated in 1978 to train scientists and technicians in nuclear physics research and neutron activation analysis and to make the existing neutron generator operational. The main equipment supplied included a liquid nitrogen cooled semiconductor X-ray spectrometer, spare parts for the neutron generator, a computerized experimental data acquisition system and related nuclear electronic units. Expert services, totalling 13 months, were provided for setting up the nuclear physics laboratory, repair of nuclear electronic equipment, and the installation and utilization of the neutron generator. Eleven fellows were trained for a total of 121 months. By 1989, the neutron generator became operational at the Centre for Energy Research and Development and the X-ray fluorescence (XRF) analysis system became operational at the Department of Physics of the Obafemi Awolowo University. These laboratories are now able to carry out routine assessment of the quality of food by measuring the protein content by means of activation analysis, uranium-thorium concentration analysis, and by quality control measurements using fast neutron activation analysis and XRF.

NIR/9/003 RADIATION PROTECTION

COMPLETED: **92-07-13** TOTAL COST: **$235,145**

TO ESTABLISH RADIATION MONITORING SERVICES AND STUDY RADIATION EFFECTS IN AREAS OF HIGH BACKGROUND RADIOACTIVITY.

With the assistance of the Agency, the Federal Radiation Protection Service (FRPS), Ibadan, has been strengthened and is now fully operational. The project has been ongoing since 1982 and, in addition to thermoluminescence dosimeters, computers, multichannel analysers and an uninterruptible power supply, the Agency has supplied radioactive isotopes, various chemicals and numerous minor equipment items. Ten expert missions were carried out for a total duration of over 15 months, helping to install equipment and train local staff. Although there was no provision for fellowships, four local staff members associated with the project have been trained for a combined duration of about 27 months either under the regional manpower development project or under type II fellowships. Other staff members participated in regional and interregional training courses on radiation protection. The project has contributed to strengthening the FRPS, which has meanwhile assumed overall responsibility for nuclear safety and protection in Nigeria. Besides personnel and environmental monitoring, the FRPS has also been charged by the Government with performing radioanalysis of foodstuffs imported into the country. The FRPS is now generating funds from consultancy work and some of these funds have been used to purchase additional equipment with the assistance of the Agency. The follow-up project, NIR/9/005, is expected to upgrade and further consolidate the available services.

PAKISTAN

PAK/4/027 CONTROL AND INSTRUMENTATION

COMPLETED: **92-12-30** TOTAL COST: **$249,466**

TO ESTABLISH A LABORATORY FOR TESTING, CALIBRATION AND REPAIR OF ELECTRONIC, ELECTRIC AND OTHER EQUIPMENT RELATED TO THE NUCLEAR POWER PLANT CONTROL SYSTEM.

The Karachi Nuclear Power Plant (KANUPP) intended to establish a control and instrumentation applications laboratory in order to test, calibrate, repair and replace the existing control equipment of the plant which had either become obsolete or deteriorated with age. The Agency was requested to provide expert services and some laboratory equipment. Under this project, approved in 1984, the Agency supplied testing and calibration equipment, including a precision calibration unit for electronic process control instrumentation and dynamic process simulation, a portable pneumatic calibrator, and a flow-through calibrator. The Government contributed funds-in-trust for equipment to supplement the Agency funds. Two experts undertook three missions to advise and assist the counterpart in planning the laboratory, in developing a programme for real-time simulation and on the selection of instrumentation and control equipment for backfitting KANUPP's control and instrumentation (C&I) system. Three long-term training fellowships were also awarded under the Agency's manpower development programme. As a result of the project, a modern laboratory for C&I applications has been set up which is already providing services for testing, calibration and maintenance of the KANUPP C&I system; C&I familiarization test-rigs have been designed, installed and commissioned, and a comprehensive study has been completed to specify the equipment required to replace the existing operational C&I as well as safety instrumentation loops for KANUPP which have become obsolete. The Government has contributed substantially by constructing a separate laboratory building and supplying additional equipment. Further Agency assistance is being provided through a related project, PAK/4/035, to advise on the upgrading of KANUPP's C&I system.

PAK/5/017 RADIOISOTOPES IN AGRICULTURE

COMPLETED: **92-12-30** TOTAL COST: **$105,491**

TO STUDY THE INFLUENCE OF LEGUME/NON-LEGUME CROPPING SEQUENCES AND DIFFERENT IRRIGATION AND FERTILIZER MANAGEMENT PRACTICES ON CROP PRODUCTION WITH A VIEW TO MAXIMIZING YIELDS WITH MINIMAL INPUTS.

The project was approved in 1982 to identify suitable fertilizer management practices for crop production using isotopes and related nuclear techniques. The Agency provided equipment and supplies including a N-15 analyser along with the sample preparation line and an analytical analyser. Two Agency experts advised on the use of the analyser and on the application of N-15 in nitrogen fertilizer and biological nitrogen fixation studies. Five counterpart staff were awarded long-term fellowship training and one was offered a scientific visit under the Agency's manpower development programme. As a result of the project, the Atomic Energy Agricultural Research Centre at Tandojam has carried out a number of studies: estimation of nitrogen fixed by legumes, fertilizer practices for an intercropping system, land utilization efficiency, and

the effect of residual nitrogen on subsequent wheat crops. Experiments with groundnut and soybean have shown that the yields of these pulses could be substantially increased by the use of proper combinations of rhizobium strains and legume cultivars. Studies of cotton grown as an intercrop with a legume produced useful information on the best fertilizer management practice to adopt in order to achieve higher yields. As a result of this project, a research group has been established at the Institute that is able to tackle problems of soil fertility and crop production, especially those concerning nitrogen, by using isotope techniques. The project has also resulted in a number of scientific publications.

PAK/5/022 ISOTOPE-AIDED STUDIES ON SALINE SOILS

COMPLETED: **92-12-30** TOTAL COST: **$126,345**

TO DEVELOP MANAGEMENT PRACTICES AIMED AT IMPROVING CROP PRODUCTIVITY IN AREAS WITH HIGH SOIL SALINITY.

Salinity and water retention over large tracts of arable land in the Indus basin are major problems in Pakistan affecting agriculture. The Nuclear Institute for Agriculture and Biology, Faisalabad, has been studying the process of salination and attempting to work out biological methods for the utilization of salt- affected soils, including identification of salt-tolerant plant species. The Government sought Agency assistance for its plans to use nuclear techniques to develop management practices for biological amelioration of salt-affected soils so as to increase soil fertility and crop production in these areas. The project was approved in 1985 and, after a programming mission, four Agency experts provided advice and training in plant biochemistry, soil moisture studies, rhizosphere biology and molecular biological techniques. Equipment and supplies, including a gamma-ray density meter, were supplied. Two counterpart staff received long-term fellowship training under the project and another under the Agency's manpower development programme. With the assistance provided under the project, the counterpart has carried out investigations on several plant species which indicated that Kallar grass (Leptochloa fusca) is the main plant species of interest in the biological amelioration programme. This grass has been identified as a highly salt-tolerant perennial plant which can grow even under waterlogged conditions. Several tree species, especially those that can fix atmospheric nitrogen, such as Acacia, Sesbania, Prosopis and Casuarina, have been tested and found to be excellent agents of soil amelioration. Some tree provenances have even survived concentrations of sodium chloride higher than that of sea water. The growth of these grass and tree species has increased the permeability of the soil to water by as much as 20-30 cm, thereby lowering the saline water zone substantially and very much reducing the harmful effects of salt on the root system. Crops such as rice, wheat and grain legumes are now being grown experimentally in these reclaimed soils. The project proved that biological amelioration can be successfully employed to reclaim the nearly 11 million acres of arable land reported to be agriculturally barren because of salinity. The project has also resulted in a number of scientific publications.

PAK/6/007 RADIOIMMUNOASSAY

COMPLETED: **92-12-30** TOTAL COST: **$133,128**

TO PREPARE I-125 LABELLED HORMONES LOCALLY FOR USE IN RADIOIMMUNOASSAY.

This project was approved in 1983 to strengthen local capability for the production of reagents for the radioimmunoassay (RIA) of thyroid-related hormones and to establish a central laboratory in Pakistan that would also serve as a teaching and training centre. The project was originally intended for the Institute of Nuclear Medicine and Oncology (INMOL), Lahore; the Atomic Energy Medical Centre (AEMC), Jamshoro, joined the project in 1986. The Agency provided equipment and supplies including refrigerated centrifuges, an automatic gamma counter, a fume hood, two freeze drying units, two personal computers, two freezers and a fractional collector. Two Agency experts undertook four missions and advised on the preparation of RIA/immunoradiometric assay reagents, quality control and data processing. Three counterpart staff received long-term fellowship training under the project; two others were awarded long-term fellowships and one made a scientific visit under the Agency's manpower development programme. As a result of the project, a well equipped laboratory has been established at INMOL for the production of in-house assay reagents for thyroid-related hormones, while the AEMC is acting as a supporting laboratory. The INMOL laboratory can now produce and supply the reagents in bulk at national and regional levels and this self-reliance has led to a ten-fold reduction in the cost of commercial kits, which previously had to be imported. Locally prepared tracers for thyroid hormone assays are now being distributed to nine laboratories in Pakistan and to other countries in the region, including Myanmar, Sri Lanka and the Philippines. First and second antibodies for the thyroxine and tri-iodothyronine assays are being distributed in the same way. The project has had a significant impact on RIA activity on a regional scale and is a good example of technical co-operation within developing countries. A national External Quality Assessment Scheme (EQAS) for thyroid-related hormones was organized and the results were presented at an IAEA Symposium in 1991. Since 1989, the laboratory has also served as a regional centre for a regional EQAS and covers 18 other laboratories in addition to the nine in Pakistan. The laboratory prepares and distributes the EQAS samples and processes the results, for which INMOL has also developed data processing programme software. The laboratory is also organizing local RIA training courses on a regular basis.

PAK/6/009 NUCLEAR CARDIOLOGY SERVICES

COMPLETED: **92-12-30** TOTAL COST: **$134,341**

TO IMPROVE A COMPUTERIZED GAMMA CAMERA SYSTEM.

Nuclear cardiology departments with computerized gamma cameras have been established in a number of nuclear medicine centres in Pakistan. With a view to improving the existing facilities in order to provide better services to patients suffering from heart disorders, the project was initially approved in 1984 for the Atomic Energy Medical Centre (AEMC), Jamshoro. The Nuclear Medicine, Oncology and Radiotherapy Institute (NORI), Islamabad, joined the project in 1986 and the AEMC, Multan, in 1991. Under this multi-year project, the Agency has provided equipment and supplies to the first two recipient

institutes, including cardiac stress tables and collimators. Six Agency experts undertook eight missions to advise on the gamma camera interfacing and its optimization and upgrading, as well as on nuclear cardiology, medical physics and on clinical nuclear medicine. One counterpart staff member received long-term fellowship training under the project; three more were offered long-term fellowships and one a scientific visit under the Agency's manpower development programme. As a result of the project, the three recipient institutes are now better able to provide the necessary cardiology services in their own areas in co-operation with the local cardiological specialists and surgeons. The project has also resulted in a number of presentations at national and international conferences and seminars.

PAK/6/012 PREPARATION AND QUALITY CONTROL OF RADIOPHARMACEUTICALS

COMPLETED: **92-12-30** TOTAL COST: **$108,169**

TO DEVELOP PRODUCTION AND QUALITY CONTROL OF TC-99M RADIOPHARMACEUTICAL INSTANT KITS AND R&D OF NEW TC-99M LABELLED COMPOUNDS FOR NUCLEAR MEDICINE.

The Radioisotope Production Group of the Pakistan Institute of Nuclear Science and Technology (PINSTECH), Islamabad, with laboratories established through previous Agency assistance, has been producing radioisotopes and labelled compounds on a routine basis. Efforts were also under way to develop methodologies for the preparation and quality control of a variety of technetium-99m radiopharmaceutical kits mainly used for medical diagnostics. The project was approved in 1989 for establishing a centralized facility for the bulk production of these kits so as to reduce dependence on foreign imports. Under this multi-year project, the Agency provided equipment including an automatic gamma counter with sample changer, an autoclave sterilizer, a dispensing system, a freeze drying unit and a laminar flow hood. An Agency expert undertook two missions, one to advise on the laboratory set-up, including preparation of a clean room, and the other on the preparation and quality control of Tc-99m radiopharmaceutical kits. Three counterpart staff received long-term fellowship training. As a result of the project, the group is now carrying out clinical evaluation of the locally produced kits and comparing them with those imported from abroad. In collaboration with other nuclear medicine specialists in the country, the group is supplying kits for renal and hepatobiliary scanning, renal static imaging, liver function studies and the detection of ulcers on a trial basis to other nuclear medicine centres in Pakistan. Further R&D work on the development of methodologies for preparation and quality control of these kits is continuing. An infrastructure for the bulk production of Tc-99m radiopharmaceutical kits has been laid down. The project has also led to a number of research publications.

PERU

PER/4/010 OPERATION OF A RESEARCH REACTOR

COMPLETED: **92-12-30** TOTAL COST: **$201,198**

TO FACILITATE THE START-UP AND OPERATION OF A 10-MW RESEARCH REACTOR AT THE HUARANGAL CENTRE, INCLUDING PERFORMANCE OF REACTOR CALCULATIONS.

Agency assistance was approved in 1987 for start-up and operation of the new 10 MW research reactor RP-10 at the Huarangal Nuclear Centre of the Peruvian Institute of Nuclear Energy (IPEN), Lima. As the reactor was in the final stage of construction, guidance and assistance were needed to ensure proper commissioning, initial start-up, ascension to the designed power level and measurement of important reactor parameters. Assistance was also required in safety assessment and reactor utilization. In particular, large-scale expert advice was provided for neutronic and thermal hydraulic analysis of the reactor core for steady state and transient behaviour procedures in addition to tests for commissioning various systems of RP-10, preparation of essential technical reports, assessment of the reactor building containment and ventilation systems and appraisal of the safety analysis report. The Agency also provided laboratory equipment and supplies, electronic equipment, chemicals, computers as well as staff training and scientific visits. Successful completion of this project, especially in conjunction with other related projects concerning operator training, nuclear electronics and nuclear research, has contributed to proper commissioning and safe operation of a major facility at IPEN. As a result of the project, there has been a technology transfer in reactor analysis, operation and maintenance, safe utilization of the reactor and staff training.

PER/5/014 NUCLEAR TECHNIQUES IN AGRICULTURE

COMPLETED: **92-09-08** TOTAL COST: **$236,880**

TO DEVELOP RESEARCH ACTIVITIES IN SOILS, ANIMAL NUTRITION AND REPRODUCTION, AND GENETIC IMPROVEMENT OF CEREALS.

Through an extrabudgetary contribution from the USA, this project was initiated in 1984 to develop the application of isotopic techniques to soils, to animal nutrition and reproduction and to genetic improvement of cereals. In 1986, owing to administrative changes at the National Agricultural University, La Molina, the counterpart institution, activities under the project in soil science and mutation breeding were cancelled. Work in mutation breeding was resumed in 1986 under project PER/5/015, while work in soil sciences was discontinued since the counterpart institutions were unable to set up a suitable laboratory. Animal reproduction activities using radioimmunoassay procedures to determine the content and profiles of progesterone in blood and milk of dairy cattle were developed with a certain success; a laboratory was established and is operating satisfactorily. The project had a large training component with a total of 38 months for six fellows most of whom, unfortunately, returned to the provinces after their training was completed. However, some new courses were established at the Faculty of Agriculture and a large-scale programme was launched on the application of molecular genetics research to animal sciences.

PER/5/015 PLANT MUTATION BREEDING

COMPLETED: **92-09-15** TOTAL COST: **$165,941**

TO IMPROVE FROST AND DROUGHT RESISTANCE IN POTATO AND EARLY MATURITY IN WINTER WHEAT.

As continuation of activities initiated under a UNDP-financed and

Agency-executed project, PER/5/013, this US-assisted project started in 1986 when studies began at the National Agricultural University, La Molina. The Agency provided agricultural equipment including a plot thresher and a seeding machine. The implementation of several expert missions proved difficult owing to the situation prevailing in the country (e.g., several experimental plots located in the highlands were destroyed when crops were ready to be analysed). In spite of these difficulties the University made an effort to set up new experiments and achieved some success in work on quinoa varieties. The achievements under this project encouraged the design and establishment of a large-scale wheat project which is being executed by FAO.

PER/9/011 NUCLEAR SAFETY

COMPLETED: **92-07-16** TOTAL COST: **$331,685**

TO STUDY METHODS FOR TREATMENT AND DISPOSAL OF RADIOACTIVE WASTES; TO SUPPORT REGULATORY ACTIVITIES RELATED TO NUCLEAR INSTALLATIONS.

This project was initiated approved for assistance to the Peruvian Institute of Nuclear Energy (IPEN) in 1983 and received additional Agency financing in 1984, 1986, 1987, 1988 and 1989-90. During implementation, the Agency recommended that the objectives concerning waste management methods be dealt with as a separate project (PER/9/018). Emphasis in the present project was at first (1983-1987) placed on training and on expert services in areas such as the control and safe use of radioactive material and sources. Monitoring and calibration equipment was also provided under the project, leading to the establishment of a basic radiation protection infrastructure. Progress on installing the RP-10 Research Reactor of the Huarangal Nuclear Centre made it increasingly important to obtain assistance on the regulatory aspects of siting and licensing nuclear installations and safety and inspection activities, both at the national level and, particularly, at the reactor. Expert services included advice and assistance to the National Nuclear Regulatory Authority, siting and seismic studies, physical protection, accident analysis, emergency preparedness, radiation protection and monitoring, reactor safety analysis, and training of reactor operators. A large-scale programme also provided training abroad for ten IPEN staff members by means of fellowships and scientific visits, with particular emphasis on licensing, regulatory and safety analysis. The Agency supplied mainly radiation monitoring and data processing equipment. As a result of this project, Peru now has adequate inspection and control of radioactive sources and of IPEN's two research reactors. The project has strengthened the Directorate for Nuclear Safety and Radiation Protection, established appropriate regulations and controls in radiation protection, and raised the level of staff trained in nuclear safety. The original waste management objectives are now being pursued in Project PER/9/018, while project PER/9/019 (1991-92 programme) concentrates on safe operation and control of the RP-10 Research Reactor.

PHILIPPINES

PHI/0/007 NUCLEAR INFORMATION SERVICES

COMPLETED: **92-12-30** TOTAL COST: **$41,546**

TO FACILITATE ACCESS TO NUCLEAR INFORMATION AND ITS RETRIEVAL THROUGH COMPUTERIZATION OF LIBRARY SERVICES AND THE ESTABLISHMENT OF ON-LINE LINKS WITH INIS.

The Scientific Library and Documentation Centre (SLDC) at the Philippine Nuclear Research Institute (PNRI) houses the country's only comprehensive collection of nuclear literature and information. To deal with the increasing volume of material received and the growing demand for information services, PNRI sought Agency assistance in computerizing library services and establishing links with the Agency's INIS database. Under this project, approved in 1987, equipment and material essential for an information centre, including two personal computers, a CD-ROM player, computer software, etc., were provided. Three Agency experts assisted in the installation of CDS/ISIS software and training in the use of the various databases. Agency experts also demonstrated the use of CD-ROM and provided the counterpart staff with in-depth training on computer processing and retrieval of technical information. Four project-related fellowships and a scientific visit were awarded for training in INIS information retrieval, the uses of CDS/ISIS, and in public information. PNRI has automated its library functions through the creation of local databases, including a serials database, a Filipiniana database, and a PERS database. A total of 2516 local and foreign document titles have been encoded in the databases, which are searchable through titles, subject and descriptors. The library has also begun to provide retrospective searches for nuclear researchers from the INIS database. After the arrival of the updated INIS CD-ROM, the searches had reached a total of 650 during the period May 1990 to May 1991. A computerized library loan system has been established. The SLDC is now capable of participating in the national information networks sponsored by the Department of Science and Technology and provides better nuclear information services in the Philippines. PNRI plans to continue the project and expand its activities, particularly training local staff in the use of the INIS database and disseminating nuclear information to the public.

PHI/0/008 WORKSHOP ON THE MANAGEMENT AND EVALUATION OF TC PROJECTS

COMPLETED: **92-12-17** TOTAL COST: **$16,661**

TO MANAGE AND EVALUATE TECHNICAL CO-OPERATION PROJECTS IN THE PHILIPPINES.

Under this project, financed from the Reserve Fund, three Agency staff members conducted a National Workshop on the Management and Evaluation of TC Projects in the Philippines. The workshop was held from 24 to 27 February 1992 at the Philippine Nuclear Research Institute, Manila, and was attended by 29 participants from 11 Philippine institutions and organizations. The participants, mainly project counterparts, received training on how to apply the various elements of an integrated approach to the design, management and evaluation of TC projects. In particular, the workshop was intended to identify ways in which the Agency and national counterpart staff

could give each other mutual support in order to achieve their project objectives and make the maximum possible contribution to national development. Lectures given by Agency staff were followed by group activities and discussions. The workshop strengthened the ties and interaction between project counterparts and the national co-ordinator, on one hand, and between the national staff and the Agency, on the other. The lessons learnt from the workshop are expected to contribute to an improvement in the quality of project proposals and project implementation at counterpart institutions in the Philippines.

PHI/1/014 NEUTRON ACTIVATION ANALYSIS

COMPLETED: **92-12-30** TOTAL COST: **$95,560**

TO ENHANCE THE CAPACITY OF CONDUCTING NEUTRON ACTIVATION ANALYSIS.

In connection with the conversion of the Philippine research reactor (PRR-1) from 1 MW to 3 MW, the Philippine Nuclear Research Institute (PNRI) intended to set up a sample irradiation and counting system for neutron activation analysis (NAA). The project was financed by an extrabudgetary contribution from the United Kingdom in 1986 and was subsequently supported by TACF resources. The Agency provided a pneumatic sample transfer system and accessories, radiation monitoring survey meters, dosimeters and auxiliary items. A counterpart staff member was awarded a fellowship and trained abroad. Unfortunately, the upgraded PRR-1 has been shut down since 1988 for repairing a leak in its pool lining, and the reactor-dependent NAA could not be initiated. The PNRI expects PRR-1 to be operational soon and that NAA will again be able to serve the needs of users in the Philippines.

PHI/5/019 NUCLEAR TECHNIQUES IN ANIMAL SCIENCE

COMPLETED: **92-12-18** TOTAL COST: **$131,703**

TO CONDUCT A MULTIDISCIPLINARY STUDY COVERING THE NUTRITIONAL, HEALTH AND REPRODUCTIVE ASPECTS OF THE CARABAO AT VILLAGE LEVEL.

Although the indigenous buffalo (carabao) is important to Philippine agriculture (as draught animals and for meat and milk), its reproductive performance and milk yields are low. In 1988, three Philippine Government institutions (the Philippine Nuclear Research Institute, the Bureau of Animal Industry, and the University of the Philippines College of Veterinary Medicine), together with the International Institute of Rural Reconstruction, conducted with Agency assistance a multidisciplinary study of the carabao at village level. Under this multi-year project the Agency supplied equipment, including an automatic gamma counter, an ultra low temperature freezer, an enzyme-link immunosorbent assay (ELISA) spectrophotometer, a computer system with software, a contamination monitor, laboratory supplies, and radioimmunoassay (RIA) kits. Eight Agency experts advised and trained counterpart staff on the use of nuclear and related techniques for studies on livestock reproduction. The experts also assisted in studies of the nutrition/reproduction interactions in Philippine dairy and beef cattle, diet supplement with urea-molasses blocks, as well as herd fertility assessment and improvement studies. With the assistance of Agency experts, two workshops on ELISA techniques for diagnosis of brucellosis and haemorrhagic septicaemia were conducted in 1990. Three

counterpart staff were awarded Agency fellowships for training abroad and are now actively involved in research and field work. As a result of the project, considerable progress has been made on multidisciplinary studies. The technique of solid-phase RIA was established for measuring reproductive hormones, specifically progesterone, in the blood and milk of cattle and buffalo. Studies were undertaken on the causes of reproductive inefficiency in the indigenous buffalo (carabao) kept by small farmers. A pilot trial was undertaken to monitor the effects of improved management, nutrition and disease control on overall productivity. Studies are under way to monitor effects of supplementary feeding using urea-molasses blocks in dairy cows on co-operative farms. Local scientists now have the equipment and expertise to use advanced nuclear and related techniques to continue their studies; their findings are being used to improve livestock production. Another result of the project is the establishment of strong ties between counterpart institutions, which will facilitate future applied research on local farming problems. The first phase of the project has been successfully completed, and studies will be continued under Project PHI/5/023 in the 1993-94 Programme.

PHI/6/015 MEDICAL PHYSICS (PHASE II)

COMPLETED: **92-12-17** TOTAL COST: **$27,050**

TO TRAIN MEDICAL PHYSICISTS, VIA A TWO-YEAR POST-GRADUATE COURSE, WHILE BUILDING UP A TEACHING FACILITY AND DEVELOPING THE CAPACITY OF THE TEACHING STAFF.

A post-graduate programme in medical physics was established at the Graduate School of the University of Santo Tomas (UST), Manila, with Agency assistance provided under Project PHI/6/010 (completed in 1989). This project was designed to extend the MSc programme in medical physics and to produce competent medical physicists for nuclear medicine, radiation therapy, diagnostic radiology, radiation protection, and government regulation at hospitals and other institutions. The programme is structured as a two-year combination of didactic study and thesis work. A radiation medicine expert and a radiology expert supplied by the Agency conducted lectures and laboratory exercises in the physics of radiotherapy and the physics of medical imaging. They also advised the graduate students on their thesis work and helped to improve the post- graduate programme, particularly the experiments and procedures. Both students and faculty participated in the establishment of quality assurance programmes in diagnostic radiology and nuclear medicine in selected hospitals of the Department of Health. In 1990-1991, six graduate medical physicists have been employed by hospitals, medical centres and other institutions. The project has broadened the scope of the post-graduate teaching programme.

PHI/8/009 STERILIZATION OF MEDICAL PRODUCTS

COMPLETED: **92-12-17** TOTAL COST: **$234,619**

TO EVALUATE EFFECTIVENESS AND ECONOMIC FEASIBILITY OF RADIATION STERILIZATION OF LOCALLY MANUFACTURED MEDICAL PRODUCTS.

Following an Agency expert's recommendation, the Philippine Nuclear Research Institute (PNRI) sought Agency assistance in feasibility studies of

gamma radiation sterilization of medical products and tissue grafts. Under this project, initiated in 1979, expert missions assisted in the preparation of shield building layout, design of the radiation source storage pool and reviewing engineering drawings for the shield building. During 1979-1987, three staff members were awarded project-related fellowships and were trained abroad. The major items of equipment provided under the project included a gamma beam 651 PT irradiator and auxiliary items, a source storage container, and stainless steel sheets as liner for the storage pool. Owing to the long and unexpected delay in construction of the shield building, the irradiator was not installed until January 1989. A 30 000 Ci Co-60 source provided under a parallel project PHI/8/010 was loaded at the same time. Since then the irradiation facility has been used by the counterpart staff for feasibility studies. In 1989, 269 bone grafts and 217 tissue grafts (amnion grafts) supplied by the Philippine General Hospital and the National Orthopaedic Hospital were processed and sterilized by radiation at PNRI. The grafts were successful in clinical tests by orthopaedic doctors in hospitals. Radiation sterilization was undertaken of locally manufactured medical products such as urinary drainage bags with push/pull valve, nelaton catheters, oxygen catheters, rectal tubes, and nasal oxygen cannulae. These products are still being studied by PNRI staff. After the establishment of the irradiation facility, the project was combined with PHI/8/010 in late 1990. The work is being continued under Project PHI/8/013.

PHI/8/010 RADIATION STERILIZATION FACILITY

COMPLETED: **92-12-30** TOTAL COST: **$135,940**

TO UPGRADE THE EXISTING IRRADIATION FACILITY AT PAEC FOR USE AS A DEMONSTRATION FACILITY.

To meet the growing national demand for medical supplies and tissue grafts, the Philippine Atomic Energy Commission (PAEC), now the Philippine Nuclear Research Institute (PNRI), sought Agency assistance to establish a radiation sterilization facility. The project, originally approved in 1980 with footnote-a status, was made operational through an extrabudgetary contribution from the USA in August 1980 and was subsequently financed by Agency reserve and regular funds. In 1982, the Government made a commitment to construct a shielded building to house the radiation facility, but this was delayed, mainly owing to financial constraints. The building was eventually completed in 1988. Implementation of the project actually started in 1988, apart from a project-related fellowship awarded in 1984. The main items of equipment provided included a 30 000 Ci Co-60 source, a UV-VIS spectrophotometer, an electronic analytical balance, a closed circuit TV system, dosimeters, a gamma ray monitor and detector, and spare parts for the gamma beam 651 PT irradiator. An exhaust system vent was installed and a safety access road was constructed under the project. Two fellowships were awarded for training in radiation processing and in operation and process control of the gamma irradiation facility. In 1989, a parallel project, PHI/9/009, was initiated in order to complete the radiation facility. Following completion of the shielded building in 1988, the gamma beam 651 PT irradiator provided by the Agency under PHI/8/009 and the auxiliary system were installed in January 1989 and the Co-60 source loaded. An Agency expert also advised on determination of the dose of the facility. A 300 000 Ci Co-60 irradiation facility with a suitably equipped laboratory has now been set up at PNRI, and R&D work on radiation sterilization of medical products and food irradiation is being conducted. PNRI now provides irradiation services to the tissue bank, agriculture institutes and

other users. The team of scientists and support staff has gained experience during the installation, commissioning and operation of the facility and from the research programmes. The work is being continued under Project PHI/8/013.

PHI/9/016 RADIOACTIVE WASTE MANAGEMENT

COMPLETED: **92-12-17** TOTAL COST: **$84,747**

TO ESTABLISH A FACILITY FOR CONDITIONING AND IMMOBILIZATION OF RADWASTE; TO DEVELOP PROCEDURES FOR TESTING AND QUALITY CONTROL OF WASTE FORMS AND PACKAGES PRIOR TO TRANSPORT, STORAGE AND DISPOSAL.

The Philippine Nuclear Research Institute (PNRI), as the national nuclear regulatory body, is responsible for the management of radioactive waste (radwaste) generated by all licensed users of radiation and radioisotopes. PNRI sought Agency assistance to establish a facility for conditioning and immobilizing radwaste and to develop procedures in their routine management. Under this project, approved in 1985, two experts assisted in establishing a radwaste facility and quality control procedures. Agency experts also advised on the management of spent sealed sources, in particular on safe storage of those sources and design of the storage facility. Some equipment, including a hydraulic baling press, in-drum cement mixers, slurry transfer pumps and ventilation fans, were provided by the Agency. One of the counterpart staff was awarded a 12-month project-related fellowship. During the period 1986-1988 there were some difficulties in implementing the project owing to the mothballing of PNPP-1 and the reorganization of PNRI. However, considerable progress has been made by counterpart staff since 1989. The facility for conditioning and immobilization of radwaste has been established and is now the radwaste management centre for all radwastes generated from the use of unsealed and sealed radioisotopes by PNRI and others, including research, medical and industrial institutions nationwide. Management procedures covering all aspects in the routine management of radwastes have also been finalized. Conditioning of radwaste by the cementation process is now routinely undertaken with the use of equipment provided by the Agency. The protection of both the general public and PNRI personnel from radiation hazards associated with radioactive wastes has been much more assured by the establishment of the facility and related procedures. The work is being continued under Project PHI/9/018.

POLAND

POL/6/003 UPGRADING OF THE NUCLEAR MEDICINE CENTRE

COMPLETED: **92-12-30** TOTAL COST: **$325,890**

TO UPGRADE THE EXISTING NUCLEAR MEDICINE CENTRE BY SUPPLYING A MODERN GAMMA CAMERA WITH A COMPUTERIZED DATA PROCESSING SYSTEM AND OTHER FACILITIES.

This footnote-a project was approved in 1991 and subsequently funded by Germany. The Nuclear Medicine Centre of the Department of Endocrinology, Poznan, has been active in the application of radioisotopes for diagnostic purposes and in the treatment of thyrotoxicosis and polycythemia. The

Institute's activities were severely reduced in recent years owing to the economic conditions in the country and the lack of opportunity to upgrade its available technology by replacing obsolete and unserviceable equipment. The Agency provided the hospital with a computerized Anger type scintillation camera system, optimized for single photon emission computerized tomography (SPECT) and whole body imaging. The system allows for both circular and whole body contour SPECT studies. The Agency also provided accessories for the camera, a CD-ROM drive and a high resolution video film imager. The hospital obtained the processing part of the computerized data acquisition system from local funds. The introduction of this advanced technology has enabled the hospital to resume on a routine basis its activities in radioisotopic studies and, as part of a university teaching hospital, to play a central and important role in Poland in this field.

POL/9/015 HEALTH EFFECTS OF IONIZING RADIATION

CANCELLED: **92-03-16**

TO EXCHANGE RELEVANT INFORMATION ON RADIATION INDUCED DISEASES AND RELATED PROBLEMS, DIAGNOSIS AND TREATMENT. TO IMPROVE THE PUBLIC PERCEPTION OF NUCLEAR POWER.

The Reserve Fund project was created at the request of the Polish Government in response to interest raised within the Polish medical community to hold a seminar on the health effects of ionizing radiation. In view of the lack of available national counterpart resources required for the successful execution of the seminar, it was agreed to cancel the project and postpone the seminar. A new project was opened as soon as local conditions permitted.

PORTUGAL

POR/3/009 URANIUM EXPLORATION

COMPLETED: **92-12-30** TOTAL COST: **$27,821**

TO DETERMINE THE URANIUM POTENTIAL IN PORTUGAL.

This project, originally with footnote-a status, was funded by an extrabudgetary contribution from France and initiated in 1989 to conduct a nationwide uranium exploration programme. The Agency supplied the Uranium Prospecting Division (SFMIE) of the General Directorate of Geology and Mines with a computer system, digitizer, plotter and software for uranium exploration evaluation. Agency experts advised the counterpart staff on exploratory studies of sedimentary uranium deposits and helped to formulate a workplan for compiling the entire geological data on sedimentary basins in Portugal by focussing on important parameters for the accumulation of uranium. Owing to staffing constraints at SFMIE it has not yet become possible to launch the nationwide exploration programme originally envisaged, so that only part of the original provision had been used when it was agreed to terminate the project.

POR/8/005 RADIATION TECHNOLOGY

COMPLETED: **92-12-16** TOTAL COST: **$51,424**

TO PROMOTE CROSS-LINKING OF POLYMERS BY MEANS OF AN ELECTRON BEAM ACCELERATOR.

This project was intended to supply an electron beam accelerator system to the Physics Department of the National Laboratory of Engineering and Industrial Technology (LNETI), Sacavem, for use in radiation processing of materials. Following inclusion of the project in the 1989 Programme, considerable efforts were made to conclude a contract with a Moscow company to supply an electron beam accelerator to LNETI. As about $143 000 in convertible currencies would have been required for the components, LNETI decided against the purchase of this equipment. The order was therefore cancelled and the project closed.

POR/9/009 URANIUM MINING AND MILLING WASTES

COMPLETED: **92-12-16** TOTAL COST: **$35,576**

TO IMPROVE METHODS FOR HANDLING URANIUM TAILINGS AND TO IMPROVE RADIATION PROTECTION BY THE ESTABLISHMENT OF A LONG-TERM INTEGRATED PLAN FOR MILL TAILINGS DISPOSAL SITES AT URGEIRIA.

Following a WAMAP mission, uranium mill tailings were identified as posing an urgent problem. The project aimed at developing regulations for managing, inspecting and disposing of the uranium tailings in a manner that minimizes detriment to the population and the environment. Three expert missions advised counterparts at the National Uranium Undertaking on management and modelling of uranium mill tailings facilities. Particular attention was paid to the management of direct radiation or emanation of radon from the tailings, migration of pollutants from the tailings (as a result of infiltration of water), and misuse by humans. Two counterpart staff members were awarded a six-month fellowship training and a three-week scientific visit, respectively, in Canada. The project has enabled the competent authorities to prepare regulations, guidelines and criteria in order to regulate the management of uranium mill tailings in Portugal.

REGIONAL AFRICA

RAF/8/010 WATER RESOURCES IN THE NILE VALLEY

COMPLETED: **92-09-15** TOTAL COST: **$175,830**

TO CARRY OUT GROUND/SURFACE WATER ASSESSMENTS IN NORTHERN SUDAN AND SOUTHERN EGYPT.

The project was approved in 1986 with footnote-a status and was upgraded by an extrabudgetary contribution from Germany. Two experts assisted the field investigations in Egypt and Sudan, which were facilitated by the provision of field hydrology equipment and chemicals under the project. Analysis of water samples was carried out under the project. The chief national

counterpart from Egypt received two months fellowship training at the Agency's Isotope Hydrology Laboratory, Vienna. The major achievements of the investigations carried out under the project in Egypt since 1988 and in Sudan since 1989 were: (a) identification and evaluation of Nile infiltration into adjacent groundwater of three study areas in Egypt and three in Sudan; (b) study of the dynamics of the High Dam Lake; (c) delimitation of the zone of infiltration of High Dam Lake water into adjacent groundwater (maximum distance from the lake about 10 km); (d) identification of paleowater resources in the aquifers of the High Dam Lake area; and (e) contribution to the reconstruction of the isotopic composition of Nile water before the construction of the High Dam. The results of these studies were presented at the Agency's Regional Seminar on Isotope Techniques in Hydrology in Africa in 1990 and at the Agency's International Symposium on the Use of Isotope Techniques in Water Resources Development, held in Vienna in 1991. Three scientific papers were also prepared for publication.

REGIONAL LATIN AMERICA

RLA/0/006 NUCLEAR SCIENCE AND TECHNOLOGY DEVELOPMENT (ARCAL)

COMPLETED: **92-12-30** TOTAL COST: **$809,080**

TO DEVELOP SCIENTIFIC AND INDUSTRIAL APPLICATIONS OF RADIOISOTOPES AND RADIATION IN THE LATIN AMERICA REGION.

At the request of the Andean Group of countries wishing to co-ordinate common activities in areas where nuclear technologies were contributing to the solution of common problems, the Agency approved this long-term regional project in 1983. Its main purpose was to support the establishment of the ARCAL Programme, which grew from a core of five Member States to the present membership of seventeen. The national counterparts in the project were the national nuclear energy authorities. The project provided over 90 months of expert services, including numerous planning and co-ordination meetings. Individual and team missions were carried out, first, to assess prevailing conditions in the countries wishing to participate in projects under ARCAL and, second, to prepare projects in the areas of radiation protection, nuclear instrumentation, radioimmunoassay (RIA) techniques in animal reproduction, food irradiation, nuclear analytical techniques, mutation breeding, utilization of research reactors, and RIA of thyroid hormones and isotope techniques in hydrology. Project formulation meetings for the activities on nuclear Instrumentation and isotope techniques in hydrology were sponsored by the project. Some experts helped to establish computer-based management operations of regional activities at the Agency. During the 1984-90 period, the project sponsored annual planning and technical co-ordination meetings held in Latin America, attended by the national co-ordinators of ARCAL Member States. As a contribution to the initiation of some ARCAL projects, one course on mutation breeding and another on nuclear analytical techniques were organized under this project. To facilitate training on various subjects related to ARCAL projects, 49 scientific visits and fellowships were sponsored. Much of this training was gained through group training events organized in the Latin America region. A gamma spectrometer, a liquid scintillation counter and computer systems were supplied by the Agency. A contribution from Germany was used to provide radiation protection equipment to participating countries. The project contributed to strengthening the ARCAL Programme, which provides a framework within which Member States of the Agency co-operate in joint projects in nuclear science

and technology which they consider useful.

RLA/0/011 MANPOWER DEVELOPMENT IN THE LATIN AMERICA REGION

COMPLETED: **92-11-18** TOTAL COST: **$711,160**

TO MAKE FUNDING AVAILABLE FOR FELLOWSHIP TRAINING AND SCIENTIFIC VISITS REQUESTED FOR COUNTRIES IN THE LATIN AMERICA REGION WHICH CANNOT BE DIRECTLY INCLUDED AS PART OF AN APPROVED PROJECT.

This project was initiated in 1989 as a mechanism to make funding available for fellowship training and scientific visits which had high priority within a specific country's nuclear development programme but could not be directly related to an approved project. Under this project 101 fellowships from 16 countries were awarded for a total of 385 months. In addition, 53 scientific visits from 13 countries were awarded for a total of 26 months. Fellowships and scientific visits covered the following areas of study: 25% infrastructure for the development of nuclear energy, including scientific documentation; 19.6% radiological protection and safety; 15% application of radiation and isotopes in agriculture; 14.4% applications of radiation and isotopes in industry and hydrology; 8.5% nuclear engineering and technology, including instrumentation; 8.5% application of radiation and isotopes in medicine, and 5.8% nuclear physics and chemistry.

RLA/4/006 NUCLEAR INSTRUMENTATION (ARCAL II)

COMPLETED: **92-12-30** TOTAL COST: **$1,209,383**

TO STRENGTHEN THE REGIONAL CAPABILITY FOR REPAIR AND MAINTENANCE OF ELECTRONIC INSTRUMENTS AND TO PROMOTE REGIONAL CO-OPERATION.

This project was approved in 1986 at the request of the ARCAL Member States, which considered that the progress and success of all experimental nuclear projects vitally depend on the correct operation of nuclear instrumentation. Since nuclear instrumentation deals with complex hardware and sophisticated software that is developing very rapidly, and in view of the lack of established programmes in Latin America for training in this field and the poor service provided by manufacturers to instrument users in the region, the project emphasised training. Twenty-three regional events were held to train 245 participants. Courses covered a wide variety of topics ranging from radiation detectors to interfacing in nuclear experiments. Workshops on selected topics trained electronic engineers from nuclear laboratories in solving specific problems such as maintenance of pneumatic transfer systems. Another important activity was the evaluation of commercial instruments in specialized workshops which combined the training component with advanced testing and publication of the results. Over 30 months of expert services were provided to help States to establish maintenance laboratories or to advise on specific tasks. Germany and the USA contributed towards the supply of equipment and the provision of expert services. Early in the project, it was realized that there were two obstacles to efficient organization of maintenance and repair centres: lack of adequate repair and maintenance manuals and lack of spare parts. A databank on manuals available in the region was therefore established and is available on diskettes. In 1987, a spare parts service was successfully organized and is being used as a model

to establish similar services in other regions. The 15 countries participating in the project provided cost-free experts, facilities to conduct the individual and group training events, and the per-diem to participants in several courses. A co-ordinated research programme on formulation and implementation of maintenance plans in Latin America was closely associated with the project. In each participating country, at least one model laboratory was created under the project for maintenance and repair of nuclear instruments. The project also trained electronic engineers in maintenance and repair and promoted co-operation among ARCAL countries in the field of nuclear instrumentation. The methodology was established for training in nuclear instrumentation maintenance, and several manuals and textbooks on the subject are now supporting these activities. A follow-up project, RLA/4/008, initiated in 1991, is strengthening the regional capability for maintenance and repair of nuclear electronic and microprocessor-based instruments.

RLA/4/007 RESEARCH REACTOR UTILIZATION (ARCAL V)

COMPLETED: **92-11-03** TOTAL COST: **$355,036**

TO PROMOTE MORE INTENSIVE UTILIZATION OF RESEARCH REACTOR WITH EMPHASIS ON EXPERIMENTAL AND THEORETICAL REACTOR PHYSICS AND NEUTRON RADIOGRAPHY AND ON RADIOISOTOPE PRODUCTION AND PROCESSING.

The project was approved in 1985, and the first activity took place in 1986. Support from Germany in 1987 made it possible to greatly expand the programme. A co-ordinated research programme was initiated in 1987 to study the problem of converting research reactors from the use of highly enriched to low enriched uranium fuels. To improve research reactor utilization, consistent with considerations of safety and economics, the programme emphasised the establishment of indigenous capabilities to perform reactor physics and thermal hydraulics calculations, which are basic to all activities involving research reactors. Between 1987 and 1990, twelve training courses and workshops were held, involving more than 120 participants from all ARCAL Member States operating research reactors, in the fields of reactor calculations, reactor operation and technology, and reactor utilization. Expert services and equipment were provided to support these activities. A co-ordinated research programme, of three years duration, developed and enhanced the calculational capabilities of the institutes in ARCAL countries. The results of the programme are expected to be published. The concluding activity of the project was a Workshop/Symposium on Research Reactors held in Chile in January 1991, the first of its kind in Latin America, which was attended by about 60 participants. It was recommended that such meetings be continued. The project, ARCAL V, has established a regionally recognized capability for research reactor calculations, has established the capability to improve the use of research reactors safely and optimally, and has created a co-operative spirit that is fostering regional co-operation in the field and should continue to do so.

RLA/5/019 RADIOIMMUNOASSAY IN ANIMAL REPRODUCTION (ARCAL III)

COMPLETED: **92-09-15** TOTAL COST: **$864,160**

TO INCREASE THE REPRODUCTIVE EFFICIENCY OF LIVESTOCK IN THE LATIN AMERICA REGION.

The joint FAO/IAEA Division initiated a co-ordinated research programme in 1984 to improve the reproductive management of livestock in the Latin America region. In 1985 a regional project was established. The co-ordinated research programme was integrated with national technical co-operation projects in animal reproduction. The regional network comprised 20 research contracts, three research agreements, and 14 TC projects with Argentina, Bolivia, Brazil, Chile, Colombia, Costa Rica, Cuba, Ecuador, El Salvador, Guatemala, Mexico, Panama, Peru, Uruguay, Venezuela, and with the USA. A regional expert was contracted to co-ordinate the regional network from 1984 until 1988. The goals were to characterize and improve the reproductive management of milk, meat and fibre-producing livestock maintained under the diverse environmental and management conditions prevailing in the region. Institutes were encouraged (a) to define the livestock production system and determine the productive and reproductive performance of animals, (b) to determine the major causes of poor reproductive performance on typical farms, and (c) to develop viable, cost-effective solutions based on modifications to existing management. The measurement of progesterone levels in blood or milk by radioimmunoassay (RIA) proved a highly effective tool to identify the real constraints to reproductive performance. RIA laboratories were established through the provision of appropriate equipment, fellowship training, expert services through the national projects and, during the last five years of the programme, standardized RIA kits supplied by the Agency's Laboratories at Seibersdorf. All counterparts attended three research co-ordination meetings in Lima, Peru (1984), San Jose, Costa Rica (1986), and Bogota, Colombia (1988). In addition, 36 Latin American scientists attended a regional seminar in Maracay, Venezuela, in 1987, and 53 scientists and 26 lecturers participated in three meetings on reproduction and nutrition. The courses were held in Lima, Peru (1984), Maracay, Venezuela (1986), and La Habana, Cuba (1990). Most of the lecturers and experts dealing with reproductive physiology and RIA in progesterone came from the region itself. A training course on disease diagnosis by RIA techniques was held in Buenos Aires, Argentina, in 1988 with the participation of 26 scientists from nine Latin American countries. The major constraint on the reproductive efficiency of farm livestock in Latin America was identified as a prolonged post-partum interval. The factors considered to be responsible for low reproductive performance were management and nutrition. The achievements of the programme were reported in Livestock Reproduction in Latin America, published by the Agency in 1990.

RLA/5/020 FOOD IRRADIATION (ARCAL VI)

COMPLETED: **92-05-14** TOTAL COST: **$50,057**

TO EXTEND THE LATIN AMERICA REGION'S SHARE OF WORLD TRADE IN AGRICULTURAL COMMODITIES BY PROMOTING IRRADIATION AS A TECHNIQUE FOR FOOD PRESERVATION.

The Agency approved a footnote-a regional project on food irradiation in

1986. Following a preparatory mission in 1985 to evaluate the infrastructure, manpower and needs of the Latin America region, a regional co-ordinated research programme on food irradiation (PIAAL) was set up in 1986 with ten research contracts and the participation of Argentina, Brazil, Chile, Colombia, Ecuador, Guatemala, Uruguay and Venezuela. Research laid emphasis on the techno-economic feasibility of the irradiation process and on applications at the pilot-scale level to a variety of selected foods of importance to the region. The immediate objectives were to train staff, to strengthen research and development of food irradiation applications, and to promote the dissemination of information on the health, legal and commercial aspects of the process. The project was partially upgraded in 1987 following assistance in cash and in kind from Argentina, Chile, Canada and the International Facility for Food Irradiation Technology to implement training activities and conduct a feasibility study in some countries of the region. One workshop was held in Brazil in 1986 on aspects of food irradiation, with the participation of 18 scientists from 11 countries. Two specialized training courses were held in Argentina (1987) and Chile (1988) to train 32 scientists from 10 countries in the development of applications and quality control in the food industry and related subjects. All counterparts attended two research co-ordination meetings. Individual training was also provided. A mission to evaluate an economic feasibility study was carried out in Brazil, Colombia and Ecuador in 1988 to demonstrate the viability of the process under commercial or pilot-scale conditions. It was concluded that the best near-term prospect was for insect disinfestation of fruits and vegetables in order to meet the quarantine requirements of importing countries such as the USA. It is hoped that health authorities of importing countries will implement regulations on food irradiation following the principles of the Codex General Standard for Irradiated Foods and its associated Code of Practice. Research through a co-ordinated programme has contributed to support of the commercial use of food irradiation facilities in the Latin America region. Four ARCAL countries, Argentina, Brazil, Chile and Mexico, are playing a key role in the practical applications of food irradiation technology in the region.

RLA/6/006 QUALITY CONTROL OF NUCLEAR MEDICINE PROCEDURES IN-VIVO

COMPLETED: **92-12-18** TOTAL COST: **$302,526**

TO ESTABLISH NATIONAL QUALITY CONTROL PROGRAMMES IN THE LATIN AMERICA REGION.

This regional project was approved in 1980 to improve quality control of nuclear medicine equipment and to promote more effective use of equipment, particularly scanners and gamma cameras, in Latin America. Argentina, Brazil, Chile, Costa Rica, Colombia, Cuba, Ecuador, Guatemala, Mexico, Paraguay, Peru and Uruguay benefitted from expert missions to assist in setting up national programmes and prepare for relevant education at the national level. The Agency also supported twelve one-week workshops by providing lecturers, some test tools and phantoms. The project was linked with two co-ordinated research programmes. A total of 55 months training was awarded under this or related projects. Training courses were also provided on radioimmunoassay in Colombia and on quality control in-vivo procedures in Cuba, as well as workshops on SPECT (tomography) quality control and nuclear cardiology. The project led to great improvements in instrument care in the region, increased awareness of the concept of quality and a lower down-time for nuclear medicine instruments. A follow-up project to promote quality control of nuclear medicine equipment and quality assurance in nuclear medicine in the region

will be initiated in 1994, closely linked with a new co-ordinated research programme on certification of quality control and preventive maintenance.

RLA/6/011 RADIOIMMUNOASSAY OF THYROID-RELATED HORMONES (ARCAL VIII)

COMPLETED: **92-12-30** TOTAL COST: **$638,528**

TO REDUCE COSTS AND INCREASE THE RELIABILITY OF RADIOIMMUNOASSAYS OF THYROID-RELATED HORMONES.

Following a request from ARCAL Member States,the Agency approved this footnote-a project in 1986. The Commission of the European Communities upgraded the project the following year by an extrabudgetary contribution. Eighty laboratories in Argentina, Bolivia, Brazil, Chile, Colombia, Costa Rica, Cuba, Ecuador, Guatemala, Mexico, Paraguay, Peru, Uruguay and Venezuela participated in this project, which supported the establishment of bulk reagent-based methodology and local reagent production for radioimmunoassay (RIA) of thyroid-related hormones. The transfer of technology was accomplished by means of several expert missions to advise participating laboratories, four regional training events at which 73 participants were trained on radioisotope methodology and external quality in RIA, and 40 national courses on the same subjects, at which participants in regional events lectured to more than 600 participants. A regional course on preparation and use of bulk reagents also supported the project. The co-ordinated research programme on promotion of optimum use of bulk reagents for RIA of thyroid-related hormones was closely linked to this project. Participating countries provided infrastructure available in their laboratories, cost-free lecturers for training courses and to advise the less advanced laboratories. In some cases the participating countries provided reagents produced in the region. As a result, dependence on imported commercial RIA kits has been greatly reduced and indigenous production of primary reagents has been achieved to a large extent in the region and in many cases also in participating countries. The project has succeeded in considerably reducing costs, with a subsequent expansion of diagnostic services. Analytical reliability of the results has been assured by insistence on standard RIA practice and internal quality control procedures in all laboratories. A regional external quality assessment (EQAS) scheme is ongoing, in addition to which several countries have organized their own national EQAS. A follow-up project on production of RIA reagents will utilize the achievements of the present project to create total self-sufficiency in the production of reagents and kits for RIA of thyroid-related hormones and their application to the clinical area of neonatal hypothyroidism screening, which is of great concern to the Latin American region.

RLA/8/005 NON-DESTRUCTIVE TESTING IN LATIN AMERICA

COMPLETED: **92-12-30** TOTAL COST: **$2,605,676**

TO PROVIDE TRAINING IN INDUSTRIAL RADIOGRAPHY AND OTHER NON-DESTRUCTIVE TESTING TECHNIQUES AT MEDIUM AND ADVANCED LEVELS.

In 1982, the IAEA, the United Nations Financing System for Science and Technology for Development (UNFSSTD) and the United Nations Industrial Development Organization (UNIDO) joined forces to start the Regional NDT

Project for Latin America and the Caribbean, with six member countries. By 1985, an additional 11 countries had joined, and in early 1988 Costa Rica became the 18th country to participate. The IAEA has funded the management of the project co-ordination office, located in facilities provided by the CNEA in Buenos Aires. Additional funds were provided initially by UNIDO. The project has also had substantial in-cash contributions from the Governments of Italy and Germany. The Government of Canada has also participated in the project, through in-kind contributions, during 1985-1986. The project achieved and surpassed its main objective of building up an autonomous capacity in non-destructive testing (NDT) in the region. From the small groups competent in specific techniques which were identified at the beginning of the project, there are now sufficient personnel in all participating countries trained in the five basic techniques to at least level 2 to meet their everyday NDT needs and are able to give training in the basic techniques with their own personnel. A total of 1680 persons participated in 85 regional training events, 4595 persons participated in 254 national training events with project input, and at least 22 213 persons were trained in national events without project input but following project training guidelines and methodology. Regional lecturers from 13 project countries carried out 258 expert missions. (In the early years only two countries were able to provide sufficiently trained specialists). A total of 98 missions were carried out by international experts mainly from donor countries. The region played a major role in drafting a standard for the International Organization of Standardization (ISO) for the qualification and certification of NDT personnel, thus ensuring that the needs of developing countries were respected and included. Training programmes for the main NDT techniques were elaborated and published by the Agency as TECDOC-407. This document is also a recommended guideline in the ISO standards. Fourteen countries have national standards for the qualification and certification of NDT personnel. An efficient and effective computer-based management system and a regional communication network were built up, and an electronic mail system was developed. The Regional Federation of National Non-Destructive Testing Organizations of Latin America and the Caribbean was established in 1988 to ensure continuity in NDT activities in the future. The above achievements were based on close integration of this project with projects RLA/8/006 and RLA/8/013.

REPUBLIC OF KOREA

ROK/4/014 NUCLEAR FUEL CYCLE TECHNOLOGY

COMPLETED: **92-12-30** TOTAL COST: **$192,033**

TO DEVELOP NUCLEAR FUEL CYCLE TECHNOLOGY INCLUDING REFINING, CONVERSION AND RECONVERSION OF NUCLEAR FUEL, FABRICATION OF NATURAL URANIUM FUEL AND SPENT FUEL MANAGEMENT.

This project was approved in 1984 to provide elements of nuclear fuel cycle technology in areas of fuel design and fabrication, fuel testing, quality assurance and quality control and post-irradiation examination. The project was especially important as the Government was undertaking an ambitious programme based on the construction of a 200 tonnes/year fuel fabrication line and a large-scale R&D programme on fuel fabrication and post-irradiation examination. The project was funded by an extrabudgetary contribution from Germany, supplemented with regular TC funds. Seven Agency experts undertook seven missions to provide training, to assist in developing research programmes and to advise on non-destructive examination of nuclear fuel,

metallurgical examination of irradiated fuel, quality control data acquisition, nuclear fuel design and Zircaloy characterization. Equipment provided included a particle size analyser and a high performance liquid chromatograph. Two long-term fellowships and one scientific visit were awarded. Three project-related fellowships were granted, one of which was funded by the USA. The project has contributed to improvements in the methodology of fuel fabrication and associated quality assurance and in post-irradiation examination, both destructive and non-destructive. The Daeduk Engineering Centre of KAERI assessed the country's total fuel fabrication development needs and initiated studies on fuel materials processing.

ROK/4/021 QUALITY ASSURANCE

COMPLETED: **92-09-15** TOTAL COST: **$82,441**

TO DEVELOP QUALITY ASSURANCE CAPABILITY FOR THE NATIONAL NUCLEAR POWER PROGRAMME.

In 1989, the Korea Atomic Energy Research Institute (KAERI), sought Agency assistance to develop quality assurance capabilities for R&D activities related to nuclear science and technology, with particular reference to the national nuclear power programme. The Agency assigned six experts to conduct three workshops on quality assurance and quality control. One fellowship was also awarded for training abroad. The knowledge and practical experience gained through the project have helped to develop and improve KAERI's overall quality assurance system. In particular, it can help to move from an individual quality control system to an auditable quality assurance programme, in accordance with the regulatory requirements of the country's nuclear standards.

ROK/4/022 NUCLEAR FUEL QUALIFICATION

COMPLETED: **92-12-30** TOTAL COST: **$19,775**

TO ESTABLISH TECHNOLOGY FOR THE DESIGN AND CONSTRUCTION OF A LOOP SYSTEM FOR RESEARCH/POWER REACTORS.

The 30 MW(th) Korean Multipurpose Research Reactor (KMRR) is under construction at the Korean Atomic Energy Research Institute (KAERI) and will be critical by mid-1993. The project was approved in 1989 to assist KAERI in designing in-pile loops to test fuels for nuclear research and power reactors and to test other reactor materials to ensure the proper performance and safety of nuclear materials. Three Agency experts undertook three missions and worked with local staff on in-pile tests in the research reactor, using test loops or rigs. Two senior staff members were awarded scientific visits abroad. The project has strengthened R&D efforts in evaluating fuel performance and materials testing and will contribute towards better utilization of the research reactor.

ROK/4/023 NUCLEAR POWER PLANT WATER CHEMISTRY

COMPLETED: **92-12-30** TOTAL COST: **$45,417**

TO ESTABLISH EXPERTISE IN WATER CHEMISTRY OF THE NPP SYSTEM, PARTICULARLY OXYGEN REMOVAL.

The Government sought Agency assistance for its plans to improve the management of water chemistry of nuclear power plants (NPPs) in operation and to develop advanced technology for self-reliant design of NPPs. The project was initiated in 1989. Two experts provided advice and training on catalytic removal of dissolved oxygen using wet-proofed catalysts, on the mechanism of catalytic deoxygenation, and in studying the behaviour of corrosion products and optimum control chemistry in the primary water system, thus contributing to the reduction of occupational radiation exposure in NPPs. One counterpart received 12 months training abroad in water chemistry management and water purification technology. The project has contributed to the improvement of the methodological basis for regulating water chemistry and to the R&D activity of primary water chemistry control in nuclear power reactors.

ROK/9/021 RADIOACTIVE WASTE DISPOSAL

COMPLETED: **92-12-30** TOTAL COST: **$508,854**

TO SOLVE EXISTING RADWASTE MANAGEMENT PROBLEMS INCLUDING TREATMENT AND DISPOSAL.

This project, initiated in 1982, intended to assist the Korea Atomic Energy Research Institute (KAERI) and the Korea Institute of Energy and Resources in support of the Government's policy for safe treatment and disposal of low- and intermediate-level radioactive waste (radwaste) arising primarily from nuclear power generation. Under this project, the Agency provided 22 international experts and two staff members, who carried out twenty missions for a total of over 26 months. These missions advised and trained personnel in various aspects of radwaste disposal including management policy, site selection, decontamination of nuclear facilities, solidification and volume reduction of radwaste, and depository design. A national training course on radwaste management was also organized. Equipment provided included a differential thermal analyser system and a low-level counter. Seven counterpart staff were awarded long-term training abroad. Four project-related fellowships were granted for practical training abroad, two of which were funded by the USA. These activities have also been supported by four related research contracts. As a result of the project, reference data for a national radwaste master plan were provided (the plan was established in December 1984 and specified in July 1988), and criteria for waste acceptance and site selection were established. The site investigation and selection technologies presented by the experts are being used as a reference for site selection by KAERI; several candidate sites have been identified. The treatment and disposal technologies transferred by expert services and training, and the monitoring equipment supplied under the project, have improved the capability of the institutes to the level that they can carry out self-sustaining R&D programmes, within the scope identified in this project, to support the national radwaste management programme.

ROK/9/031 PROBABILISTIC SAFETY ASSESSMENT TECHNIQUES

COMPLETED: **92-12-30** TOTAL COST: **$66,501**

TO CARRY OUT A CRITICAL REVIEW OF THE PROBABILISTIC SAFETY ASSESSMENT OF THE WOLSUNG PLANT.

Under this project, approved in 1989, an intensive International Peer Review Service (IPERS) mission on Probabilistic Safety Assessment (PSA) for the KORI-3 and 4 nuclear power plants (NPPs) (Westinghouse three-loop PWRs) was performed. The net electrical output of each unit is 913 MW(e). Unit 3 has been in commercial operation since 1985 and Unit 4 since 1986. The NPPs are operated by the Korea Electric Power Corporation (KEPCO). The Korea Atomic Energy Research Institute (KAERI), which is responsible for reviewing this assessment, requested the Agency to conduct the review. The PSA for the KORI-3 and 4 NPPs was elaborated on behalf of the utility mainly by domestic manpower from KEPCO with the assistance of consulting companies from the USA. The review was carried out in two stages. The pre-IPERS meeting took place in Vienna from 27 to 31 May 1991 while the main part of the mission was carried out in Seoul a few months after the preparatory meeting. Six Agency experts led by an Agency staff member participated in the mission, which focussed on the adequacy of the treatment of important technical and methodological issues in the study. The review identified a number of issues appropriate for improvement, which were accepted and used by the PSA team to retrieve and update the study. This IPERS mission is the first full scope level I PSA carried out in the Republic of Korea. As a result of the project, confidence in the PSA models and results and in the local capabilities for conducting a PSA review have been strengthened.

ROMANIA

ROM/3/002 NUCLEAR TECHNIQUES IN MINING

COMPLETED: **92-07-13** TOTAL COST: **$329,854**

TO DEVELOP THE USE OF NUCLEAR TECHNIQUES IN GEOPHYSICS, MINERAL ANALYSIS, ON-LINE COAL ANALYSIS AND HYDROLOGY.

Under this project, initiated in 1986, several laboratories at the Institute of Atomic Physics, Bucharest, were supported by the Agency within a national mineral resources development programme in the following directions: nuclear logging; use of isotope tracers for groundwater resources assessment and management; elemental analysis of geological samples with very low elemental concentrations; fossil fuel analysis. Six expert missions covered all these fields and furthered subsequent R&D programmes. The Agency provided complete systems for elemental analysis, precision electronics measurement instruments, chemicals, detectors, and radioactive sources. Four scientific visits helped to update information on the use of carbon and oxygen tracers for petroleum geology and for the study of water migration. As a result of the project, gamma ray, thermal and epithermal neutron logging methods and technologies were introduced for great depth, including production of some prototype logging equipment. The R&D work pursued under this project also resulted in the publication of more than ten scientific papers.

ROM/9/009 OSART AND FOLLOW-UP OSART (FOLLOW-UP PRE-OSART TO CERNAVODA)

COMPLETED: **92-12-30** TOTAL COST: **$10,865**

TO REVIEW THE OPERATIONAL SAFETY OF THE CERNAVODA NUCLEAR POWER PLANT THROUGH AN OSART MISSION.

The project was approved in 1991 at the request of the Romanian Government, which is constructing five CANDU-type reactor units at Cernavoda. Continuing the assistance provided during 1990, a follow-up visit to Cernavoda nuclear power plant (NPP) was undertaken in 1991. In 1992 the Agency sponsored an Assessment of Safety Significant Events (ASSET) training seminar for 16 participants drawn from the operating organization, regulatory body and technical support staff. Topics covered included ASSET root cause analysis methodology and event rating techniques for the International Nuclear Event Scale (INES) system. The training programme took into consideration the lack of operating experience on the Romanian side and emphasised specific examples of operational events relevant to CANDU reactors. The project also enabled one Romanian scientist to participate as an observer in an OSART mission to the Grafenrheinfeld NPP, Germany, and another to the Blayais NPP, France.

SPAIN

SPA/5/002 NUCLEAR TECHNIQUES IN AGRICULTURE

COMPLETED: **92-12-17** TOTAL COST: **$105,671**

TO OPTIMIZE PRODUCTION OF PASTURE, FORAGE, GRAINS AND LEGUMES IN THE ARID AND SEMI-ARID REGIONS OF SPAIN BY APPLYING THE TECHNIQUE OF BIOLOGICAL FIXATION.

The Estacion Experimental del Zaidin (EEZ), Granada, embarked on nitrogen fixation and water-use efficiency studies as a means of improving plant development in the arid and semi-arid regions of Spain. Through this project, approved in 1989, the Agency assisted the EEZ in field and analytical studies on the evaluation of plant/microbe symbiosis, in which selected nitrogen-fixing microorganisms (rhizobium) and mycorrhizal fungi assist in restoring and maintaining soil fertility. The Agency provided an emission spectrometer for N-15 analysis, a sample preparation line, an autoregulated Kjeldahl digester and laboratory supplies. Advice was provided on N-15 isotope techniques for estimating biological nitrogen fixation by plants, on planning nursery and field experiments in nitrogen-fixing shrubs and trees, and on interpretation of results from data obtained in N-15 analysis. One counterpart staff member received fellowship training on N-15 techniques at the Agency's Laboratories at Seibersdorf. The introduction of biological nitrogen fixation and mycorrhiza research at the EEZ has been very successful, as demonstrated by the number and quality of the studies conducted and the publications by counterparts as a result of the project. The EEZ is now actively engaged in transferring the nuclear techniques acquired under the project to other Spanish institutions.

SRI LANKA

SRL/0/002 NUCLEAR SCIENCE TRAINING

COMPLETED: **92-12-30** TOTAL COST: **$391,494**

TO ESTABLISH LABORATORY FACILITIES AND DEVELOP CURRICULA, INCLUDING RESEARCH PERFORMANCES, FOR TRAINING IN NUCLEAR SCIENCE, ELECTRONICS AND ENGINEERING AT GRADUATE AND POST-GRADUATE LEVEL.

The project aimed at establishing laboratory facilities and developing teaching curricula for training post-graduate students in nuclear science and techniques. Under this project, initiated in 1983, the Radioisotope Centre (RIC) of the University of Colombo was provided with equipment including a multichannel analyser with data processing system, a semiconductor detector, radiation detectors and monitors, calibration standards, computer systems and software, and electronic components. A reasonably equipped laboratory was established. Agency experts also undertook nine missions to assist in developing teaching curricula and experiments for radiochemistry, applied nuclear physics, nuclear analytical techniques, and nuclear power courses. Four counterpart staff were awarded fellowships and scientific visits for training abroad. Between 1984 and 1986, two MSc courses and two electronics courses were conducted and completed at the Centre. Ten candidates successfully completed the MSc programme, most of whom are currently employed at the Atomic Energy Authority and the RIC. The Centre also introduced new teaching units for radiobiology, radiochemistry and applied nuclear science at the undergraduate level for the University of Colombo. Unfortunately, the University was closed for two years (1987-1989) owing to the political upheaval and no work could be done during that period. However, with the gradual functioning of the University, the project activities were resumed in 1989. The teaching units at the undergraduate level have been extended to three other universities. Agency experts also assisted in repairing equipment which was malfunctioning owing to the lack of regular maintenance and repair while the University was closed. A nitrogen liquifier was installed in 1991 and is in use. The laboratory is now being used by other institutions for applications of nuclear techniques in various fields. The research work conducted under the project resulted in fourteen publications. It is expected that the facility will be used continuously to meet the increasing demand for trained manpower in nuclear science and techniques.

SRL/3/004 NUCLEAR RAW MATERIALS

COMPLETED: **92-12-17** TOTAL COST: **$50,907**

TO IDENTIFY URANIUM DEPOSITS IN AREAS WITH ANOMALIES AND TO STRENGTHEN ANALYTICAL FACILITIES.

The project is a continuation of Project SRL/3/003 under which the Geological Survey Department (GSD) of Sri Lanka has carried out a reconnaissance survey of the entire island for uranium and other metals. The project aimed at strengthening the uranium analytical laboratory of the Department and analysis of the geochemical survey results for the assessment of Sri Lanka's uranium potential. Under this project, approved in 1982, a fluorimeter and three portable scintillation counters were supplied. An Agency expert reviewed the preliminary regional survey and assisted the counterpart staff in

planning detailed surveys of anomalous areas and dense sampling in selected areas. Two GSD scientists were granted project-related fellowships and trained abroad. Unfortunately, owing to the political unrest in the north and east of the country, where the prospective areas of interest are located, field work has become very difficult since 1984. It was therefore decided to shift the emphasis from follow-up field work to the development of the data processing capability of the Department in dealing with the large amount of geochemical and radiometric data obtained from past activities. A computer system for automatic data processing and map production was provided and technical staff was trained under a regional manpower development project in the use of computer software and its application for routine geological studies. With the assistance provided by the Agency, a new fluorimetric laboratory for uranium analysis and a data processing system have been established at the GSD. It is expected that the Department will maintain its modest activity in assessing the country's radioactive mineral potential as part of its general mineral inventory programme.

SRL/8/009 ISOTOPES IN HYDROLOGY

COMPLETED: **92-12-17** TOTAL COST: **$129,094**

TO SET UP AN ENVIRONMENTAL TRITIUM LABORATORY AND DEVELOP THE USE OF ENVIRONMENTAL ISOTOPE METHODS FOR GROUNDWATER INVESTIGATIONS.

An extensive drilling programme on groundwater development for rural community water supplies has been carried out in the hard rock terrain of the dry zone of Sri Lanka. Approximately 15 000 tube wells fitted with hand pumps were installed during 1980-89. The Atomic Energy Authority (AEA) and the Radioisotope Centre (RIC) at Colombo University sought Agency assistance in the use of environmental isotopes and tracer methods to determine groundwater recharge and movement to supplement the conventional hydrological and hydrogeological studies carried out by the National Water Supply and Drainage Board (NWS&DB), in collaboration with WHO and UNICEF, as part of the UN International Water Supply and Sanitation Decade. Under this multi-year project, the Agency provided the AEA and the RIC with equipment including two liquid scintillation counters, a germanium detector, a multichannel analyser with data processing system, and some laboratory supplies. Two Agency experts advised on the use of tracer techniques for land-soil movement and erosion studies, and assisted the counterpart staff in evaluation and interpretation of isotope data obtained from water samples. The Agency's Isotope Hydrology Laboratory provided analytical services for the measurement of deuterium and O-18 and other isotopes in 454 water samples collected by counterpart staff. With Agency assistance, an environmental tritium enrichment and measurement facility has been established at the RIC, and the tritium tracer method has been used to estimate groundwater recharge. Stable isotopic composition (deuterium and O-18) of the precipitation has been analysed during monsoon seasons. It was observed that there are two different origins of groundwater recharge. The SW monsoon has the more enriched composition and reflects the fact that the source of moisture is primarily from the ocean, while the composition of the NE monsoon is more depleted and the range of values greater, which reflects the fact that the source of moisture is from the continent. These findings were presented at the Agency's 1991 Symposium on Isotope Hydrology. Conventional hydrological, hydrogeological and hydrometrological studies have also been completed by NWS&DB and the results recommended to the relevant authorities for long-term planning of water resources. It is expected that the

findings of the project will enable the Sri Lankan authorities to assess the situation regarding groundwater resources and ensure that those resources are not being overused or wasted.

SYRIAN ARAB REPUBLIC

SYR/3/003 URANIUM RECOVERY FROM PHOSPHORIC ACID

COMPLETED: **92-12-30** TOTAL COST: **$142,898**

TO RECOVER URANIUM FROM PHOSPHORIC ACID.

Syria's nuclear power programme has been shelved for financial and contractual reasons. The possibility was considered of developing a domestic uranium supply as one component of the overall programme. A commercial fertilizer operation at Homs produces phosphoric acid from phosphatic rock mined from the Charkia and Knifes deposits which contain about 60 to 100 parts per million of uranium. Through this project, the Agency provided the Atomic Energy Commission of Syria (AECS) with a micro-plant facility, spare parts and chemicals to enable yellow cake uranium to be recovered on an experimental basis from the phosphoric acid produced at Homs plant. This was to be the first step in the nuclear power programme cycle; subsequent steps would include a pilot plant, an industrial scale plant and then possibly operations such as refining, conversion, enrichment and fuel fabrication. Five expert missions were organized to train and advise the counterpart staff on the operation of the micro-plant. A Canadian company was later awarded a sub-contract for pre-feasibility evaluation of the micro-plant results with a view to a pilot plant and eventually to an industrial scale plant for uranium recovery from phosphoric acid produced at the Homs plant. Three counterpart staff members were trained during the pre-feasibility studies; two others received fellowship training in Indonesia on the uranium recovery process. The results of the pre-feasibility studies indicate that while the basic technology for extracting uranium from the phosphoric acid produced at the Homs plant is workable, the industrialization of the process is not at present advisable in view of the depressed world market price of uranium. The AECS has submitted a request to the UNDP for assistance in the construction of a pilot plant as the next stage in the uranium recovery process. The counterparts are continuing with detailed investigations on solvent extraction methods for uranium recovery at the AECS.

SYR/9/006 ENVIRONMENTAL RADIOACTIVITY

COMPLETED: **92-12-30** TOTAL COST: **$66,402**

TO DETERMINE RADON AND THORON LEVELS AND TO ASSESS COLLECTIVE DOSE AND INTERVENTION LEVELS AS PART OF THE NATIONAL RADIATION PROTECTION PROGRAMME.

This project was initiated in 1988 to assist the Atomic Energy Commission of Syria (AECS) to establish a solid state nuclear track detection (SSNTD) laboratory. Monitoring was envisaged of radon, thoron and their decay products inside buildings and in the environment with a view to establishing intervention levels for these natural radioactivity hazards. Agency experts advised the counterpart staff on SSNTD, radon and neutron dosimetry

techniques. A radon monitoring programme was embarked upon to determine the background levels in the country; a chemical and electrochemical etching programme was established to count nuclear tracks in films by means of a microscope, microfiche reader and a spark counter. Various items of monitoring equipment, including radioisotopes, were provided under the project. One counterpart staff member was trained abroad for one month. The laboratory established at the AEC is functioning normally, and the counterparts can now carry out a nationwide programme of radon monitoring, particularly determination of radon and thoron levels both indoors and in the vicinity of the phosphate mining areas.

THAILAND

THA/4/008 RADIOISOTOPE PRODUCTION FACILITY

COMPLETED: **92-12-30** TOTAL COST: **$1,171,729**

TO IMPROVE LOCAL CAPABILITY FOR PRODUCTION OF RADIOISOTOPES AND LABELLED COMPOUNDS TO BE USED IN NUCLEAR MEDICINE.

The project was intended to set up laboratory facilities for indigenous production of technetium-99m and iodine-131 to meet the increasing demand by nuclear medicine services in Thailand. The Government gave a high priority to this multi-year project and provided funds-in-trust under the project to purchase hot cells. The Government also made available the TRIGA Mark II reactor, a new building to house the laboratories, and extra scientists and engineers for the project. The Agency has provided, over the period 1982-88, convertible and non-convertible currency for the purchase of laboratory facilities and supplementary equipment. Hot cell lines for the production of Tc-99m and I-131 were installed at the new laboratories of the Office of Atomic Energy for Peace (OAEP) in 1985 and 1987 respectively. The counterpart staff later modified and adjusted the facilities to make them operational. During that period, eight Agency experts (a total of 8 months) assisted the OAEP in the design of hot cells and trained local staff in the production of Tc-99m and I-131. The experts also helped to solve problems pertaining to the facilities. At the onset of the project, the emphasis placed on staff training facilitated a real transfer of technology. Ten OAEP staff members were awarded Agency fellowships and one was granted a scientific visit. At present, 2 to 2.5 Ci/week I-131 are produced routinely and given nationwide distribution, meeting approximately the entire national demand. Owing to its very short half-life, 1.8 to 2 Ci of Tc-99m are produced every day, covering the demand from hospitals in the Bangkok area. The OAEP also produces I-131 labelled compounds and several kinds of Tc-99m kits for hospitals. A quality control and quality assurance measurement system has also been established for radioisotopes, which are now of a quality comparable to that of those that are imported. A core of local professionals capable of sustaining reliable and efficient radioisotope production has been established at the OAEP. The project made a valuable contribution to the public health services, in particular to nuclear medicine, by indigenous production of high quality Tc-99m and I-131 at a low price. The expanded project activities are being continued under Project THA/2/010 (1991-94).

THA/5/032 MUTATION BREEDING

COMPLETED: **92-09-09** TOTAL COST: **$74,010**

TO DEVELOP IN-VITRO CULTURE TECHNIQUES FOR OBTAINING CULTIVARS OF ECONOMICALLY IMPORTANT CROPS WITH GREATER RESISTANCE TO FUNGAL AND BACTERIAL DISEASES.

The Plant Pathology and Microbiology Division of the Department of Agriculture (DOA), Bangkok, intended to develop a capability for the application of in-vitro and radiation-induced mutation breeding techniques for developing disease resistance of several economic crops. Under this project, initiated in 1987, the Agency provided equipment including a laminar flow cabinet, spectrophotometer, cooling incubator, autoclave, centrifuge, ultrasonic cleaner, thin-layer and liquid column chromatography sets. Expert missions assisted the counterparts in establishing plans for experiments and advised on modern techniques for assaying phytopathogens. Three fellowships and a scientific visit were awarded under the regional manpower development project during 1989-1991. Experiments were conducted on screening advanced generations of tomato for resistance to bacterial wilt disease and on mulberry for resistance to bacterial blight disease. In-vitro culture techniques were also used to obtain disease resistant varieties of roselle, jute and mungbean; the methods of regeneration are under investigation. The project contributed to the establishment of an in-vitro culture laboratory at the DOA, at which research is being conducted on tissue and cell culture and radiation- and chemical-induced mutation for disease resistance. The counterparts, in collaboration with Khonkaen University, Kasetsart University and the Office of Atomic Energy for Peace, have also obtained some promising results in disease resistant cultivars of tomato and mulberry. They are also training technicians, graduate students and researchers of the DOA and the universities in in-vitro techniques and assisting those institutions in their research. The in-vitro laboratory at the DOA is expected to be expanded in 1992 to further develop in-vitro culture techniques in order to increase the disease resistance of economically important crops.

THA/8/010 TRAINING CENTRE FOR NON-DESTRUCTIVE TESTING

COMPLETED: **92-09-08** TOTAL COST: **$132,123**

TO ESTABLISH A NATIONAL TRAINING CENTRE FOR NON-DESTRUCTIVE TESTING CAPABLE OF TRAINING LOCAL PERSONNEL FOR QUALIFICATION, CERTIFICATION AND EXAMINATION; TO ASSIST THE NATIONAL CERTIFICATION BODY.

The Office of Atomic Energy for Peace (OAEP), Bangkok, sought Agency assistance to set up a National Non-Destructive Testing (NDT) Centre to support the national industrial development programme and to provide training, qualification and certification for local personnel. Under this project, initiated in 1987, the Agency supplied equipment including a gamma-ray unit, a mobile X-ray unit, ultrasonic flaw detectors, a portable eddy current flaw detector, a magnetic particle testing unit and radiography source, as well as some training facilities. Experts advised the counterparts on the development of infrastructure to implement the national scheme for qualification and certification of NDT personnel, and assisted local staff in organizing national NDT training courses. A fellowship was awarded to train a local staff member abroad. The OAEP, in co-operation with the King Mongkut Institute of

Technology, the Electricity Generating Authority of Thailand, Thai Airways International and various NDT service companies, organized 22 national NDT training courses in radiographic testing, ultrasonic testing and surface method. These courses trained 402 local staff in NDT during 1987-91. Two seminars were also held during that period with 110 participants from various NDT institutions. With Agency assistance Thai Government support, a national NDT training centre has been established at OAEP with laboratory and training facilities and a cadre of engineers and technicians capable of providing training in NDT. The existing NDT centre is expected to continue to provide NDT training to support the national industrial development programme.

TUNISIA

TUN/0/003 NUCLEAR POWER PLANNING

COMPLETED: **92-07-13** TOTAL COST: **$130,424**

TO EVALUATE A NUCLEAR POWER FEASIBILITY STUDY.

This project was approved in 1982 to assist in evaluating a nuclear power feasibility study. At a later stage of implementation, several activities related to nuclear power plant siting were added to the project. The initial objectives were attained through a number of expert missions dealing mostly with the transfer and implementation of the IAEA-supported computer models MAED and WASP and by training local staff, who have now acquired sufficient skill to use these models for energy feasibility studies. Subsequently, with the provision of seismic instrumentation in 1989, the project took a different direction and focussed primarily on siting studies involving micro-earthquake monitoring. Thirty expert missions were carried out for a total of eight months, and a fellowship was awarded for one month's training abroad. These activities are being pursued under the follow-up project, TUN/9/007.

TUN/0/004 NUCLEAR LEGISLATION AND REGULATIONS

COMPLETED: **92-07-13** TOTAL COST: **$13,545**

TO ADVISE ON NUCLEAR LEGISLATION AND REGULATORY ACTIVITIES IN CONNECTION WITH LONG-TERM ENERGY AND NUCLEAR POWER PLANNING.

The project has provided legal advice and guidance to the Tunisian authorities for the elaboration of various drafts relating to nuclear legislation and regulations. Thus, draft decrees on radiation protection, licensing and control of nuclear installations, radiation emergency, safe transport of radioactive material, civil liability and nuclear law have been elaborated and submitted to the competent authorities for enactment. The draft decree on radiation protection has already been promulgated. One counterpart staff member has been trained abroad in nuclear safety assessment and regulation.

TURKEY

TUR/8/010 DEVELOPMENT OF NDT AT NUCLEAR RESEARCH AND TRAINING CENTRE

COMPLETED: **92-04-29** TOTAL COST: **$243,771**

TO IMPROVE INDUSTRIAL QUALITY CONTROL STANDARDS AND DEVELOP A BASIS FOR QUALITY ASSURANCE AND QUALITY CONTROL AT THE NATIONAL NUCLEAR POWER PLANTS.

Under this project non-destructive testing (NDT) activities were amplified to include the organization and operation of a national NDT centre, training there in basic NDT techniques, and direct service to industry and the nuclear power plant programme. Training of local staff was initiated and expertise in certification of NDT personnel was transferred. The Agency provided expert services on quality assurance, eddy current, radiography and ultrasonic testing as well as radiographic equipment and standard reference blocks for the NDT personnel. A national committee for NDT and a national certification body were established; an NDT framework and capabilities for the certification of NDT personnel were developed. Systematic training is being continued under a related UNDP project.

UGANDA

UGA/6/006 NUCLEAR MEDICINE

COMPLETED: **92-12-16** TOTAL COST: **$45,914**

TO REHABILITATE THE JOINT MEDICAL RADIOISOTOPE LABORATORY OF THE MULAGO HOSPITAL AND THE MEDICAL SCHOOL OF MAKERERE UNIVERSITY.

This project, initiated in 1988, aimed at upgrading the very rudimentary radioimmunoassay (RIA) facilities available at the Makerere Hospital Medical School, Kampala, which is the only such centre in Uganda. Equipment, including a modern gamma counter with computer, centrifuge, etc., was provided during the first two years, supplemented by regular supplies of reagents, obtained in bulk from the United Kingdom. An expert mission was undertaken to install the new equipment and introduce the RIA techniques. The assay methods established were mainly for thyroid-related hormones; all equipment was safely installed and continues to work satisfactorily. The objectives of the project have been met in that the RIA laboratory is now well equipped and able to carry out RIA for thyroid-related hormones. The laboratory was considered suitable for inclusion in the Regional African project RAF/6/006, in operation since 1991, from which it will receive further inputs.

URUGUAY

URU/6/016 USE OF COMPUTERS IN NUCLEAR MEDICINE

COMPLETED: **92-12-18** TOTAL COST: **$74,869**

TO MANAGE INFORMATION FROM PATIENT CARE IN NUCLEAR MEDICAL DIAGNOSTIC SERVICES.

This project, proposed as a follow-up of activities supported by the Agency since 1978, was made possible by contributions from the USA. The aim of the project was to introduce a computer-based system for the management of diagnostic test data for the Nuclear Medicine Centre at the Clinical Hospital, Montevideo. All necessary equipment for automated handling of information on patient care was provided under the project, while expert advice on setting up the system was given through a nuclear medicine project which ran parallel and was completed in 1990. The automated data processing system installed under the project for patient information and for research data is facilitating the daily work at the Centre in dealing with the demand of about 70% of the country's requirements for nuclear medicine services.

VENEZUELA

VEN/2/006 X-RAY FLUORESCENCE LABORATORY

COMPLETED: **92-09-09** TOTAL COST: **$132,888**

TO INSTALL AN X-RAY FLUORESCENCE LABORATORY TO COMPLEMENT EXISTING ANALYTICAL FACILITIES.

The Faculty of Science of the Simon Bolivar University, Caracas, required versatile nuclear analytical techniques that could be used in academic training at the University as well as for routine analyses of samples obtained from the national economy. Within three years the project has achieved most of its objectives, and the following techniques have been introduced: radioisotope-excited X-ray fluorescence analysis; tube-excited analysis with secondary targets; and a total X-ray reflection analytical system. Major items of equipment provided under the project include an X-ray tube excitation system and a Si(Li) detector. With the assistance of three experts, the counterparts have mastered these methods of advanced X-ray analysis, and are now capable of analysing any sample for elements of atomic number above 15. The counterparts were thoroughly trained in the application of quantitative X-ray analysis software and are able to use and if necessary to modify the computer programmes designed by the Agency. The X-ray analysis methods are being used continuously in the Faculty of Science for training chemists and physicists, and some specific topics have been developed as thesis subjects. The project's only deficiency is that the potential for application of these techniques in the national economy has not been fully achieved. Some analyses have been performed for outside customers in exceptional cases only.

VEN/3/005 NUCLEAR TECHNIQUES IN MINERAL EXPLORATION

COMPLETED: **92-12-30** TOTAL COST: **$43,551**

TO ORGANIZE A NATIONAL TRAINING COURSE ON THE UTILIZATION OF NUCLEAR AND NUCLEAR-RELATED ANALYTICAL TECHNIQUES IN EXPLORATION FOR MINERAL RESOURCES.

The project, approved in 1991, was intended to evaluate the potential application in Venezuela of nuclear techniques in mineral exploration and development by the Geology Directorate of the Ministry of Energy and Mines. While nuclear techniques have been routinely used in the principal chemical and petrological/mineralogical laboratories of this directorate, their application in field operation was almost non-existent. It was concluded that the best way to introduce nuclear techniques of possible use in field operation was by means of a national training course. A three-weeks course was organized during the first half of 1992, attended by twelve participants from the Ministry of Energy and Mines, related organizations and the Central University of Venezuela. The course covered three main subjects: field gamma-ray spectrometry, nuclear borehole logging, and the use of field X-ray fluorescence instruments for in-situ analysis. Expert services in nuclear instrumentation were also available. A portable gamma-ray spectrometer complete with accessories for downhole logging was purchased under the project. The usefulness of these techniques in gold and phosphate exploration was demonstrated in the field. The project has demonstrated the value of nuclear techniques in the exploration of mineral reserves; as a result, a systematic car-borne gamma-ray spectrometric survey to explore the phosphate resources potential of western Venezuela is planned to start in 1993 (Project VEN/3/006). Interest has also been shown in using the car-borne system to establish natural background radioactivity and for environmental monitoring.

VEN/5/009 CENTRE FOR NUCLEAR AGRICULTURE (CINAGRI)

COMPLETED: **92-09-15** TOTAL COST: **$677,969**

TO ESTABLISH NUCLEAR AND BIOTECHNOLOGY TECHNIQUES AND PRACTICES IN ORDER TO INCREASE AGRICULTURE AND LIVESTOCK PRODUCTIVITY AND TO TRANSFER THIS TECHNOLOGY TO FARMERS.

This is an integral part of Project VEN/5/011, with the same objectives, which were to be achieved by means of the establishment of a Centre for Nuclear Agriculture in Maracay. The project was created as a multi-disciplinary programme in 1984, funded by the UNDP (1987-91) and the Agency (1984-91) with a Government counterpart contribution in cash from Venezuela. Implementation of the project was hampered by its very complexity. Activities in the three areas of soil science, plant mutation breeding and livestock productivity were carried out at five institutions in three cities: the National Fund for Agricultural and Livestock Research (FONAIAP) and the Central University of Venezuela's Faculty of Agronomy and Faculty of Veterinary Sciences in Maracay, the University of Zulia's Faculty of Agronomy in Maracaibo and the Universidad Centro Occidental in Barquisimeto. Co-ordination of activities also involved the Ministry of Energy and Mines Division of Nuclear Affairs and the UNDP, as well as the Agency. Numerous visits had to be made by experts and Agency staff members (under Project VEN/5/011). The Centre for Nuclear

Agriculture was never established, but an analytical laboratory was set up at FONAIAP in Maracay for the analysis of soil samples by N-15 techniques. Intensive training activities were supported by VEN/5/011. Eighteen fellowships, two of which were project-related, and two scientific visits were provided under this project. Acknowledgement of the project's three separate areas, no longer considered on a multi-disciplinary basis, contributed towards a thrust of activities in 1989 and 1990. Expert services provided under both projects (48 months) as well as laboratory equipment and supplies helped to introduce nuclear techniques at institutions working in the three areas of the project. Although some significant results were obtained in each area (some new sesame varieties and leguminous plants obtained by mutation breeding; improvement of fertilizer management and nitrogen fixation in soils; studies in the reproducibility of cattle and sheep), the major achievement of this project lay in a transfer of specialized knowledge which will only be fully utilized under national follow-up activities in the three areas.

VIET NAM

VIE/0/002 NUCLEAR INSTITUTE DEVELOPMENT

COMPLETED: **92-12-30** TOTAL COST: **$927,778**

TO ASSIST AND UPGRADE THE DALAT NUCLEAR RESEARCH INSTITUTE.

This multi-year, multi-disciplinary project was approved following the recommendations of an Agency advisory mission fielded in 1982, to establish a range of services and infrastructure appropriate for a research reactor institute. Eleven missions were undertaken by thirteen experts, three of them Agency staff members, for a total of nearly ten months. One of the first missions, conducted by an Agency staff member in June 1983, advised the Government on the organization of radiation protection and environmental monitoring on a nationwide scale. A second mission, by two Agency experts, reviewed the safety and radiation protection of the TRIGA reactor immediately after it was handed over for operation in Viet Nam. An isotope production facility and iodine-131 production lines were supplied for production of radioisotopes and labelled compounds, and installation was completed in 1987. To facilitate the production of technetium-99m labelled kits, special hot cell equipment was provided and the facility was made operational in 1991. Production at the two facilities is now serving the needs of Vietnamese hospitals. Nuclear analytical techniques established include instrumental neutron activation analysis (NAA) and X-ray fluorescence. A small gamma-ray irradiator provided under the project has facilitated pilot scale studies on irradiation of medical products and agricultural produce (e.g. potatoes and onions), as well as pilot scale radiation chemistry studies, including cross-linking of polyethylene, vulcanization of natural rubber latex and fabrication of wood polymer composites. With the assistance of an expert mission, the use of personal computers for control and data processing in nuclear experiments was established. Fellowship training was awarded to 23 staff members of the Dalat Nuclear Research Institute and one staff member benefitted from a scientific visit. The project has helped establish a thermoluminescence dosimetry-based personnel dosimetry service and an environmental monitoring programme at the Institute. NAA is being used for analysing up to 3000 ore samples, and X-ray fluorescence for up to 5000 biological, pharmaceutical and crude oil samples per year. Over 600 Ci of phosphorus-32, technetium-99m, chromium-51 and iodine-131 have been produced so far. Approximately 1000 technetium-99m labelled kits are being produced annually

at the facility installed in 1991. The project has thus considerably improved the scientific and technical profile of Viet Nam in the nuclear field.

VIE/0/005 NUCLEAR INFORMATION CENTRE

COMPLETED: **92-12-30** TOTAL COST: **$21,788**

TO ESTABLISH A CENTRE FOR DISSEMINATION OF SCIENTIFIC INFORMATION AND DEVELOPMENTS IN NUCLEAR TECHNOLOGY IN HANOI.

The project was approved with footnote-a status in 1989 and upgraded with Agency funding in 1990 to help establish an information centre at Hanoi capable of using personal computers for the organization, management and retrieval of scientific information, particularly from INIS. The Agency provided a personal computer (with printer) and a CD-ROM player with the software to retrieve information from INIS compact disks. A complete set of INIS archival discs with one year update subscription was also provided to facilitate the introduction of information services to end-users in Viet Nam. The information centre is expected to renew the subscription in subsequent years from the national budget. A counterpart staff member attended the regular INIS Training Seminar, followed by on-the-job training on the use of personal computers for information retrieval. An Agency expert conducted a mission to install the personal computer and a CD-ROM drive for retrieval of information from the INIS database on CD-ROM. The counterpart staff received training to exploit the CD-ROM database for information services to the end-users. The project was implemented in close collaboration with the National INIS Centre at Ho Chi Minh City. As a result of the project, the information support to the programme of the Viet Nam National Atomic Energy Commission has been strengthened.

VIE/5/011 ISOTOPE TECHNIQUES IN SOIL PLANT STUDIES

COMPLETED: **92-12-30** TOTAL COST: **$290,288**

TO ESTABLISH A FACILITY FOR THE USE OF ISOTOPE AND RADIATION TECHNIQUES IN SOIL/PLANT STUDIES AND TO INITIATE A COLLABORATIVE RESEARCH PROGRAMME AIMED AT IMPROVING SOIL MANAGEMENT PRACTICES TO INCREASE PRODUCTION OF CERTAIN FOODS, PARTICULARLY RICE.

The main object of this project was to establish a laboratory for isotope and related nuclear studies at the Centre for Nuclear Techniques, Ho Chi Minh City, for the improvement of agriculture in Viet Nam. Major items of equipment provided by the Agency were an emission spectrometer for N-15 analysis, a liquid scintillation counter and a UV-VIS spectrometer. N-15 and P-32 labelled fertilizers were also supplied for field experiments. Two scientists received fellowship training. Three experts provided assistance in the design and initiation of field experiments on nitrogen and phosphorus use efficiency for rice, using N-15 and P-32, and in the analysis and interpretation of data. A national workshop was organized, with the assistance of one of the experts, to train local scientists in the use and handling of isotopes in agricultural research. Field experiments conducted with N-15 showed that optimum rice yields could be achieved by the use of 100-120 kg N/ha given in a 3-split application. These data are of great value in developing management practices for the rational use of nitrogen fertilizer in rice production and in reducing the cost of inputs. Comparison of seven different rock phosphates

demonstrated that the local phosphate rock is not a very efficient source of phosphorus for rice. As a result of the project, encouraging results have been achieved in research, and local infrastructure for isotope aided research in agriculture has been developed. Further studies are continuing.

VIE/6/015 NUCLEAR MEDICINE (LAM DONG HOSPITAL)

COMPLETED: **92-12-30** TOTAL COST: **$58,342**

TO ESTABLISH A NUCLEAR MEDICINE LABORATORY FOR THE DIAGNOSIS AND STUDY OF DISEASES OF THE THYROID, LIVER, BLOOD, URINARY AND NERVOUS SYSTEMS.

This project, based at the Lam Dong Provincial Hospital, located near the Dalat Nuclear Research Centre, was approved in 1988 to establish both in-vitro radioimmunoassay (RIA) and in-vivo nuclear medicine services at the hospital. Equipment, including an automatic gamma counter, a centrifuge, a balance and a pH meter, was provided in the early stages of project implementation in order to initiate RIA work. A personal computer back-up manual counter and water de-ionizing equipment were provided later. A dual channel renography and thyroid uptake system for in-vivo work together with an isotope calibrator with a radioactive check device and a surface contamination monitor were also supplied. An Agency expert conducted a mission to facilitate the introduction of basic in-vivo and in-vitro nuclear medicine techniques. Long-term fellowship training for the project counterpart was arranged in conjunction with participation in an Agency training course on nuclear medicine. The project has helped establish wide ranging basic nuclear medicine services.

VIE/8/005 NON-DESTRUCTIVE TESTING

COMPLETED: **92-12-30** TOTAL COST: **$168,228**

TO ESTABLISH NUCLEAR NON-DESTRUCTIVE TESTING FOR INDUSTRY, PARTICULARLY SHIPBUILDING AND MACHINE INDUSTRIES.

The project, approved with footnote-a status in 1984, was upgraded in 1985 to establish facilities for the use of radiography-based non-destructive testing (NDT) methods in quality control of welds and castings in high pressure boilers, oil pipelines, and in testing industrial machinery. Equipment was provided under the project for gamma-radiography, X-radiography, ultrasonic flaw detection, and processing exposed X-ray films in the darkroom. Two expert missions were fielded for a total duration of three months; the first helped the counterpart to set up a radiography laboratory, while the second conducted counterpart training in establishing quality control procedures for industrial products. Although only one project staff member was trained under the Agency fellowship programme, five participated in regional training courses organized in RCA Member States under an IAEA/RCA/UNDP industrial project. Two Agency experts, provided under an RCA project, conducted national training courses in ultrasonic testing and radiography (level 2), and consequently almost all project staff are now qualified NDT personnel. A national training course on ultrasonic testing (level 1), three short national training courses on NDT, and an NDT workshop on non-metallic materials were organized through local efforts. The project has been highly successful in introducing radiography and ultrasonic methods to industry in South Viet Nam. About 1000 requests for quality control of industrial products, in particular high

pressure equipment, were handled by the counterpart institute during the last three years. Several institutions and factories have established their own NDT laboratories with the help of the counterpart institute. The activities will be expanded to cover non-metallic materials under Project VIE/8/009, approved for the 1993-94 Programme.

VIE/8/006 NON-DESTRUCTIVE TESTING

COMPLETED: **92-12-30** TOTAL COST: **$109,993**

TO ESTABLISH CAPABILITY FOR NON-DESTRUCTIVE TESTING.

This multi-year project was made operational in 1989 to establish non-destructive testing (NDT) services at the Laboratory of Industrial Application of Nuclear Techniques, Hanoi. The equipment provided included complete units for industrial X-radiography, gamma-radiography and eddy current testing, supplemented by provision of a laboratory to process X-ray films. Two Agency experts, one under this project and the other under an RCA/UNDP industrial project, helped establish the laboratory facilities and conducted training courses in radiography (level 1) and ultrasonic testing (level 2). The laboratory facilities included the design and operation of a darkroom needed for loading and processing X-ray films. An industrial X-ray machine was installed and made operational. During a field visit to a paper factory, the Agency expert gave advice on the inspection methodology to be used for welded joints. As a result of the project, the counterpart institute is already providing inspection services to industries in North Viet Nam.

YUGOSLAVIA

YUG/9/024 DEVELOPMENT OF DOSIMETRY TECHNIQUES

COMPLETED: **92-09-08** TOTAL COST: **$38,402**

TO INSTALL NEW TECHNIQUES FOR MEASURING DOSE EQUIVALENCE IN MIXED RADIATION FIELDS.

The radiation and Environmental Protection Laboratory of the Boris Kidric Institute of Nuclear Science, Vinca, is a member of an IAEA/WHO secondary standards dosimetry laboratory network. A dosimetry laboratory of the Institute has been operational for many years and deals mainly with calibration on the radiation protection level. Under this project, initiated in 1989, the Agency has assisted the laboratory to improve the quality of measurements and to develop operational techniques for measuring dose equivalent and mean quality factors. A small laboratory for calibration of radiation protection instrumentation was successfully set up, which will contribute significantly to the safe application of ionizing radiation.

ZAIRE

ZAI/3/002 URANIUM EXPLORATION

COMPLETED: **92-07-13** TOTAL COST: **$99,634**

TO STRENGTHEN THE CHEMICAL LABORATORY'S CAPABILITY THROUGH THE PROVISION OF FLUORIMETRIC EQUIPMENT; TO SET UP A DATABASE IN SUPPORT OF RADIOACTIVE MINERALS EXPLOITATION.

The dual objectives of this project, which was initiated in 1988, have been attained through the supply of equipment and the provision of expert services. A fluorimeter and accessories were supplied by the Agency. An expert, through a six-week mission, assisting in setting up a fluorimetric laboratory for geochemical analysis and trained the staff of the Regional Centre for Nuclear Research, Kinshasa, in the rapid fluorimetric method of uranium analysis in heavy minerals, rock and water samples, and stream sediments. To organize and process the geological and geochemical data related to uranium exploration, the project provided the Centre's chemical laboratory with a PC-AT computer, printer, plotter, digitizer and various software packages. Another expert assisted the local staff, also through a six-week mission, to use the computer system for setting up an appropriate database. The local staff should now be capable of undertaking fluorimetric analysis of geological and geochemical samples and processing the relevant data without further assistance.

ZAI/6/004 RADIOPHARMACEUTICALS

COMPLETED: **92-11-03** TOTAL COST: **$107,348**

TO TRAIN STAFF IN THE PREPARATION OF TC-99M GENERATORS USING THE REACTOR FACILITY TO BUILD UP A CAPABILITY FOR THE ENVISAGED RADIOISOTOPE PRODUCTION.

Under this project, the Regional Nuclear Research Centre, Kinshasa, received assistance in setting up facilities for the preparation of Tc-99m pertechnetate and other Tc-99m radiopharmaceuticals and their in-vivo kits. The main equipment and material provided by the Agency included complete in-cell equipment for solvent extraction separation of fine pertechnetate from irradiated molybdenum dioxide, a freeze-drying unit (lyophilizer) for kit preparation, a pyrogen test telethermometer assembly, as well as chemicals and reagents for sterility testing and kit preparation. Three expert missions for a total of about two months helped in the commissioning of the solvent extraction set-up for Tc-99m and in training the Centre's staff in the preparation of pharmaceutical grade Tc-99m. Four staff members received training abroad for a total of about eight months. As a result of the project, Zaire is now capable of producing pharmaceutical grade Tc-99m and some of its labelled compounds.

ZAI/9/004 RESEARCH REACTOR SAFETY

COMPLETED: **92-05-14** TOTAL COST: **$223,140**

TO IMPROVE THE SAFETY SYSTEM AND OPERATIONAL RELIABILITY OF THE TRIGA MARK II RESEARCH REACTOR.

The Regional Centre for Nuclear Research, Kinshasa (CREN-K), operates a TRIGA Mark II reactor, which became critical in 1972 with a maximum steady state power level of 1 MW. The Agency carried out three expert missions. Following certain suggestions about emergency planning, the first mission recommended an underwater optical inspection of the tank. The subsequent mission by four experts revealed some very serious corrosion attacks on the tank bottom. The reactor was dismantled, repaired, reassembled and made operational again in 1989. The third expert mission dealt essentially with the installation of a pneumatic transfer system. Under this project, five staff members were trained for a total of over 13 months on subjects related to the safe operation of the reactor. Various items of equipment required for radiation protection, nuclear safety and fuel handling were supplied by the Agency. The operational safety of the reactor has been improved as a result of the project.

IMPLEMENTATION SUMMARY I

ALL FUNDS*

Description	Adjusted Programme	Share of Total Programme	New Obligations	Imple-mentation Rate	Earmarkings
	($)	(%)	($)	(%)	($)
Current year					
Area breakdown					
Africa	15,448,450	26.0%	8,698,432	56.3%	6,750,018
Asia & Pacific	15,253,267	25.7%	9,337,140	61.3%	5,916,127
Latin America	12,667,205	21.4%	8,337,432	65.9%	4,329,773
Middle East & Europe	12,063,011	20.3%	5,736,914	47.6%	6,326,097
Interregional	3,121,952	5.3%	2,477,641	79.4%	644,311
Global	783,366	1.3%	606,761	77.5%	176,605
Total	59,337,251	100.0%	35,194,320	59.3%	24,142,931
Component breakdown					
Experts	16,117,379	27.2%	9,020,840	55.9%	7,096,539
Equipment	22,352,015	37.7%	14,070,558	63.0%	8,281,457
Fellowships	12,061,650	20.3%	5,989,947	49.8%	6,071,703
Training Courses	6,813,754	11.5%	5,032,900	73.9%	1,780,854
Sub-contracts	1,163,227	1.9%	453,834	39.0%	709,393
Miscellaneous	829,226	1.4%	626,241	75.6%	202,985
Total	59,337,251	100.0%	35,194,320	59.3%	24,142,931
Fund breakdown					
TACF	47,522,529	80.1%	29,393,068	61.9%	18,129,461
UNDP	1,270,164	2.1%	620,102	48.8%	650,062
Extrabudgetary	9,386,805	15.8%	4,281,859	45.6%	5,104,946
Funds-In-Trust	1,157,753	2.0%	899,291	77.7%	258,462
Total	59,337,251	100.0%	35,194,320	59.3%	24,142,931
Current and future years					
Current	59,337,251	78.2%	35,194,320	59.3%	24,142,931
Future	16,570,687	21.8%	154,272	0.9%	16,416,415
GRAND TOTAL	75,907,938	100.0%	35,348,592		40,559,346

* As at 31 December 1992

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	12,752,296	26.8%	7,439,326	58.3%	5,312,970
Asia & Pacific	12,133,654	25.5%	7,701,764	63.5%	4,431,890
Latin America	9,527,496	20.1%	6,649,247	69.8%	2,878,249
Middle East & Europe	9,321,132	19.6%	4,607,047	49.4%	4,714,085
Interregional	3,004,586	6.3%	2,388,924	79.5%	615,662
Global	783,365	1.7%	606,760	77.5%	176,605
Total	47,522,529	100.0%	29,393,068	61.9%	18,129,461
Component breakdown					
Experts	12,707,062	26.7%	7,663,922	60.3%	5,043,140
Equipment	16,779,494	35.3%	10,784,797	64.3%	5,994,697
Fellowships	11,145,623	23.5%	5,639,863	50.6%	5,505,760
Training Courses	5,794,859	12.2%	4,565,509	78.8%	1,229,350
Sub-contracts	285,438	0.6%	119,804	42.0%	165,634
Miscellaneous	810,053	1.7%	619,173	76.4%	190,880
Total	47,522,529	100.0%	29,393,068	61.9%	18,129,461
Current and future years					
Current	47,522,529	74.1%	29,393,068	61.9%	18,129,461
Future	16,570,686	25.9%	154,272	0.9%	16,416,414
GRAND TOTAL	64,093,215	100.0%	29,547,340		34,545,875

* As at 31 December 1992

IMPLEMENTATION SUMMARY III

ALL FUNDS BY DEPARTMENT AND DIVISION*

Description	Adjusted Programme ($)	Share of Total Programme (%)	New Obligations ($)	Imple-mentation Rate (%)	Earmarkings ($)
Current year					
DEPARTMENT OF RESEARCH AND ISOTOPES					
Joint FAO/IAEA Division	9,909,413	16.7%	6,854,345	69.2%	3,055,068
Division of Life Sciences	6,502,705	11.0%	3,702,519	56.9%	2,800,186
Division of Physical and Chemical Sciences	15,737,100	26.5%	9,130,031	58.0%	6,607,069
The Agency's Laboratories	2,642,014	4.4%	1,716,218	65.0%	925,796
Laboratory of Marine Radioactivity, Monaco	465,988	0.8%	290,784	62.4%	175,204
Total	35,257,220	59.4%	21,693,897	61.5%	13,563,323
DEPARTMENT OF NUCLEAR ENERGY AND SAFETY					
Division of Nuclear Safety	9,895,584	16.7%	5,474,371	55.3%	4,421,213
Division of Nuclear Power	4,235,028	7.1%	2,274,750	54.0%	1,960,278
Division of Scientific and Technical Information	299,942	0.5%	161,731	53.9%	138,211
Division of Nuclear Fuel Cycle and Waste Management	3,322,842	5.6%	2,255,230	67.9%	1,067,612
Total	17,753,396	29.9%	10,166,082	57.3%	7,587,314
DEPARTMENT OF ADMINISTRATION					
Legal Division	3,611	0.0%	3,611	100.0%	0
DEPARTMENT OF SAFEGUARDS					
Division of Operations A	36,386	0.1%	31,653	87.0%	4,733
DEPARTMENT OF TECHNICAL CO-OPERATION					
Evaluation Section	15,609	0.0%	12,109	77.6%	3,500
Programme Co-ordination Section	271,507	0.5%	93,081	34.3%	178,426
Division of Technical Co-operation Programmes	105,458	0.2%	102,978	97.6%	2,480
Total	392,574	0.7%	208,168	53.0%	184,406
GLOBAL (not distributed by Department)	5,894,064	9.9%	3,090,909	52.4%	2,803,155
GRAND TOTAL	59,337,251	100.0%	35,194,320	59.3%	24,142,931

* As at 31 December 1992

Explanatory Notes to Figures

Figure 1. Resources available for Agency technical co-operation programmes: 1986-1992

This figure shows all resources made available to the Agency for technical co-operation activities from all funds for the programme years 1986-1992. 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 1986-1992 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: 1992

This figure shows, by component and by Agency programme, the distribution of all assistance provided in 1992, 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 and their costs are accounted for accordingly.

Figure 3. Disbursements by programme component: 1983-1992

The total assistance provided during the ten year period 1983-1992 ($400,134,700) 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: 1992

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: 1992

Total disbursements for equipment, grouped by origin and recipient regions, are shown in this figure; individual recipient countries are shown in Table 7. Table 3C lists the equipment by country of origin.

Figure 6. Summary data on training programmes: 1992

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: 1992

This figure, which refers only to the Technical Assistance and Co-operation Fund, gives total disbursements for 1992 broken down by region and for convertible and non-convertible currencies.

Figure 8. Technical assistance and co-operation disbursements by programme and region: 1992

At the top, the overall expenditures by Agency Programme are shown in a summary bar chart. The bar charts at the bottom illustrate the different emphasis to the various Agency Programmes in each region. (Please note that the scales are different for each region).

Figure 9. Distribution of technical co-operation disbursements by source and region: 1992

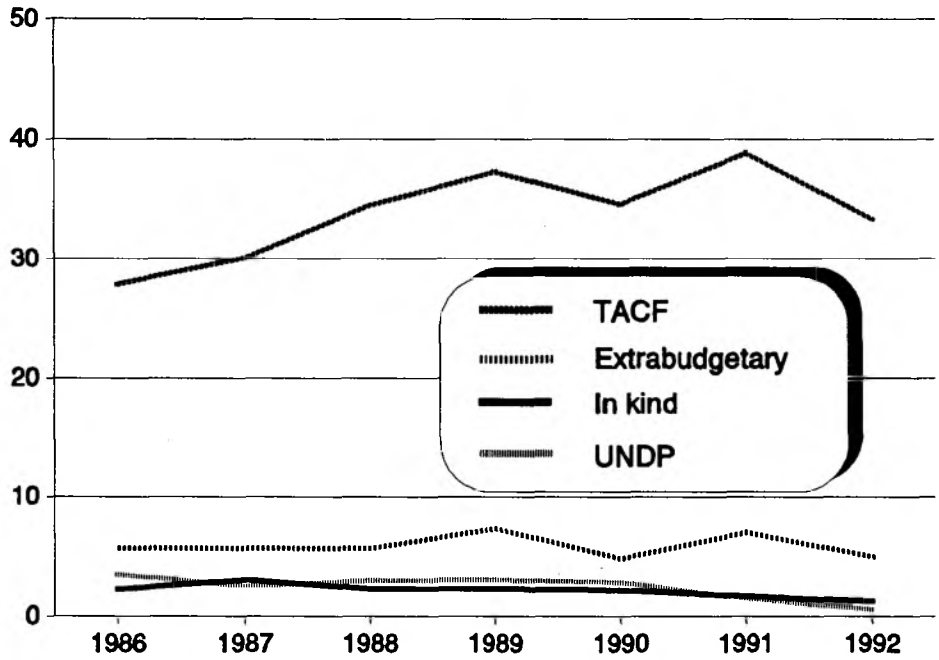
In this graphic presentation, disbursements from the Technical Assistance and Co-operation Fund, extrabudgetary funds, assistance in kind and from UNDP funds are shown for each region, as are total disbursements from all funds by region.

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 1992. 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



(millions of dollars)

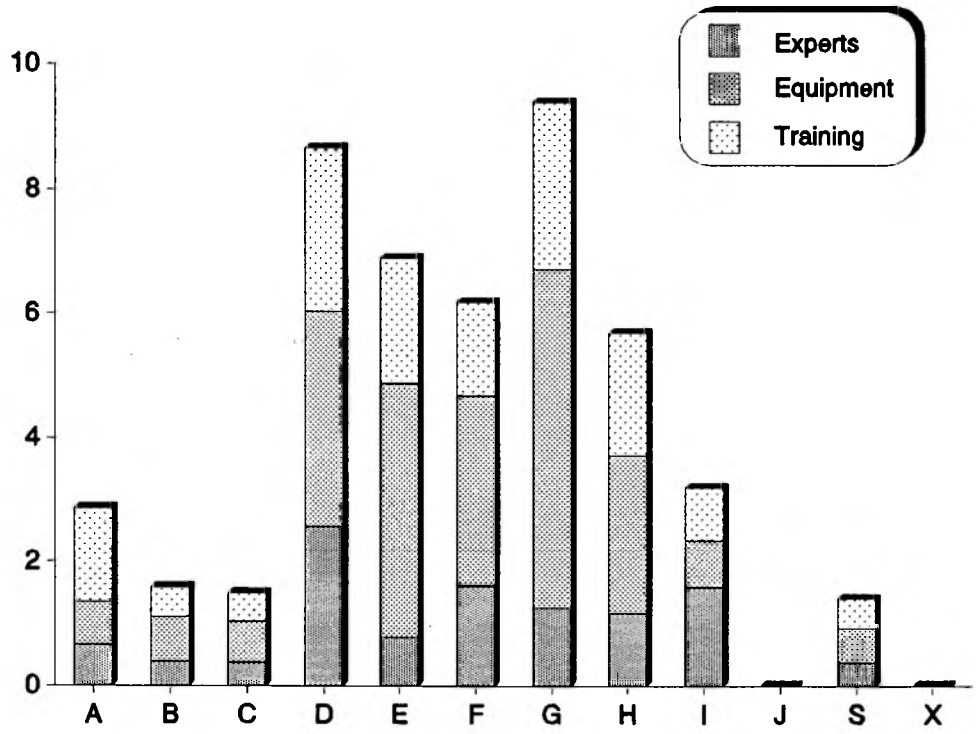
	1986	1987	1988	1989	1990	1991	1992
TACF	27,860	30,153	34,510	37,312	34,660	38,882	33,411
Extra-budgetary funds	5,702	5,700	5,710	7,375	4,820	7,018	4,975
Assistance in kind	2,282	3,066	2,322	2,295	2,214	1,702	1,302
UNDP	3,480	2,568	3,051	3,106	2,856	1,513	620
TOTAL	39,324	41,487	45,593	50,088	44,550	49,115	40,308

(thousands of dollars)

FIGURE 2

DISBURSEMENTS BY PROGRAMME: 1992

(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: 1983 - 1992

(in millions of dollars)

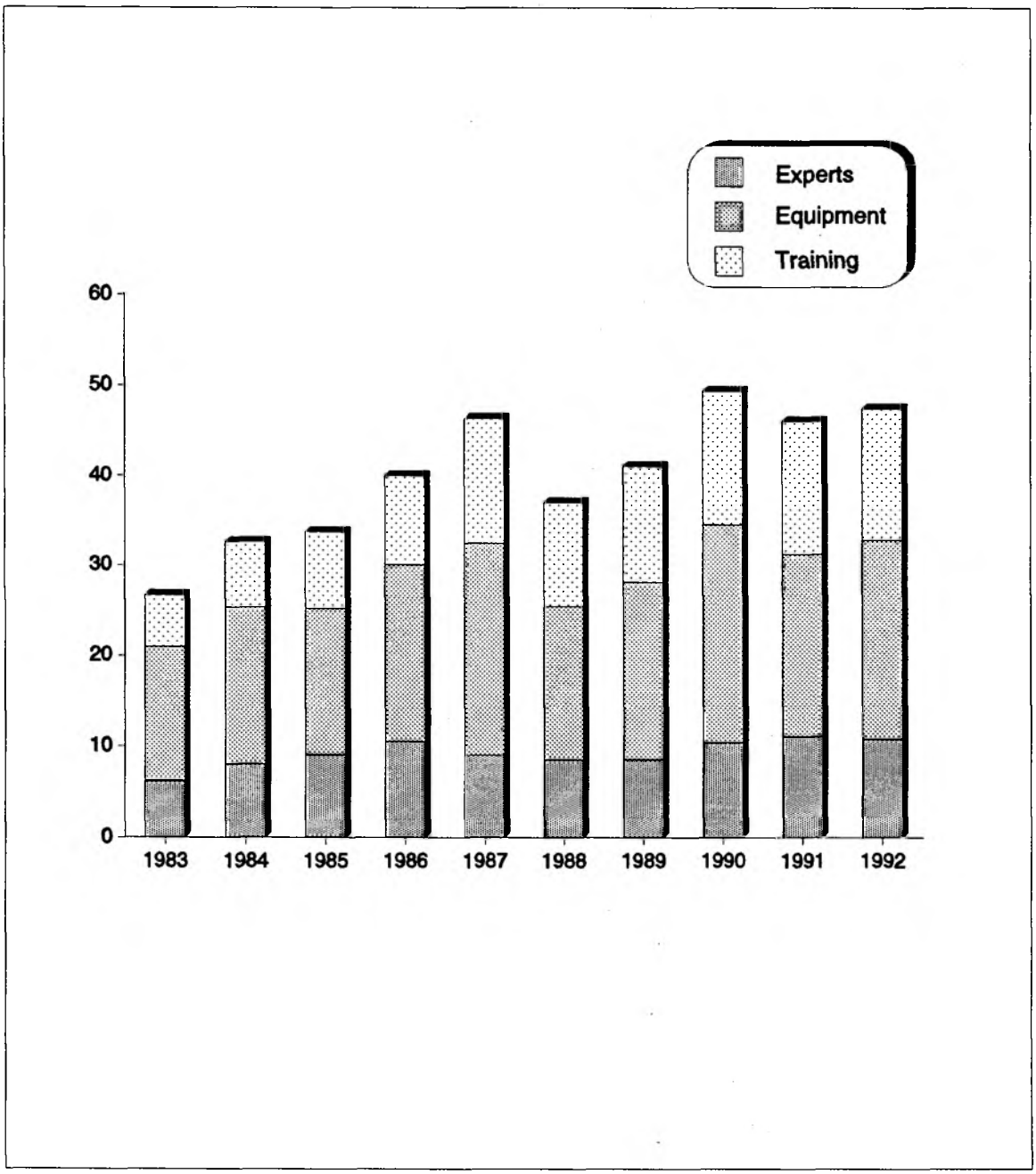


FIGURE 4

TECHNICAL CO-OPERATION PERSONNEL SERVICES BY REGION: 1992

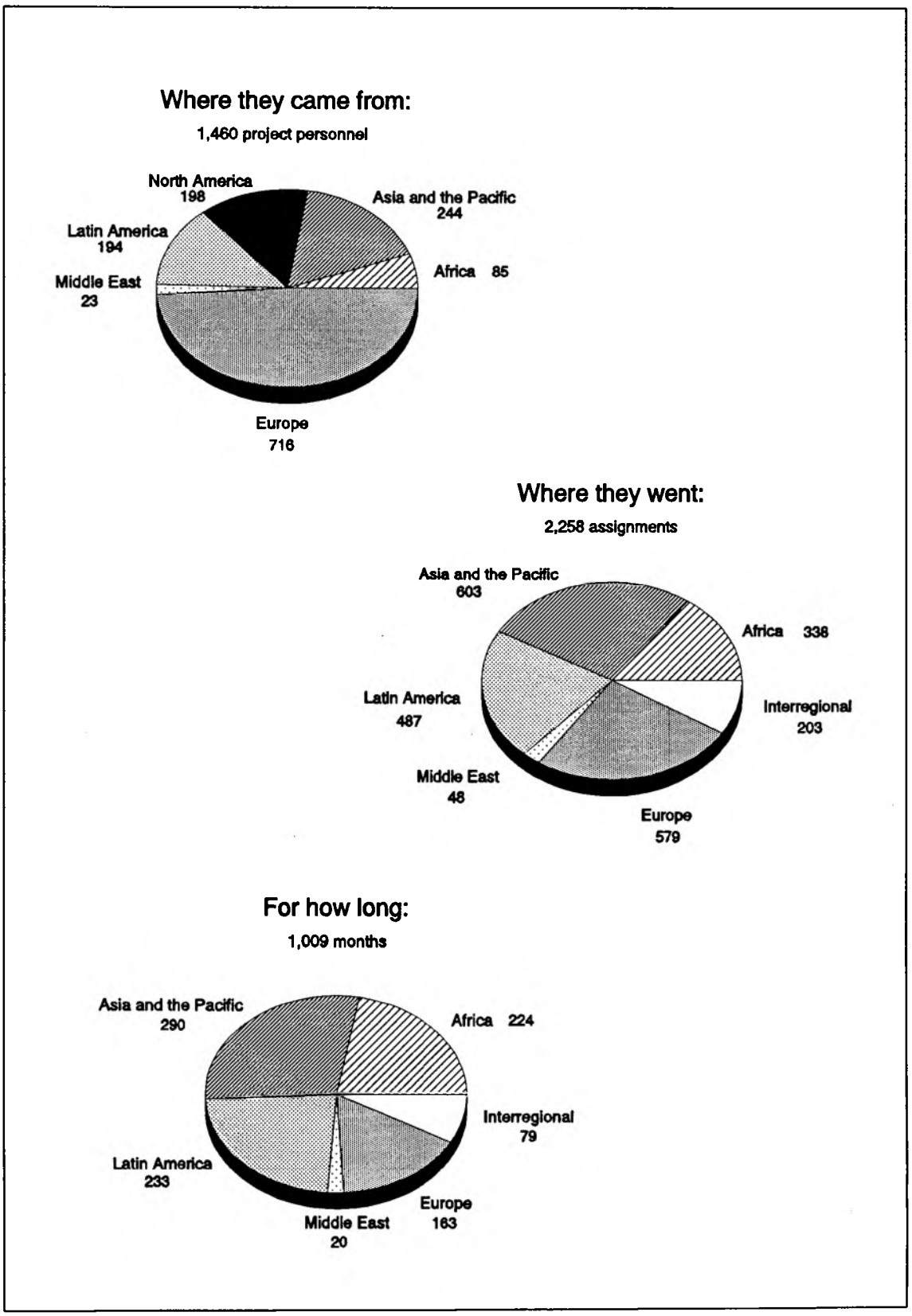


FIGURE 5

DISTRIBUTION OF EQUIPMENT DISBURSEMENTS BY REGION: 1992

(in thousands of dollars)

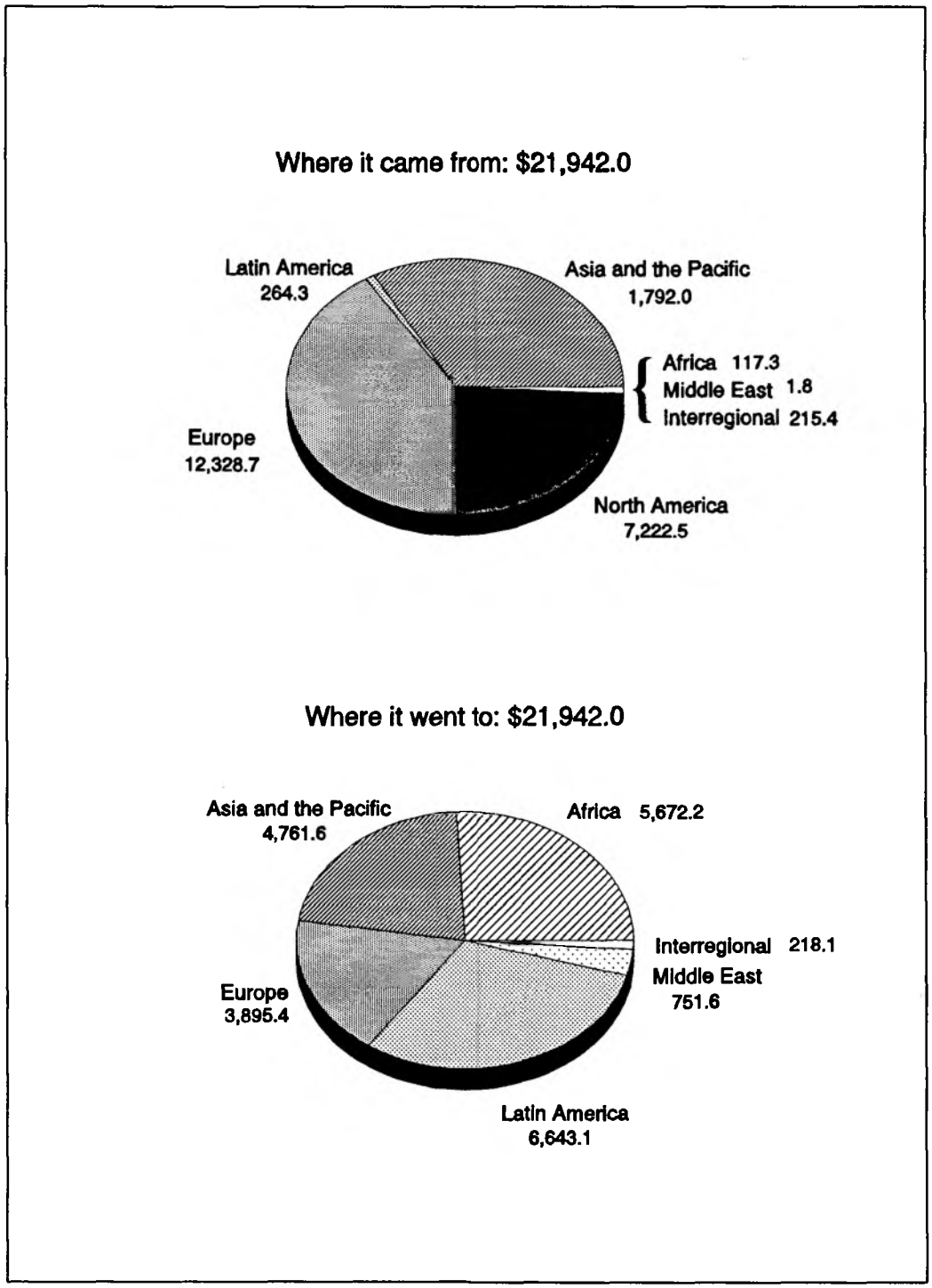


FIGURE 6

SUMMARY DATA ON TRAINING PROGRAMMES: 1992

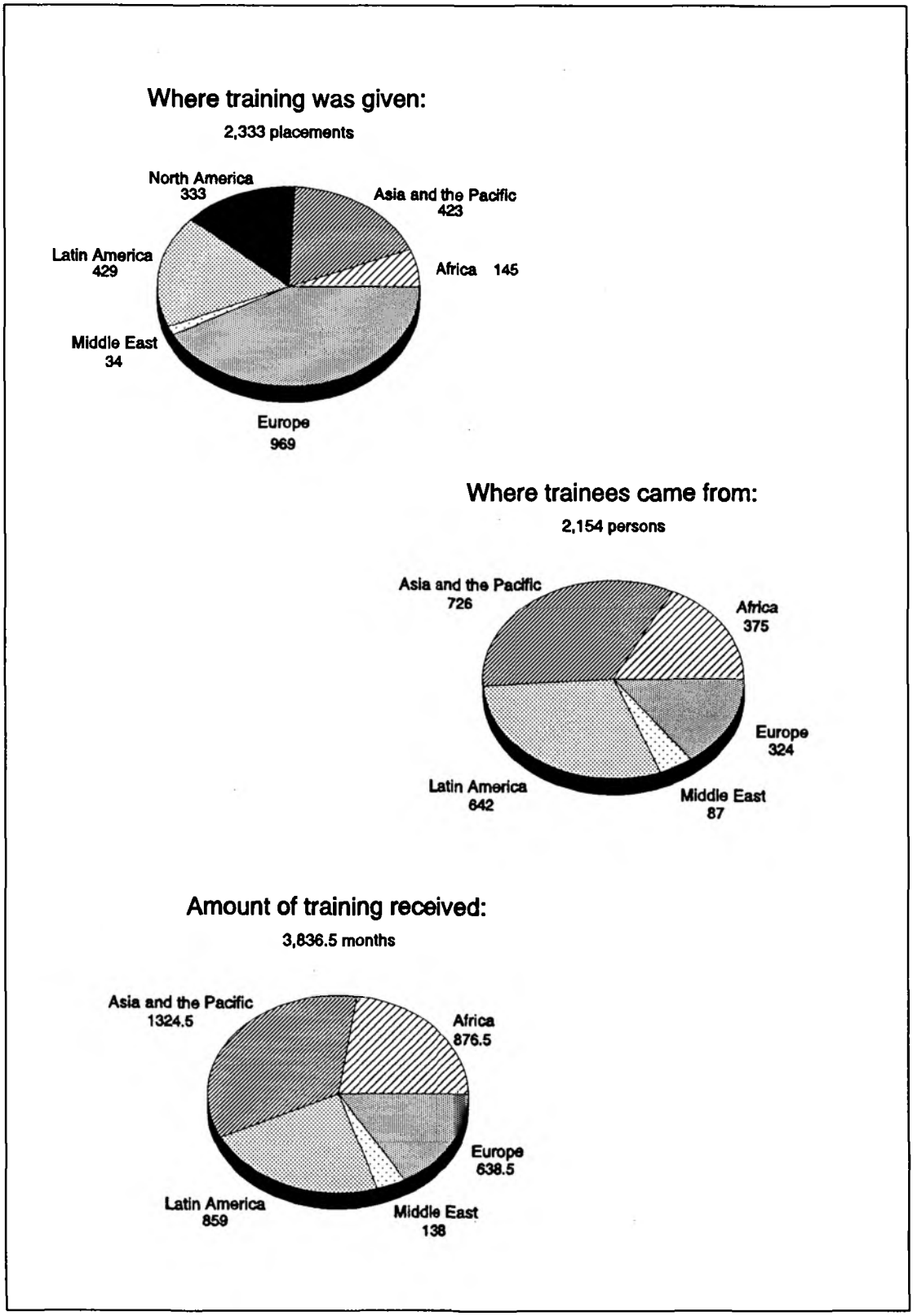


FIGURE 7

TECHNICAL ASSISTANCE AND CO-OPERATION FUND DISBURSEMENTS BY TYPE OF CURRENCY AND REGION: 1992

(in millions of dollars)

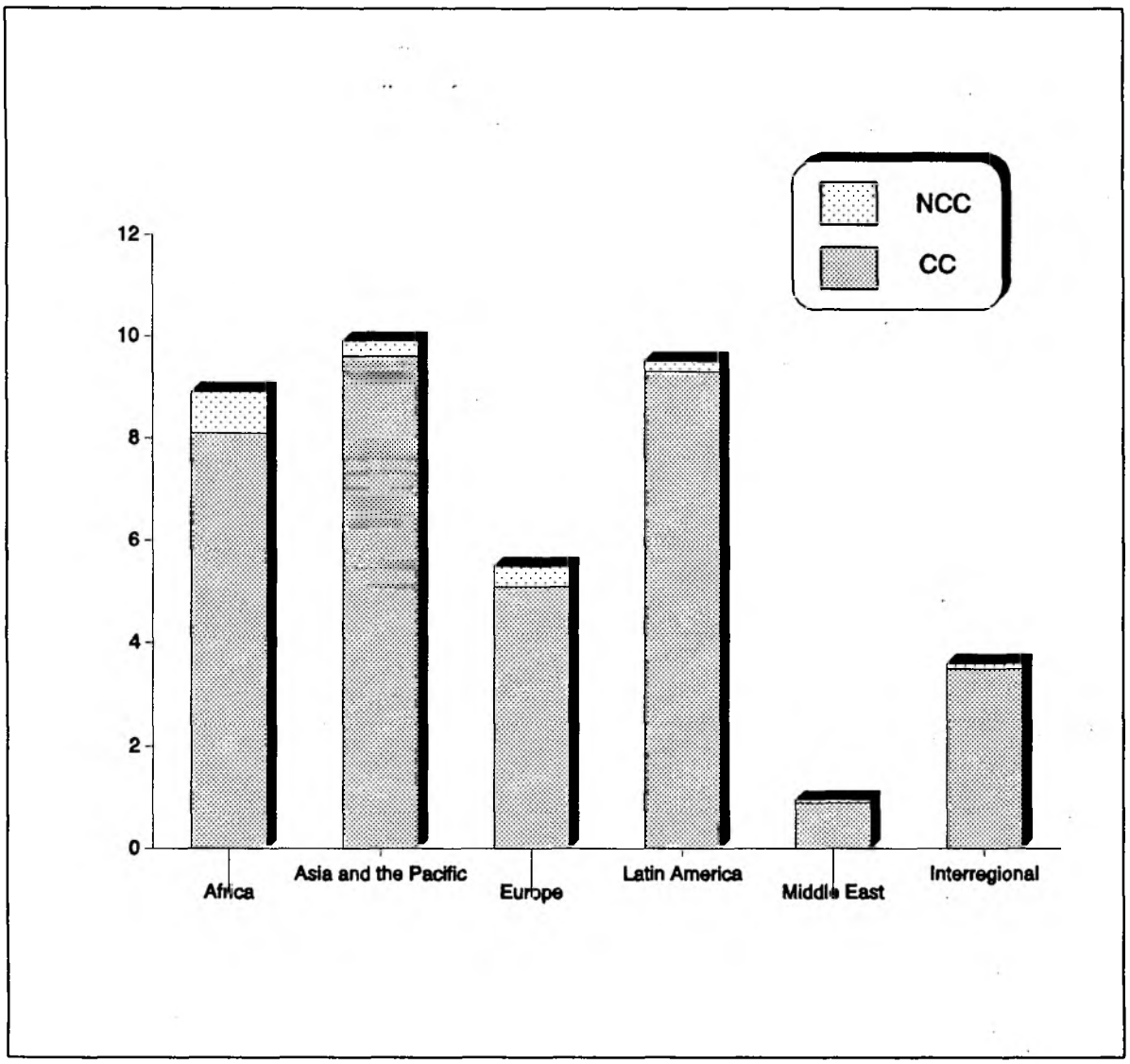


FIGURE 8

TECHNICAL ASSISTANCE AND CO-OPERATION DISBURSEMENTS BY PROGRAMME AND REGION: 1992

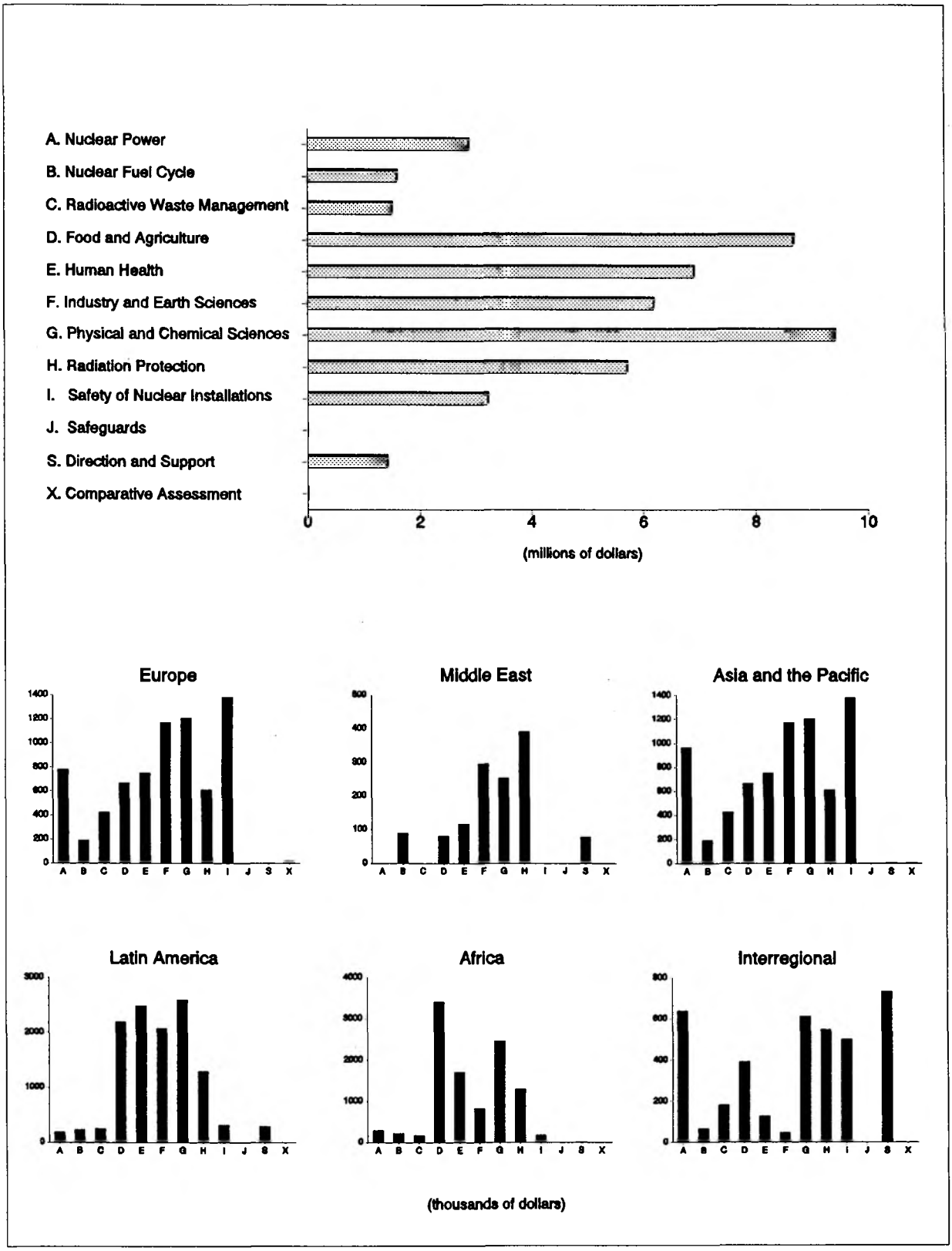


FIGURE 9

DISTRIBUTION OF TECHNICAL CO-OPERATION DISBURSEMENTS BY SOURCE AND REGION: 1992

(in thousands of dollars)

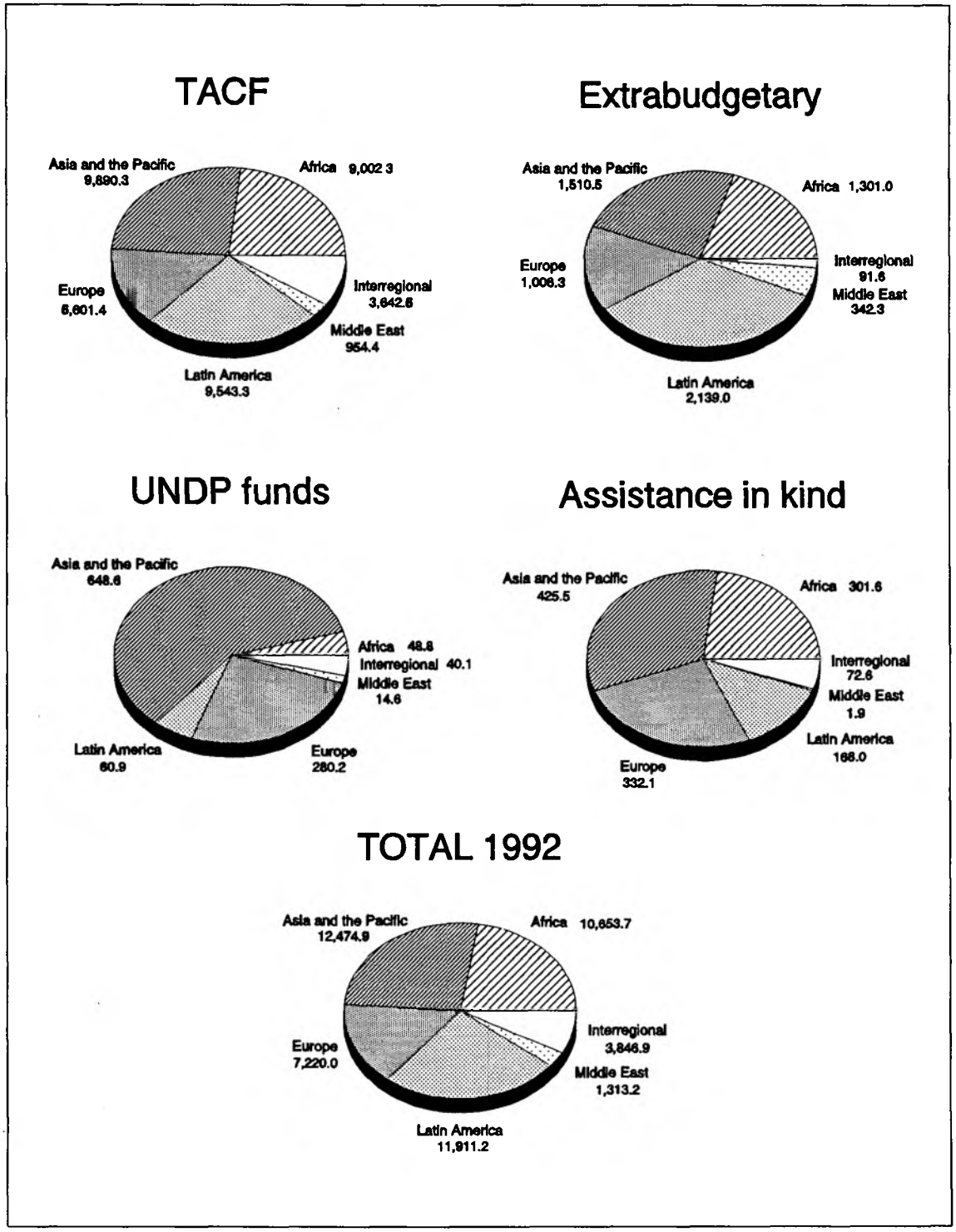
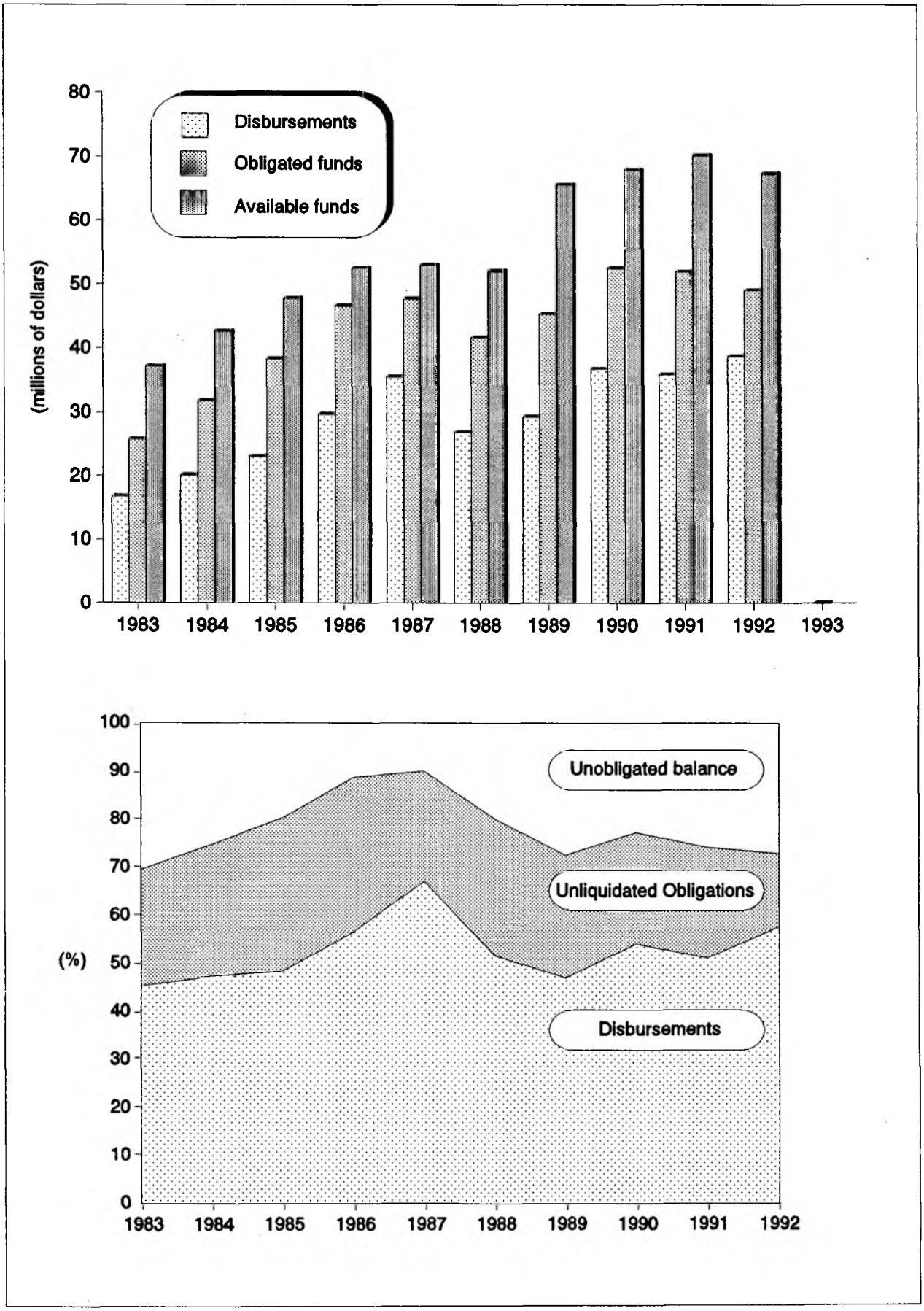


FIGURE 10

UTILIZATION OF THE TECHNICAL ASSISTANCE AND CO-OPERATION FUND

(status at year end)



Explanatory Notes to Tables

Table 1. Available resources: 1983-1992

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 1992, please see text section II.E.1.

Table 2. Technical Assistance and Co-operation Fund: 1983-1992

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 1992). 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. Therefore, new pledges or withdrawals against prior year targets are recorded against that year and the percentages for earlier years may change. The graphic presentation below 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: 1992

This table shows the number of individuals, both international and national, who undertook technical co-operation assignments during 1992. They came from 97 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: 1992

A breakdown is given for trainees (fellows, training course participants and visiting scientists) based on the place of study. There were 67 places of study involved.

Table 3C. Equipment by country of origin: 1992

This new table lists the total equipment purchases made by country of origin, which may differ from the country of where the vendor is located. Both disbursements and number of purchase orders placed are given. Disbursements can be made, for equipment ordered in previous years; likewise there may be purchase orders placed for equipment for which payments will be made in future years.

Table 4. Distribution of technical co-operation disbursements by type: 1988-1992

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 1992 for fellows who had already started their studies in 1992. "Miscellaneous" refers to disbursements in all components for telex charges, health insurance, copying fees and for other minor items or services. In 1992, it also included a charge for radiation protection services.

Table 5. Extrabudgetary funds for technical co-operation activities by donor as at 31 December 1992

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: 1992

A list is given of 76 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: 1992

The list shows the 89 recipient countries, number of trainees and the total months of training received in 1992.

Table 7. Financial Summary: 1992

This major table shows, by type of assistance and by source, the total technical assistance furnished to 80 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: 1958-1992

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 1991 and 1992.

TABLE 1

AVAILABLE RESOURCES: 1983-1992

(in thousands of dollars)

Year	Technical Assistance and Co-operation Fund				Other resources				Grand total (1+5)
	Voluntary contributions		Miscellaneous income	Sub-total	Extrabudgetary funds	Assistance in kind	UNDP	Sub-total	
	CC	NCC							
	(1a)	(1b)	(1c)	(1)	(2)	(3)	(4)	(5)	(6)
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
1992	36,549	1,067	(4,205)	33,411	4,975	1,302	620	6,897	40,308
1983-1992	255,183	46,289	1,941	303,458	60,849	22,186	26,095	109,130	412,588

TABLE 2

TECHNICAL ASSISTANCE AND CO-OPERATION FUND: 1983-1992

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
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	38,503,592	84.6	34,313,843	75.4
1991	49,000,000	37,816,993	77.2	38,255,458	78.1
1992	52,500,000	37,615,142	71.6	32,496,460	61.9

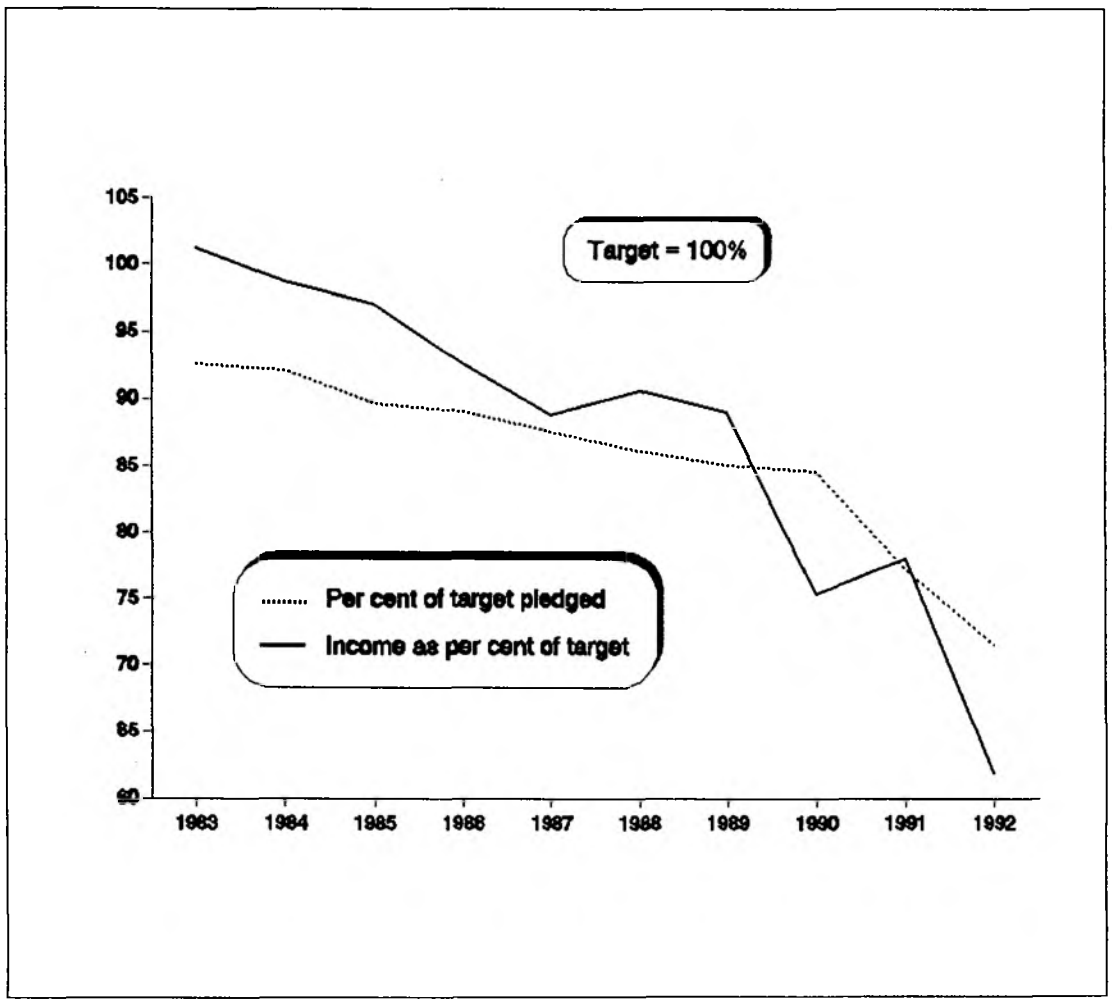


TABLE 3A

PROJECT PERSONNEL BY PLACE OF ORIGIN: 1992

Place of origin	Total individuals[a]	Assignments				
		International experts [b]	National experts	Lecturers[c]	Other project personnel	Total
Albania	4	0	5	0	0	5
Algeria	7	0	7	0	0	7
Argentina	37	42	6	24	0	72
Australia	29	41	0	7	0	48
Austria	33	51	0	11	2	64
Bangladesh	10	11	5	5	0	21
Belgium	19	29	0	4	0	33
Bolivia	7	5	8	6	0	19
Brazil	41	22	17	19	2	60
Bulgaria	26	3	32	2	0	37
Cameroon	1	0	1	0	0	1
Canada	53	50	0	17	0	67
Chile	18	20	5	5	0	30
China	25	15	14	5	0	34
Colombia	7	6	3	1	0	10
Costa Rica	4	1	3	0	0	4
Cote d'Ivoire	1	1	0	0	0	1
Croatia	6	16	2	2	0	20
Cuba	10	2	10	2	0	14
Cyprus	3	1	1	1	0	3
Czech & Slovak F.R.	36	7	47	3	0	57
Dem. P.R. Korea	1	0	1	0	0	1
Denmark	2	4	0	0	0	4
Dominican Republic	2	1	0	1	0	2
Ecuador	7	2	5	1	0	8
Egypt	6	2	4	2	0	8
Ethiopia	1	0	1	0	0	1
Finland	10	8	0	4	0	12
France	91	90	0	23	0	113
Germany	85	83	0	35	0	118
Ghana	5	10	2	0	0	12
Greece	5	4	2	2	0	8
Guatemala	2	1	2	0	0	3

Place of origin	Total individuals[a]	Assignments				
		International experts [b]	National experts	Lecturers[c]	Other project personnel	Total
Hungary	44	30	45	6	0	81
Iceland	2	3	0	0	0	3
India	40	47	8	10	0	65
Indonesia	15	2	11	4	0	17
Iran, Islamic Rep.	7	6	3	0	0	9
Iraq	1	1	0	0	0	1
Ireland	2	2	0	0	0	2
Israel	6	6	0	4	0	10
Italy	25	43	0	3	0	46
Jamaica	1	0	0	1	0	1
Japan	32	28	0	6	0	34
Jordan	3	0	4	0	0	4
Kenya	2	0	1	1	0	2
Korea, Rep. of	8	0	7	3	0	10
Libyan Arab J.	4	1	5	0	0	6
Madagascar	1	0	1	0	0	1
Malaysia	14	6	7	3	0	16
Mali	4	2	2	0	1	5
Mauritius	1	0	1	0	0	1
Mexico	23	18	7	10	0	35
Mongolia	2	0	2	0	0	2
Morocco	16	7	15	0	0	22
Myanmar	1	1	0	0	0	1
Netherlands	11	20	0	3	0	23
New Zealand	3	3	0	0	0	3
Niger	3	0	3	0	0	3
Nigeria	6	7	3	2	0	12
Norway	2	2	0	0	0	2
Pakistan	17	25	8	2	0	35
Panama	3	1	2	0	0	3
Paraguay	2	0	2	0	0	2
Peru	8	13	4	2	0	19
Philippines	7	1	7	0	1	9
Poland	32	38	38	3	0	79
Portugal	6	0	2	4	0	6
Romania	20	12	17	1	0	30

Place of origin	Total Individuals[a]	Assignments				
		International experts [b]	National experts	Lecturers[c]	Other project personnel	Total
Russian Federation	39	37	19	16	0	72
Saudi Arabia	5	0	5	0	0	5
Senegal	1	0	1	0	0	1
Sierra Leone	1	0	1	0	0	1
Singapore	3	0	3	0	0	3
Slovenia	5	7	0	1	0	8
South Africa	4	2	0	2	0	4
Spain	29	38	0	10	0	48
Sri Lanka	8	17	2	2	0	21
Sudan	2	0	2	0	0	2
Sweden	23	42	0	12	0	54
Switzerland	4	3	0	1	0	4
Syrian Arab Rep.	8	1	8	1	0	10
Thailand	11	6	9	2	0	17
Tunisia	7	3	4	1	0	8
Turkey	8	21	2	2	0	25
Uganda	1	0	1	0	0	1
Ukraine	10	0	10	2	0	12
UK	102	102	0	25	1	128
United Rep. Tanzania	1	6	0	0	0	6
USA	145	178	0	31	0	209
Uruguay	7	3	3	3	0	9
Venezuela	15	4	13	6	0	23
Viet Nam	11	0	10	1	0	11
Yugoslavia	32	47	10	12	0	69
Zaire	1	0	1	0	0	1
Zambia	1	0	1	0	0	1
Zimbabwe	8	0	8	0	0	8
TOTAL	1460	1370	501	380	7	2258

[a] includes 175 IAEA staff member and 5 other international organization members. [b] Includes 409 assignments of IAEA staff members and 2 assignments of other international organization members as international experts. [c] Includes 120 assignments of IAEA staff members and 3 assignments of international organization members as lecturers.

TABLE 3B

TRAINEES IN THE FIELD BY PLACE OF STUDY: 1992

Place of Study	Fellows	Training course participants	Visiting scientists	Total[a]
Algeria	0	14	0	14
Argentina	21	39	3	63
Australia	25	37	7	69
Austria	18	0	4	22
Bangladesh	0	11	1	12
Belgium	13	0	7	20
Brazil	12	113	1	126
Bulgaria	2	8	2	12
Burkina Faso	2	0	1	3
Canada	46	0	30	76
Chile	8	60	2	70
China	8	89	1	98
Colombia	1	34	1	36
Costa Rica	2	0	1	3
Cuba	1	0	0	1
Cyprus	0	13	0	13
Czech & Slovak F. R.	4	40	3	47
Denmark	4	0	3	7
Ecuador	0	27	0	27
Egypt	7	14	4	25
Ethiopia	0	13	0	13
Finland	6	21	0	27
France	47	47	19	113
Germany	49	23	26	98
Ghana	1	25	0	26
Greece	5	0	0	5
Guatemala	4	0	1	5
Hungary	41	10	9	60
Iceland	0	0	2	2
India	27	28	8	63
Indonesia	2	27	8	37
Iran, Islamic Rep.	0	0	1	1
Israel	4	0	2	6
Italy	17	27	8	52
Japan	11	14	6	31
Kenya	2	22	1	25
Korea, Republic of	3	9	6	18
Malaysia	1	10	6	17

Place of Study	Fellows	Training course participants	Visiting scientists	Total[a]
Mexico	20	37	6	63
Morocco	0	13	0	13
Netherlands	13	0	5	18
Niger	0	0	1	1
Norway	2	0	1	3
Pakistan	14	18	2	34
Paraguay	0	16	0	16
Poland	32	0	10	42
Portugal	1	0	5	6
Romania	1	0	1	2
Russian Federation	7	18	0	25
Saudi Arabia	0	6	0	6
Singapore	1	0	0	1
Spain	20	55	7	82
Sweden	4	21	2	27
Switzerland	3	0	0	3
Syrian A.R.	0	0	5	5
Thailand	11	29	2	42
Tunisia	1	13	0	14
Turkey	1	10	2	13
U.A. Emirates	0	23	0	23
UK	76	0	22	98
Ukraine	7	0	0	7
U.R. Tanzania	1	10	0	11
USA	74	157	26	257
Uruguay	6	10	0	16
Venezuela	3	0	0	3
IAEA	78	40	30	148
European Nuclear Res. Center	11	0	0	11
TOTAL	781	1,251	301	2,333

[a] The difference between the number of trainees (2,154 see Table 6B) and the number of places of study (2,333) is due to the fact that a number of fellows, training course participants and visiting scientists went to more than one country/place.

TABLE 3C

EQUIPMENT BY COUNTRY OF ORIGIN: 1992

Country	Disbursements ($ thousand)	New purchase orders placed
ALGERIA	1.1	0
ARGENTINA	42.1	7
AUSTRALIA	189.9	16
AUSTRIA	1,001.8	490
BANGLADESH	0.8	1
BELGIUM	38.9	8
BOLIVIA	2.8	5
BRAZIL	45.5	7
BULGARIA	10.6	0
CAMEROON	3.6	3
CANADA	203.1	20
CHILE	53.6	8
CHINA	688.7	53
COLOMBIA	1.2	5
COSTA RICA	2.6	3
CUBA	20.4	5
CYPRUS	20.7	3
CZECH AND SLOVAK F. R.	132.0	9
DEM. P.R. KOREA	0.6	0
DENMARK	114.1	38
DOMINICAN REPUBLIC	3.3	1
ECUADOR	2.8	3
EGYPT	1.8	1
EL SALVADOR	19.6	3
ETHIOPIA	8.7	5
FINLAND	197.0	23
FRANCE	1,628.9	130
GERMANY	3,180.8	352
GHANA	5.8	2
GREECE	35.6	1
GUATEMALA	0.9	3
HUNGARY	583.5	27
ICELAND	2.3	1
INDIA	270.4	16
INDONESIA	18.5	7
ISRAEL	1.8	2
ITALY	151.0	19
JAPAN	354.5	67
KENYA	14.1	2
MALAYSIA	8.3	4
MALI	5.0	3
MEXICO	22.4	2

Country	Disbursements ($ thousand)	New purchase orders placed
MONGOLIA	0.1	1
MOROCCO	13.3	1
MYANMAR	0.9	2
NETHERLANDS	676.8	56
NEW ZEALAND	18.6	2
NICARAGUA	0.2	1
NIGER	10.1	1
NIGERIA	12.5	4
NORWAY	28.5	5
PANAMA	18.0	1
PARAGUAY	0.0	1
PERU	4.1	1
PHILIPPINES	39.6	5
POLAND	345.5	20
ROMANIA	64.4	0
RUSSIAN FEDERATION	1,333.6	21
SENEGAL	10.2	4
SIERRA LEONE	0.0	1
SINGAPORE	0.0	1
SLOVENIA	26.7	2
SPAIN	107.2	3
SRI LANKA	1.4	1
SUDAN	0.0	2
SWEDEN	228.7	30
SWITZERLAND	367.2	53
SYRIAN ARAB REPUBLIC	0.0	1
TAIWAN, CHINA	15.6	4
THAILAND	14.0	3
TUNISIA	6.1	0
UGANDA	0.0	1
UK (HONG KONG)	150.7	16
UNITED KINGDOM	2,052.1	407
UNITED REPUBLIC OF TANZANIA	15.2	6
UNITED STATES OF AMERICA	7,019.4	790
URUGUAY	9.2	1
VENEZUELA	15.6	5
VIET NAM	19.2	3
YUGOSLAVIA	0.8	0
ZAMBIA	10.0	3
TOTAL COUNTRIES	21,726.6	2,814
LOCAL COSTS	215.4	
TOTAL	21,942.0	

TABLE 4

DISTRIBUTION OF TECHNICAL CO-OPERATION DISBURSEMENTS BY TYPE: 1988 - 1992

(in thousands of dollars)

Year	Source	Experts		Equipment		Fellowships		Scientific visits		Training courses		Sub-contracts		Miscellaneous		TOTAL		Unliquidated obligations	In-kind balance	TOTAL
		$	%	$	%	$	%	$	%	$	%	$	%	$	%	$	%	$	$	$
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	0.0	0.0	1,891.0
	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	0.0	0.0	35,800.6
	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	0.0	0.0	6,682.6
	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	0.0	1,701.5
	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	0.0	0.0	46,075.7
1992	UNDP funds	284.1	26.0	324.0	29.6	139.3	12.7	6.7	0.6	159.0	14.6	169.0	15.5	11.1	1.0	1,093.2	100.0	627.6	0.0	1,720.8
	Agency funds	8,199.4	21.2	17,405.2	45.1	5,742.1	14.9	1,057.0	2.7	5,370.2	13.9	250.4	0.6	610.0	1.6	38,634.3	100.0	11,218.5	0.0	49,852.8
	Extrabudgetary funds	1,367.8	21.4	3,782.0	59.2	199.1	3.1	58.7	0.9	629.1	9.9	351.4	5.5	2.6	0.0	6,390.7	100.0	2,242.6	0.0	8,633.3
	Assistance in kind	272.9	21.0	0.0	0.0	770.8	59.2	21.7	1.7	236.3	18.1	0.0	0.0	0.0	0.0	1,301.7	100.0	0.0	262.5	1,564.2
	Total	10,124.2	21.4	21,511.2	45.4	6,851.3	14.4	1,144.1	2.4	6,394.6	13.5	770.8	1.6	623.7	1.3	47,419.9	100.0	14,088.7	262.5	61,771.1
1988-1992	UNDP funds	3,479.7	30.3	3,394.7	29.6	1,810.2	15.8	417.6	3.6	1,614.1	14.1	636.6	5.6	111.6	1.0	11,464.5	100.0	627.6	0.0	12,092.1
	Agency funds	35,388.4	21.2	76,654.9	45.8	24,262.0	14.5	3,883.6	2.3	23,040.7	13.8	1,443.4	0.9	2,541.6	1.5	167,214.5	100.0	11,218.5	0.0	178,433.0
	Extrabudgetary funds	6,541.7	20.2	18,925.7	58.4	760.8	2.4	152.0	0.5	3,865.9	11.9	2,134.8	6.6	2.6	0.0	32,383.5	100.0	2,242.6	0.0	34,626.1
	Assistance in kind	1,505.3	15.3	198.7	2.0	6,154.0	62.6	81.4	0.8	1,894.7	19.3	0.0	0.0	0.0	0.0	9,834.1	100.0	0.0	262.5	10,096.6
	Total	46,915.1	21.2	99,174.0	44.9	32,987.0	14.9	4,534.6	2.1	30,415.4	13.8	4,214.8	1.9	2,655.7	1.2	220,896.6	100.0	14,088.7	262.5	235,247.8

TABLE 5

EXTRABUDGETARY FUNDS FOR TECHNICAL CO-OPERATION ACTIVITIES BY DONOR

(as at 31 December 1992)

Donor	Funds available 1 January 1992	New funds in 1992	Total funds available	Disbursements in 1992	Unliquidated obligations at year-end	Unobligated balance
Part A: Funds for activities where donor is not recipient						
Asian Dev. Bank	0	80,000	80,000	80,000	0	0
Australia	447,107	0	447,107	256,976	42,342	147,789
Belgium	324,976	0	324,976	20,555	5,948	298,473
Canada	1,510	(1,510)	0	0	0	0
Chile	0	10,000	10,000	6,000	4,000	0
Colombia	7,180	0	7,180	4,317	0	2,863
CEC	28,238	157,885	186,123	74,747	42,869	68,507
Finland	55,806	0	55,806	45,000	0	10,806
France	778,416	613,950	1,392,366	630,413	296,492	465,461
Germany, F.R.	1,300,099	31,910	1,332,009	1,024,629	92,857	214,523
Italy	196,905	288	197,193	73,619	26,789	96,785
Japan	355,507	337,000 [a]	692,507	198,944	73,623	419,940
Korea, Rep. of	237,812	32,065	269,877	13,769	526	255,582
Kuwait	2,410	0	2,410	2,410	0	0
Norway	505	(505)	0	0	0	0
Russian Federation	367,233	(195,519)[b]	171,714	171,452	262	0
Saudi Arabia	4,229	(4,229)	0	0	0	0
Spain	212,240	165,750	377,990	204,316	58,913	114,761
Sweden	388,313	40,000	428,313	347,486	60,577	20,250
UK	2,008,776[c]	872,800 [d]	2,881,576	1,150,842	214,414	1,516,320
USA	2,825,336	2,019,000 [e]	4,844,336	1,568,440	665,676	2,610,220
sub-total	9,542,598	4,158,885	13,701,483	5,873,915	1,585,288	6,242,280
Part B: Funds for activities where donor is recipient						
Chile	62,844	132,343	195,187	64,751	2,773	127,663
China	0	50,975	50,975	0	29,985	20,990
Colombia	21,673	142,000	163,673	20,311	110,497	32,865
Ecuador	2,301	0	2,301	0	0	2,301
Ghana	209,225	0	209,225	89,824	118,300	1,101
Iceland	1,746	31,000	32,746	39	0	32,707
Iran, Islamic Rep.	36,978	0	36,978	36,423	0	555
Libyan Arab J.	10,392	(5,896)	4,496	4,496	0	0
Malaysia	505	0	505	505	0	0
Nicaragua	0	293,040	293,040	0	0	293,040
Nigeria	149	0	149	74	0	75
Pakistan	29,302	76,416	105,718	28,876	73,767	3,075
Portugal	2,371	0	2,371	59	0	2,312
Saudi Arabia	0	14,309	14,309	0	10,090	4,219
Syrian Arab Rep.	420,113[f]	(1,619)	418,494	46,399	311,952	60,143
U.A. Emirates	147,086	100,000[g]	247,086	173,691	0	73,395
Yugoslavia	67,880	(16,592)	51,288	51,288	0	0
sub-total	1,012,565	815,976	1,828,541	516,736	657,364	654,441
TOTAL	10,555,163	4,974,861	15,530,024	6,390,651	2,242,652	6,896,721

[a] Additional funds provided under non-TC programme for the RCA project in Asia. [b] Represents $193,759 loss on exchange for funds received in earlier years and $1,760 reduction of income. [c] Includes receivable of $301,016. [d] Represents receivable of $872,800. [e] Includes receivable of $714,000. [f] Includes an amount of $48,000 not yet withdrawn from letter of credit. [g] Represents receivable of $100,000.

TABLE 6A

TECHNICAL CO-OPERATION PERSONNEL SERVICES: 1992

Recipient	Number of assign-ments	Number of months
Albania	6	1.5
Algeria	7	4.0
Argentina	18	7.5
Bangladesh	17	8.5
Bolivia	20	9.5
Brazil	36	19.5
Bulgaria	43	12.0
Cameroon	8	6.0
Chile	15	7.5
China	32	15.5
Colombia	18	10.0
Costa Rica	11	4.0
Cote d'Ivoire	4	2.0
Cuba	13	6.0
Cyprus	5	2.0
Czech & Slovak F.R.	27	6.5
Dem. P.R. Korea	9	8.0
Dominican Republic	7	4.0
Ecuador	11	4.0
Egypt	16	6.5
El Salvador	6	3.0
Ethiopia	12	7.0
Ghana	11	4.5
Greece	6	2.5
Guatemala	12	7.5
Haiti	1	2.0
Hungary	45	12.0
Indonesia	71	41.0
Iran, Islamic Rep.	40	20.0
Jamaica	4	3.0
Jordan	9	4.5
Kenya	2	3.0
Korea, Rep. of	29	16.5
Libyan Arab J.	5	19.0
Madagascar	5	3.5
Malaysia	34	19.0
Mali	2	1.5
Mauritius	3	1.5
Mexico	21	9.0
Mongolia	11	8.0
Morocco	13	4.5

Recipient	Number of assign-ments	Number of months
Myanmar	7	5.0
Namibia	5	2.5
Nicaragua	11	4.5
Niger	7	5.5
Nigeria	11	16.5
Pakistan	30	13.0
Panama	8	6.0
Paraguay	2	1.5
Peru	20	9.5
Philippines	20	9.0
Poland	11	2.0
Portugal	12	4.0
Romania	46	18.0
Saudi Arabia	15	7.0
Senegal	6	3.5
Sierra Leone	2	2.0
Singapore	2	0.5
Sri Lanka	8	6.5
Sudan	10	9.0
Syrian Arab Rep.	15	6.0
Thailand	40	22.0
Tunisia	15	5.0
Turkey	23	9.0
Uganda	5	3.0
Ukraine	15	3.0
United Arab Emirates	8	2.5
UK (Hong Kong)	4	2.0
U.R. Tanzania	5	6.5
Uruguay	9	5.0
Venezuela	22	7.0
Viet Nam	18	9.0
Yugoslavia	33	7.5
Zaire	2	1.0
Zambia	5	3.5
Zimbabwe	1	1.0
Sub-total	1,118	555.5
Intercountry Projects	760	365.0
Training Courses	380	88.5
Sub-total	1,140	453.5
TOTAL	2,258	1,009.0

TABLE 6B

RECIPIENTS OF TRAINING ABROAD: 1992

Recipient	Fellows		Visiting Scientists		Training Course Participants		Total	
	(1)	(2)	(1)	(2)	(1)	(2)	(1)	(2)
Afghanistan	1	11.0	0	0.0	5	4.0	6	15.0
Albania	10	42.5	1	1.0	5	6.0	16	49.5
Algeria	8	39.0	0	0.0	14	8.0	22	47.0
Argentina	12	44.0	29	15.0	48	30.0	89	89.0
Bangladesh	23	89.5	0	0.0	26	21.0	49	110.5
Barbados	0	0.0	0	0.0	2	0.5	2	0.5
Belarus, Republic of	0	0.0	0	0.0	1	0.5	1	0.5
Benin	0	0.0	0	0.0	1	1.0	1	1.0
Bolivia	6	22.0	1	0.5	14	6.5	21	29.0
Brazil	16	45.0	2	1.0	37	25.5	55	71.5
Bulgaria	26	117.5	3	2.0	26	27.5	55	147.0
Cameroon	2	14.0	1	1.0	3	2.0	6	17.0
Chad	0	0.0	0	0.0	1	1.0	1	1.0
Chile	16	76.0	3	2.0	28	13.5	47	91.5
China	35	138.5	10	5.0	47	43.0	92	186.5
Colombia	6	20.5	2	2.0	22	14.0	30	36.5
Costa Rica	4	6.5	3	1.5	19	9.0	26	17.0
Cote d'Ivoire	1	2.5	0	0.0	6	4.5	7	7.0
Cuba	20	106.5	5	3.5	33	23.5	58	133.5
Cyprus	1	2.0	2	1.0	5	2.0	8	5.0
Czech & Slovak F.R.	12	56.0	6	3.0	36	26.0	54	85.0
Dem. P.R. Korea	8	32.5	0	0.0	0	0.0	8	32.5
Dominican Rep.	5	25.0	1	0.5	8	4.0	14	29.5
Ecuador	15	54.0	1	0.5	20	11.0	36	65.5
Egypt	25	110.5	4	2.0	22	22.0	51	134.5
El Salvador	3	12.5	0	0.0	6	5.5	9	18.0
Estonia, Republic of	0	0.0	0	0.0	2	1.5	2	1.5
Ethiopia	4	9.0	0	0.0	7	5.0	11	14.0
Ghana	9	35.5	0	0.0	9	5.0	18	40.5
Greece	3	8.0	3	1.0	4	2.0	10	11.0
Guatemala	8	12.5	0	0.0	20	10.0	28	22.5
Guyana	0	0.0	0	0.0	1	0.5	1	0.5
Hungary	8	33.0	2	0.5	19	16.5	29	50.0
Haiti	0	0.0	0	0.0	1	0.5	1	0.5
India	0	0.0	0	0.0	32	22.0	32	22.0
Indonesia	22	69.0	18	13.0	44	35.5	84	117.5
Iran, I.R.	25	56.5	4	2.5	16	13.5	45	72.5
Jamaica	2	12.5	0	0.0	4	1.5	6	14.0
Jordan	9	29.0	7	5.0	20	16.0	36	50.0
Kenya	10	34.0	0	0.0	7	4.5	17	38.5
Korea, Republic of	18	106.0	1	0.5	30	24.0	49	130.5

Recipient	Fellows		Visiting Scientists		Training Course Participants		Total	
	(1)	(2)	(1)	(2)	(1)	(2)	(1)	(2)
Libyan Arab J.	14	49.0	4	2.0	5	8.0	23	59.0
Madagascar	2	5.0	0	0.0	3	1.0	5	6.0
Malta	0	0.0	0	0.0	1	0.5	1	0.5
Malawi	0	0.0	0	0.0	1	0.5	1	0.5
Malaysia	17	39.0	6	4.0	32	21.5	55	64.5
Mali	3	7.0	0	0.0	1	0.5	4	7.5
Mauritius	0	0.0	1	0.5	4	2.5	5	3.0
Mexico	19	46.0	4	3.0	52	32.5	75	81.5
Mongolia	21	80.0	3	1.0	5	5.5	29	86.5
Morocco	30	93.0	2	1.5	11	10.5	43	105.0
Myanmar	9	27.5	1	0.5	4	5.5	14	33.5
Namibia	0	0.0	0	0.0	2	1.5	2	1.5
Nicaragua	3	16.0	0	0.0	2	1.5	5	17.5
Niger	7	11.0	0	0.0	4	2.5	11	13.5
Nigeria	22	144.0	0	0.0	10	5.0	32	149.0
Pakistan	26	111.5	7	3.5	33	24.0	66	139.0
Panama	6	15.5	1	0.5	10	4.5	17	20.5
Paraguay	2	8.0	0	0.0	8	3.0	10	11.0
Peru	4	11.0	4	2.0	37	24.5	45	37.5
Philippines	10	42.5	4	2.5	32	26.0	46	71.0
Poland	10	37.0	4	3.0	8	6.0	22	46.0
Portugal	3	4.0	0	0.0	2	1.5	5	5.5
Romania	36	119.5	5	3.0	27	20.0	68	142.5
Russian Federation	0	0.0	0	0.0	6	6.5	6	6.5
Saudi Arabia	2	3.0	0	0.0	9	5.0	11	8.0
Senegal	1	3.0	0	0.0	5	3.0	6	6.0
Sierra Leone	4	12.0	0	0.0	2	1.0	6	13.0
Singapore	5	14.0	0	0.0	2	2.0	7	16.0
Spain	0	0.0	0	0.0	1	1.0	1	1.0
Sri Lanka	7	24.0	0	0.0	23	16.0	30	40.0
Sudan	17	74.5	0	0.0	7	4.0	24	78.5
Syrian A.R.	17	62.5	4	2.0	15	13.0	36	77.5
Thailand	20	67.0	11	7.5	28	19.5	59	94.0
Trinidad and Tobago	0	0.0	0	0.0	2	0.5	2	0.5
Tunisia	4	9.5	2	2.0	9	5.0	15	16.5
Turkey	14	58.0	4	3.0	10	8.0	28	69.0
Uganda	5	24.0	2	1.0	5	3.0	12	28.0
Ukraine	0	0.0	3	1.0	2	1.0	5	2.0
U.A. Emirates	0	0.0	0	0.0	2	1.0	2	1.0
U.R. Tanzania	4	14.0	2	1.5	12	10.5	18	26.0
Uruguay	5	10.0	1	1.0	29	21.5	35	32.5
Venezuela	7	26.0	2	1.0	21	11.5	30	38.5
Viet Nam	20	68.0	4	2.0	31	23.5	55	93.5
Yemen	0	0.0	0	0.0	2	2.0	2	2.0
Yugoslavia	1	6.0	0	0.0	12	9.0	13	15.0

Recipient	Fellows		Visiting Scientists		Training Course Participants		Total	
	(1)	(2)	(1)	(2)	(1)	(2)	(1)	(2)
Zaire	3	13.5	0	0.0	7	4.0	10	17.5
Zambia	9	27.5	0	0.0	6	5.0	15	32.5
Zimbabwe	2	10.0	1	0.5	6	3.0	9	13.5
TOTAL	764	2,865.5	191	113.5	1,199	857.5	2,154	3,836.5

(1) Number of trainees. (2) Number of months of training received.

TABLE 7

FINANCIAL SUMMARY: 1992

(in thousands of dollars)

Recipient	ASSISTANCE PROVIDED, BY TYPE						ASSISTANCE PROVIDED, BY SOURCE						Unliq. oblig.	TOTAL
	Experts	Equip-ment	Fellow-ships	Training Courses	Sub-con-tracts	Total	UNDP	TACF CC	TACF NCC	Extra-bud.	In kind	Total		
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)
AFGHANISTAN	(5.7)	22.6	14.1	0.0	0.0	31.0	0.0	19.5	11.5	0.0	0.0	31.0	8.7	39.7
ALBANIA	6.3	48.5	83.9	0.0	0.0	138.7	9.1	112.4	17.2	0.0	0.0	138.7	23.4	162.1
ALGERIA	36.5	429.6	95.9	0.0	0.0	562.0	0.0	547.6	14.4	0.0	0.0	562.0	171.8	733.8
ARGENTINA	138.6	173.1	239.9	0.0	0.0	551.6	12.5	539.1	0.0	0.0	0.0	551.6	97.1	648.7
BANGLADESH	76.5	400.6	213.2	0.0	0.0	690.3	0.0	593.0	0.6	66.4	30.3	690.3	246.3	936.6
BOLIVIA	69.8	277.1	34.5	21.4	0.0	402.8	0.0	309.9	0.0	92.9	0.0	402.8	45.0	447.8
BRAZIL	209.8	348.7	157.2	0.0	0.0	715.7	0.0	549.0	0.0	147.1	19.6	715.7	165.7	881.4
BULGARIA	146.6	462.3	254.6	0.0	43.7	907.2	0.0	662.8	22.1	171.4	50.9	907.2	35.1	942.3
CHILE	104.1	564.1	197.3	0.0	0.0	865.5	0.0	772.4	0.0	93.1	0.0	865.5	111.1	976.6
CAMEROON	53.9	150.5	45.0	0.0	0.0	249.4	0.0	249.4	0.0	0.0	0.0	249.4	83.1	332.5
COLOMBIA	118.9	390.4	50.5	0.0	0.0	559.8	0.0	411.7	0.0	145.1	3.0	559.8	345.0	904.8
COSTA RICA	47.3	174.7	22.2	0.0	0.0	244.2	0.0	221.9	0.0	22.3	0.0	244.2	186.7	430.9
COTE D'IVOIRE	28.0	77.8	15.0	0.0	0.0	120.8	0.0	120.8	0.0	0.0	0.0	120.8	19.0	139.8
CHINA	295.4	547.7	485.7	0.0	0.0	1,328.8	214.4	990.6	18.4	68.3	37.1	1,328.8	320.2	1,649.0
CUBA	80.6	376.2	267.8	0.0	0.0	724.6	9.2	596.8	118.6	0.0	0.0	724.6	346.9	1,071.5
CYPRUS	19.3	122.8	43.1	0.0	31.0	216.2	0.0	146.3	0.0	69.9	0.0	216.2	15.3	231.5
CZECH & SLOVAK F.R.	50.8	52.4	147.8	0.0	0.0	251.0	0.0	175.6	0.0	43.7	31.7	251.0	25.5	276.5
DEM. P.R. KOREA	85.1	272.8	65.3	0.0	0.0	423.2	0.0	409.2	14.0	0.0	0.0	423.2	74.5	497.7
DOMINICAN REP.	43.2	152.8	47.4	0.0	0.0	243.4	0.0	243.3	0.1	0.0	0.0	243.4	36.1	279.5
ECUADOR	67.1	633.5	159.0	0.0	0.0	859.6	0.0	731.7	17.6	90.1	20.2	859.6	173.5	1,033.1
EGYPT	78.4	1,129.5	333.4	0.0	45.0	1,586.3	48.8	613.1	642.6	210.6	71.2	1,586.3	317.1	1,903.4
EL SALVADOR	33.6	129.2	23.1	0.0	0.0	185.9	0.0	95.7	0.0	90.2	0.0	185.9	65.4	251.3
ETHIOPIA	81.3	148.1	29.8	0.0	0.0	259.2	0.0	248.6	3.1	0.1	7.4	259.2	277.2	536.4
GABON	0.0	1.5	0.0	0.0	0.0	1.5	0.0	1.5	0.0	0.0	0.0	1.5	0.0	1.5
GHANA	66.4	663.1	97.7	0.0	0.0	827.2	0.0	476.0	113.9	237.3	0.0	827.2	800.5	1,627.7
GREECE	25.4	247.5	21.1	0.0	0.0	294.0	0.0	259.9	11.0	17.8	5.3	294.0	151.0	445.0
GUATEMALA	63.8	474.8	27.0	0.0	0.0	565.6	0.0	292.8	0.0	268.3	4.5	565.6	102.2	667.8
HAITI	15.0	3.9	0.0	0.0	0.0	18.9	0.0	18.8	0.1	0.0	0.0	18.9	0.0	18.9
HUNGARY	139.5	397.0	82.4	0.0	0.0	618.9	0.0	487.2	0.0	28.0	103.7	618.9	105.2	724.1
INDONESIA	567.0	471.8	300.8	0.0	2.5	1,342.1	25.1	820.8	5.8	398.3	92.1	1,342.1	264.2	1,606.3
IRAN, I.R.	271.2	460.9	99.8	0.0	0.0	831.9	0.0	697.8	97.7	36.4	0.0	831.9	172.5	1,004.4
IRAQ	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.7	0.7
JAMAICA	55.9	179.7	4.4	0.0	0.0	240.0	0.0	240.0	0.0	0.0	0.0	240.0	17.6	257.6
JORDAN	42.9	241.4	111.1	0.0	0.0	395.4	0.0	259.4	14.3	119.8	1.9	395.4	70.0	465.4
KENYA	29.5	219.0	101.0	0.0	0.0	349.5	0.0	231.1	0.0	61.7	56.7	349.5	96.3	445.8
KOREA, REP. OF	183.5	30.9	219.4	0.0	0.0	433.8	0.0	385.5	0.0	27.1	21.2	433.8	147.5	581.3
LIBYAN A.J.	245.7	100.8	91.3	0.0	0.0	437.8	0.0	193.3	18.9	225.6	0.0	437.8	161.8	599.6
MADAGASCAR	44.7	48.6	20.3	0.0	0.0	113.6	0.0	113.6	0.0	0.0	0.0	113.6	5.9	119.5
MALAYSIA	223.0	189.3	173.6	0.0	0.0	585.9	0.0	482.5	0.0	95.9	7.5	585.9	143.4	729.3
MALI	23.6	103.6	42.0	0.0	0.0	169.2	0.0	155.7	0.0	0.0	13.5	169.2	22.1	191.3
MAURITIUS	24.9	31.0	5.2	0.0	0.0	61.1	0.0	61.1	0.0	0.0	0.0	61.1	22.6	83.7
MEXICO	128.3	845.5	154.0	0.0	0.0	1,127.8	0.0	633.5	25.2	457.8	11.3	1,127.8	274.1	1,401.9
MONGOLIA	101.5	363.7	164.0	0.0	0.0	629.2	0.0	547.5	81.7	0.0	0.0	629.2	92.5	721.7
MOROCCO	57.2	271.2	262.0	0.0	0.0	590.4	0.0	546.6	6.3	20.6	16.9	590.4	179.6	770.0

Recipient	ASSISTANCE PROVIDED, BY TYPE						ASSISTANCE PROVIDED, BY SOURCE						Unliq. oblig.	TOTAL
	Experts	Equip-ment	Fellow-ships	Training Courses	Sub-con-tracts	Total	UNDP	TACF CC	TACF NCC	Extra-bud.	In kind	Total		
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)
MYANMAR	61.4	115.9	52.8	0.0	0.0	230.1	0.0	230.1	0.0	0.0	0.0	230.1	28.8	258.9
NAMIBIA	36.0	0.0	0.0	0.0	0.0	36.0	0.0	32.2	0.0	0.0	3.8	36.0	2.1	38.1
NICARAGUA	36.5	174.8	34.0	0.0	0.0	245.3	0.0	245.3	0.0	0.0	0.0	245.3	27.6	272.9
NIGER	52.6	158.3	27.5	0.0	0.0	238.4	0.0	181.2	0.0	56.9	0.3	238.4	56.5	294.9
NIGERIA	125.4	443.5	333.7	0.0	73.3	975.9	0.0	583.5	2.0	291.7	98.7	975.9	213.9	1,189.8
PAKISTAN	156.1	259.9	234.1	42.4	106.8	799.3	0.0	740.9	28.7	28.9	0.8	799.3	398.7	1,198.0
PANAMA	59.3	71.2	37.7	0.0	0.0	168.2	0.0	150.2	0.0	18.0	0.0	168.2	36.1	204.3
PARAGUAY	10.3	11.8	12.5	0.0	0.0	34.6	0.0	34.0	0.0	0.6	0.0	34.6	5.2	39.8
PERU	106.5	336.6	55.4	0.0	0.0	498.5	0.0	445.4	0.0	41.0	12.1	498.5	431.0	929.5
PHILIPPINES	116.6	299.8	153.5	0.0	0.0	569.9	0.0	510.4	0.0	49.9	9.6	569.9	207.2	777.1
POLAND	38.1	885.4	112.9	0.0	0.0	1,036.4	0.0	505.3	187.6	321.8	21.7	1,036.4	81.2	1,117.6
PORTUGAL	78.1	498.2	7.9	0.0	0.0	584.2	0.0	503.3	36.0	44.9	0.0	584.2	146.3	730.5
ROMANIA	163.3	295.7	329.6	0.0	30.0	818.6	79.9	542.8	6.1	81.8	108.0	818.6	146.2	964.8
SAUDI ARABIA	83.2	26.0	12.7	0.0	0.0	121.9	0.0	121.9	0.0	0.0	0.0	121.9	24.1	146.0
SENEGAL	31.3	99.4	4.0	0.0	0.0	134.7	0.0	134.7	0.0	0.0	0.0	134.7	17.2	151.9
SIERRA LEONE	22.0	93.1	42.1	0.0	0.0	157.2	0.0	147.3	3.1	0.0	6.8	157.2	177.9	335.1
SINGAPORE	13.9	3.7	32.6	0.0	0.0	50.2	0.0	50.2	0.0	0.0	0.0	50.2	45.2	95.4
SPAIN	0.0	2.0	0.0	0.0	0.0	2.0	0.0	2.0	0.0	0.0	0.0	2.0	0.0	2.0
SRI LANKA	71.1	190.6	70.7	0.0	0.0	332.4	0.0	290.4	0.0	21.4	20.6	332.4	50.4	382.8
SUDAN	76.7	116.8	118.1	0.0	0.0	311.6	0.0	299.5	12.1	0.0	0.0	311.6	162.8	474.4
SYRIAN A.R.	83.9	281.6	155.9	0.0	32.6	554.0	0.0	468.7	36.5	48.8	0.0	554.0	1,042.2	1,596.2
THAILAND	317.5	184.6	233.8	0.0	0.0	735.9	12.7	593.4	0.0	94.1	35.7	735.9	215.8	951.7
TUNISIA	51.5	176.5	35.8	0.0	0.0	263.8	0.0	196.0	6.9	55.3	5.6	263.8	105.7	369.5
TURKEY	99.4	376.7	128.5	0.0	87.2	691.8	191.2	472.9	27.7	0.0	0.0	691.8	403.9	1,095.7
UGANDA	46.6	163.2	57.8	0.0	0.0	267.6	0.0	267.6	0.0	0.0	0.0	267.6	245.9	513.5
UK (HONG KONG)	35.6	48.8	0.0	0.0	0.0	84.4	0.0	84.4	0.0	0.0	0.0	84.4	2.2	86.6
UKRAINE	62.4	21.5	11.2	0.0	0.0	95.1	0.0	86.7	0.0	0.0	8.4	95.1	0.0	95.1
URUGUAY	49.7	229.6	31.7	0.0	0.0	311.0	0.0	294.9	4.6	11.5	0.0	311.0	48.4	359.4
U.A. EMIRATES	28.7	198.6	0.0	0.0	0.0	227.3	0.0	53.6	0.0	173.7	0.0	227.3	23.2	250.5
U.R. TANZANIA	49.2	124.9	47.5	0.0	0.0	221.6	0.0	211.9	0.2	9.5	0.0	221.6	39.1	260.7
VENEZUELA	65.7	384.0	83.5	4.1	0.0	537.3	5.3	526.9	0.0	0.0	5.1	537.3	31.8	569.1
VIET NAM	111.6	572.5	194.1	0.6	0.0	878.8	0.0	852.4	20.4	0.0	6.0	878.8	273.0	1,151.8
YUGOSLAVIA	75.9	193.7	16.6	0.0	0.0	286.2	0.0	114.5	0.0	171.7	0.0	286.2	198.7	484.9
ZAIRE	17.0	157.0	27.4	0.0	0.0	201.4	0.0	192.8	0.0	0.0	8.6	201.4	78.7	280.1
ZAMBIA	48.7	115.7	79.5	0.0	0.0	243.9	0.0	243.9	0.0	0.0	0.0	243.9	67.3	311.2
ZIMBABWE	18.0	41.6	33.1	0.0	0.0	92.7	0.0	92.7	0.0	0.0	0.0	92.7	20.2	112.9
Sub-Total	6,674.2	19,783.4	7,811.0	68.5	452.1	34,789.2	608.2	26,768.9	1,627.0	4,827.3	957.8	34,789.2	11,073.9	45,863.1
INTERREGIONAL	599.6	43.9	0.0	2,602.6	4.1	3,250.2	40.1	2,938.5	107.4	91.6	72.6	3,250.2	824.6	4,074.8
REGIONAL AFRICA	1,035.7	583.0	0.0	514.2	48.0	2,180.9	0.0	2,037.1	0.0	131.7	12.1	2,180.9	676.3	2,857.2
REG. ARAB STATES	5.4	4.0	5.2	0.0	0.0	14.6	14.6	0.0	0.0	0.0	0.0	14.6	4.9	19.5
REG. ASIA & PACIFIC	675.4	256.6	53.0	1,379.3	133.4	2,497.7	396.4	1,311.9	1.0	623.8	164.6	2,497.7	736.3	3,234.0
REGIONAL EUROPE	469.8	265.3	9.3	440.8	94.5	1,279.7	0.0	1,072.6	149.4	55.3	2.4	1,279.7	216.2	1,495.9
REG. LATIN AMERICA	664.0	602.0	116.9	1,389.3	38.7	2,810.9	33.9	1,987.0	36.8	661.0	92.2	2,810.9	543.2	3,354.1
Sub-Total	3,449.9	1,754.8	184.4	6,326.2	318.7	12,034.0	485.0	9,347.1	294.6	1,563.4	343.9	12,034.0	3,001.5	15,035.5
MISCELLANEOUS	128.7	273.2	106.7	84.2	3.9	596.7	0.0	596.7	0.0	0.0	0.0	596.7	13.3	610.0
GRAND TOTAL	10,252.8	21,811.4	8,102.1	6,478.9	774.7	47,419.9	1,093.2	36,712.7	1,921.6	6,390.7	1,301.7	47,419.9	14,088.7	61,508.6

TABLE 8

FINANCIAL SUMMARY: 1958-1992
(in thousands of dollars)

Recipient	Assistance provided, by type						Assistance provided, by source				
	Experts	Equip-ment	Fellow-ships	Training courses	Sub-con-tracts	Total	UNDP	Agency	Extra-bud. [a]	In kind	Total
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)
AFGHANISTAN	394.6	464.3	151.3	0.0	0.0	1,010.2	92.9	835.5	0.0	81.8	1,010.2
ALBANIA	257.5	1,922.4	415.2	38.5	0.0	2,633.6	261.5	2,322.1	0.0	50.0	2,633.6
ALGERIA	683.6	2,830.7	648.6	0.0	0.0	4,162.9	21.7	3,990.1	0.0	151.1	4,162.9
ARGENTINA	3,661.6	2,810.8	1,668.2	0.0	0.0	8,140.6	5,146.8	2,431.4	17.5	544.9	8,140.6
BANGLADESH	1,399.5	6,110.0	3,489.5	0.0	0.0	10,999.0	63.8	7,712.2	1,611.7	1,611.3	10,999.0
BELARUS, REP. OF	0.0	48.8	3.0	0.0	0.0	51.8	0.0	51.8	0.0	0.0	51.8
BOLIVIA	762.3	2,641.8	496.0	27.1	0.0	3,927.2	159.5	2,963.2	626.9	177.6	3,927.2
BRAZIL	6,832.6	7,910.0	2,994.2	0.0	0.0	17,736.8	5,674.9	7,982.5	3,209.8	869.6	17,736.8
BULGARIA	542.8	4,874.6	3,292.3	0.0	474.8	9,184.5	543.9	7,372.2	484.0	784.4	9,184.5
CAMEROON	563.5	762.4	201.9	0.0	0.0	1,527.8	297.3	1,123.2	88.3	19.0	1,527.8
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	3,158.7	4,607.3	2,029.6	0.0	0.0	9,795.6	3,615.1	5,549.9	116.1	514.5	9,795.6
CHINA	2,174.3	3,030.9	3,676.0	2.9	8.1	8,892.2	2,642.4	5,347.0	532.2	370.6	8,892.2
COLOMBIA	1,713.2	4,323.9	1,315.8	0.0	0.0	7,352.9	1,693.6	4,134.8	777.6	746.9	7,352.9
COSTA RICA	1,066.0	1,635.0	361.7	0.0	7.0	3,069.7	618.1	1,931.1	327.9	192.6	3,069.7
COTE D'IVOIRE	575.0	1,059.7	238.2	0.0	0.0	1,872.9	73.4	1,649.5	119.8	30.2	1,872.9
CUBA	900.7	7,016.8	977.2	0.0	0.0	8,894.7	2,259.5	6,438.0	39.2	158.0	8,894.7
CYPRUS	201.2	1,073.9	266.2	0.0	31.0	1,572.3	24.1	1,176.1	205.0	167.1	1,572.3
CZECH & SLOVAK F.R.	122.0	219.9	1,512.0	0.0	0.0	1,853.9	6.2	1,301.8	77.7	468.2	1,853.9
DEM. P.R. KOREA	404.0	4,836.5	931.8	0.0	0.0	6,172.3	0.0	5,641.3	52.6	478.4	6,172.3
DOMINICAN REP.	284.8	1,105.9	292.8	0.0	0.0	1,683.5	0.0	1,647.4	3.9	32.2	1,683.5
ECUADOR	1,687.6	5,184.2	1,057.4	0.0	16.9	7,946.1	547.5	5,656.3	1,249.2	493.1	7,946.1
EGYPT	4,040.9	13,385.3	5,022.0	99.6	1,260.8	23,808.6	2,119.8	10,847.0	8,096.3	2,745.5	23,808.6
EL SALVADOR	357.9	1,178.3	239.2	0.0	0.0	1,775.4	14.1	1,257.5	326.0	177.8	1,775.4
ETHIOPIA	715.4	1,350.2	678.3	0.0	0.0	2,743.9	437.5	2,099.9	45.4	161.1	2,743.9
GABON	89.6	90.7	29.3	0.0	0.0	209.6	0.0	197.0	0.0	12.6	209.6
GHANA	997.8	3,536.0	2,860.3	0.0	0.0	7,394.1	354.5	4,684.6	879.2	1,475.8	7,394.1
GREECE	2,035.3	2,576.4	1,395.5	0.0	0.0	6,007.2	1,561.9	3,131.1	624.4	689.8	6,007.2
GUATEMALA	522.5	2,380.3	470.7	0.0	224.9	3,598.4	56.2	2,551.2	868.9	122.1	3,598.4
HAITI	81.4	155.8	14.8	0.0	0.9	252.9	0.9	252.0	0.0	0.0	252.9
HONDURAS	0.0	0.0	0.7	0.0	0.0	0.7	0.0	0.7	0.0	0.0	0.7
HUNGARY	279.5	8,494.5	2,124.2	0.0	0.0	10,898.2	720.3	8,743.7	954.4	479.8	10,898.2
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	5,049.6	5,496.6	3,137.0	7.2	35.5	13,725.9	2,505.1	7,773.6	2,207.6	1,239.6	13,725.9
IRAN, I.R.	1,884.3	3,688.2	1,640.9	0.0	211.7	7,425.1	2,122.8	4,466.9	444.5	390.9	7,425.1
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
JAMAICA	350.9	917.4	75.9	0.0	55.0	1,399.2	15.3	1,204.8	108.3	70.8	1,399.2
JORDAN	836.3	1,555.1	483.7	0.0	0.0	2,875.1	89.3	2,433.9	238.1	113.8	2,875.1
KENYA	1,026.4	1,860.6	1,329.9	0.0	0.0	4,216.9	97.2	2,738.4	797.0	584.3	4,216.9
KOREA, REP. OF	4,307.1	2,196.0	4,775.0	0.0	0.0	11,278.1	1,206.8	6,106.6	1,536.7	2,428.0	11,278.1
LEBANON	248.5	298.4	129.7	0.0	0.0	676.6	139.3	482.7	31.4	23.2	676.6
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.	924.0	913.1	1,299.2	0.0	0.0	3,136.3	7.3	2,486.6	550.0	92.4	3,136.3

Recipient	Assistance provided, by type						Assistance provided, by source				
	Experts	Equip-ment	Fellow-ships	Training courses	Sub-con-tracts	Total	UNDP	Agency	Extra-bud. [a]	In kind	Total
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)
MADAGASCAR	1,438.2	1,876.4	344.4	0.0	0.0	3,659.0	1,436.6	1,910.9	244.2	67.3	3,659.0
MALAWI	5.1	0.0	0.0	0.0	0.0	5.1	5.1	0.0	0.0	0.0	5.1
MALAYSIA	2,299.3	4,213.5	1,757.7	0.0	0.0	8,270.5	1.6	6,400.9	1,254.3	613.7	8,270.5
MALI	899.0	1,546.5	458.9	0.0	0.0	2,904.4	13.4	2,625.0	143.4	122.6	2,904.4
MAURITIUS	148.9	356.6	75.5	0.0	0.0	581.0	0.0	577.2	3.8	0.0	581.0
MEXICO	3,465.1	2,811.8	1,964.3	0.0	564.8	8,806.0	419.3	5,516.6	1,864.3	1,005.8	8,806.0
MONGOLIA	722.6	2,267.2	416.0	0.0	0.0	3,405.8	0.0	3,370.4	10.6	24.8	3,405.8
MOROCCO	2,114.2	2,334.7	908.2	0.0	18.0	5,375.1	909.6	3,616.6	526.4	322.5	5,375.1
MYANMAR	958.6	1,888.3	354.2	0.0	0.0	3,201.1	537.0	2,560.5	0.0	103.6	3,201.1
NAMIBIA	36.0	0.0	0.0	0.0	0.0	36.0	0.0	32.2	0.0	3.8	36.0
NICARAGUA	208.5	997.8	172.6	0.0	0.0	1,378.9	0.0	1,378.9	0.0	0.0	1,378.9
NIGER	462.7	1,055.6	209.8	0.0	0.0	1,728.1	0.0	1,599.3	56.9	71.9	1,728.1
NIGERIA	3,363.3	4,172.1	2,514.0	0.0	257.1	10,306.5	980.9	4,098.5	4,055.7	1,171.4	10,306.5
PAKISTAN	2,305.6	4,744.5	4,442.7	42.4	112.0	11,647.2	1,842.0	8,115.6	265.7	1,423.9	11,647.2
PANAMA	520.8	1,517.8	334.7	0.0	0.0	2,373.3	4.1	2,015.8	212.3	141.1	2,373.3
PARAGUAY	355.1	1,353.5	366.9	0.0	0.0	2,075.5	0.0	1,805.0	145.9	124.6	2,075.5
PERU	3,972.9	7,434.3	1,661.1	2.7	58.6	13,129.6	3,907.6	5,467.9	2,900.5	853.6	13,129.6
PHILIPPINES	2,746.8	4,811.0	4,196.3	0.0	90.8	11,844.9	1,964.4	6,191.4	1,372.9	2,316.2	11,844.9
POLAND	310.9	6,979.3	3,580.6	0.0	0.0	10,870.8	202.9	8,486.4	1,372.2	809.3	10,870.8
PORTUGAL	573.1	4,286.2	486.5	0.0	0.0	5,345.8	0.0	4,108.0	1,048.0	189.8	5,345.8
ROMANIA	1,568.8	5,933.1	1,495.1	0.0	164.5	9,161.5	3,206.7	5,384.5	179.1	391.2	9,161.5
SAUDI ARABIA	208.2	38.3	48.1	0.0	0.0	294.6	0.0	287.6	0.0	7.0	294.6
SENEGAL	554.0	1,505.2	300.2	0.0	0.0	2,359.4	345.8	1,786.6	154.7	72.3	2,359.4
SIERRA LEONE	505.2	491.7	298.7	0.0	0.0	1,295.6	174.5	985.6	12.4	123.1	1,295.6
SINGAPORE	498.4	1,245.1	205.5	0.0	0.0	1,949.0	0.0	1,779.2	103.3	66.5	1,949.0
SPAIN	386.0	95.4	105.0	0.0	0.0	586.4	0.0	507.3	56.0	23.1	586.4
SRI LANKA	1,297.0	3,764.4	2,065.7	0.0	0.0	7,127.1	307.9	5,396.5	748.6	674.1	7,127.1
SUDAN	989.0	2,632.3	2,425.3	0.0	13.4	6,060.0	296.7	4,480.5	580.2	702.6	6,060.0
SYRIAN A.R.	995.8	2,908.6	930.3	0.0	255.5	5,090.2	693.2	3,655.8	630.9	110.3	5,090.2
THAILAND	3,581.4	5,758.4	5,969.4	19.0	3.8	15,332.0	2,019.6	7,795.8	2,623.3	2,893.3	15,332.0
TUNISIA	872.9	1,917.6	482.3	0.0	0.0	3,272.8	141.2	2,475.3	474.3	182.0	3,272.8
TURKEY	2,547.6	3,753.6	3,720.8	0.0	221.6	10,243.6	2,231.5	5,909.5	130.8	1,971.8	10,243.6
UGANDA	479.4	873.6	517.5	0.0	0.0	1,870.5	131.0	1,684.3	0.0	55.2	1,870.5
UK (HONG KONG)	167.4	213.0	58.3	0.0	0.0	438.7	0.0	429.7	0.0	9.0	438.7
UKRAINE	82.6	74.6	11.2	0.0	0.0	168.4	0.0	152.6	0.0	15.8	168.4
URUGUAY	959.7	2,982.2	630.0	0.0	0.0	4,571.9	193.1	3,138.2	917.8	322.8	4,571.9
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	109.9	913.1	28.1	0.0	0.0	1,051.1	0.0	381.6	669.5	0.0	1,051.1
U.R. TANZANIA	824.3	1,817.9	1,062.1	0.0	0.0	3,704.3	9.6	3,389.8	97.9	207.0	3,704.3
VENEZUELA	1,513.9	2,170.6	637.0	24.7	0.0	4,346.2	396.5	3,556.4	191.0	202.3	4,346.2
VIET NAM	799.7	5,737.4	2,652.9	0.6	0.0	9,190.6	31.4	8,199.9	139.5	819.8	9,190.6
YUGOSLAVIA	1,587.8	7,247.0	2,816.6	0.0	37.3	11,688.7	3,061.7	5,760.4	1,930.5	936.1	11,688.7
ZAIRE	834.9	2,263.6	1,013.7	0.0	0.0	4,112.2	578.8	2,876.6	206.5	450.3	4,112.2
ZAMBIA	1,658.1	3,131.5	954.5	0.0	0.0	5,744.1	152.5	5,135.0	180.9	275.7	5,744.1
ZIMBABWE	208.4	355.4	142.1	0.0	0.0	705.9	0.0	682.2	0.0	23.7	705.9
OTHER COUNTRIES [b]	851.6	1,086.0	1,907.0	0.0	0.0	3,844.6	736.4	1,803.0	26.5	1,278.7	3,844.6

Recipient	Assistance provided, by type						Assistance provided, by source				
	Experts	Equip-ment	Fellow-ships	Training courses	Sub-con-tracts	Total	UNDP	Agency	Extra-bud. [a]	In kind	Total
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)
SUB-TOTAL	104,223.6	234,102.8	110,353.1	264.7	4,142.3	453,086.5	65,349.7	291,042.8	54,982.9	41,711.1	453,086.5
INTERREGIONAL	13,711.1	5,249.5	17,041.9	16,064.0	523.8	52,590.3	1,830.6	43,426.6	4,354.2	2,978.9	52,590.3
REGIONAL AFRICA	4,069.0	2,739.1	353.7	2,726.6	128.9	10,017.3	332.8	9,194.8	382.0	107.7	10,017.3
REG. ARAB STATE	32.3	11.3	39.0	7.0	0.0	89.6	89.6	0.0	0.0	0.0	89.6
REG. ASIA & PACIFIC	8,091.3	4,718.6	2,703.7	7,717.0	488.2	23,718.8	9,227.9	7,577.3	4,910.8	2,002.8	23,718.8
REG. EUROPE	1,736.5	1,218.7	113.5	1,454.1	1,573.5	6,096.3	59.5	5,499.7	378.4	158.7	6,096.3
REG. LATIN AMERICA	7,204.0	6,572.0	1,633.4	6,678.9	941.3	23,029.6	3,026.4	11,986.7	5,734.3	2,282.2	23,029.6
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	34,850.0	20,510.4	21,890.5	34,647.6	3,655.7	115,554.2	14,579.1	77,685.1	15,759.7	7,530.3	115,554.2
MISCELLANEOUS	894.9	1,614.8	616.5	371.4	34.4	3,532.0	23.2	3,508.8	0.0	0.0	3,532.0
GRAND TOTAL	139,968.5	256,228.0	132,860.1	35,283.7	7,832.4	572,172.7	79,952.0	372,236.7	70,742.6	49,241.4	572,172.7

[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, Israel, 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			1991			1992		
	Total	of which women	% of women	Total	of which women	% of women	Total	of which women	% of women
Fellows	570	97	17.0	747	177	23.7	764	186	24.3
Visiting scientists	65	7	10.8	203	42	20.7	191	33	17.3
Training course participants	511	46	9.0	1401	271	19.3	1199	282	23.5
Project counterparts	519	64	12.3	1333	187	14.0	1314	184	14.0
International experts	319	7	2.2	879	48	5.5	861	56	6.5
National experts	12	0	0.0	349	46	13.2	380	54	14.2
Lecturers	119	2	1.7	342	23	6.7	320	24	7.5
Other project personnel	11	9	81.8	10	8	80.0	5	4	80.0
TC Professional staff[a]	34	5	14.7	55	14	25.5	49	10	20.4
TC General Service staff[a]	54	48	88.8	88	81	92.1	91	81	89.0

[a] Excluding the staff of Printing Section and Publishing Section.

ANNEXES

Explanatory Notes to Annexes

Annex I. Disbursements of extrabudgetary and in-kind contributions: 1992

Related to Table 5, this Annex shows, by donor and by type, the technical assistance disbursements made during 1992 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: 1992

The courses organized by the Agency in 1992 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: 1992

Technical co-operation project reports published in 1992 are listed by country.

Annex IV. Voluntary contributions pledged and paid to the Technical Assistance and Co-operation Fund for 1992

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 1992. Please note that due to the fact two new member states joined the Agency after the assessments for 1992 were determined, this annex shows a total of $52,584,000. All other tables in this report refer to the Board approved target of $52,500,000.

Annex V. Cost-free fellowships offered and awarded: 1992

Information is made available in this table on cost-free fellowships offered by Member States. Columns 3 and 4 show the number of fellows who started their training in 1992 and the duration in months (1992 and beyond) of their assignment. Columns 5 and 6 show information on all cost-free fellows receiving training in the calendar year 1992 regardless of when their assignment started.

Annex VI. Approved and on-going UNDP projects as at 31 December 1992

This table includes four projects for which IAEA acts only as an associated agency.

Annex VII. Footnote-a/ projects made operational or extended during 1992

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 1992

Information is provided on Reserve Fund approvals for new and existing projects.

Annex IX. Net programme changes by recipient: 1992

In accordance with the Revised Guiding Principles information on changes to approved projects is provided. As 847 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. Net rephasings undertaken during 1992

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 year to future years and vice versa. 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 1992.

Annex XI. Extrabudgetary contributions for activities relating to technical co-operation which are not included in the technical co-operation programme: 1992

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: 1992

A. Assistance for activities where donor is not recipient

(in thousands of dollars)

Donor	Extrabudgetary						In-kind				Total
	Experts	Equip-ment	Fellow-ships	Training courses	Sub-con-tracts	Sub-total	Experts	Fellow-ships	Training courses	Sub-total	
Countries											
ARGENTINA	0.0	0.0	0.0	0.0	0.0	0.0	22.8	0.0	20.4	43.2	43.2
AUSTRALIA	11.2	0.0	0.0	194.2	51.6	257.0	12.2	0.0	4.2	16.4	273.4
AUSTRIA	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.9	0.1	2.0	2.0
BELGIUM	0.0	20.6	0.0	0.0	0.0	20.6	3.4	34.9	0.0	38.3	58.9
BOLIVIA	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.6	0.6	0.6
BRAZIL	0.0	0.0	0.0	0.0	0.0	0.0	11.0	0.0	14.0	25.0	25.0
BULGARIA	0.0	0.0	0.0	0.0	0.0	0.0	3.0	0.0	0.0	3.0	3.0
CANADA	0.0	0.0	0.0	0.0	0.0	0.0	17.8	0.0	7.6	25.4	25.4
CHILE	0.0	0.0	0.0	6.0	0.0	6.0	1.8	0.0	1.8	3.6	9.6
COLOMBIA	0.0	0.0	0.0	4.3	0.0	4.3	0.0	0.0	1.0	1.0	5.3
CHINA	0.0	0.0	0.0	0.0	0.0	0.0	11.8	0.0	38.5	50.3	50.3
CZECH & SLOVAK FED. REP.	0.0	0.0	0.0	0.0	0.0	0.0	2.6	0.0	0.0	2.6	2.6
CUBA	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.6	0.6	0.6
DENMARK	0.0	0.0	0.0	0.0	0.0	0.0	0.0	9.0	0.0	9.0	9.0
DOMINICAN REP.	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.0	1.0	1.0
ECUADOR	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.0	1.0	1.0
FINLAND	0.0	0.0	0.0	0.0	45.0	45.0	0.0	0.0	0.8	0.8	45.8
FRANCE	126.9	440.7	15.0	47.8	0.0	630.4	65.6	57.1	3.7	126.4	756.8
GERMANY	169.0	646.1	1.7	176.6	31.2	1,024.6	3.8	93.7	8.1	105.6	1,130.2
HUNGARY	0.0	0.0	0.0	0.0	0.0	0.0	3.2	0.0	0.0	3.2	3.2
INDIA	0.0	0.0	0.0	0.0	0.0	0.0	9.2	11.8	53.9	74.9	74.9
ISRAEL	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2.7	0.0	2.7	2.7
ITALY	5.8	50.8	6.4	(0.9)	11.5	73.6	2.9	13.5	0.0	16.4	90.0
JAMAICA	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	3.1	3.1	3.1
JAPAN	143.1	0.0	14.8	41.0	0.0	198.9	31.4	0.0	6.0	37.4	236.3
KOREA, REP.	0.0	0.0	13.8	0.0	0.0	13.8	0.0	0.0	30.7	30.7	44.5
KUWAIT	0.0	2.4	0.0	0.0	0.0	2.4	0.0	0.0	0.0	0.0	2.4
MEXICO	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.4	0.4	0.4
NETHERLANDS	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2.9	2.9	2.9
PORTUGAL	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.0	1.0	1.0
RUSSIAN FEDERATION	0.0	171.5	0.0	0.0	0.0	171.5	2.0	0.0	1.3	3.3	174.8
SOUTH AFRICA	0.0	0.0	0.0	0.0	0.0	0.0	2.8	0.0	0.0	2.8	2.8
SPAIN	0.0	100.3	18.8	0.0	85.2	204.3	1.2	30.2	2.5	33.9	238.2
SWEDEN	284.0	36.2	27.3	0.0	0.0	347.5	4.4	0.0	3.0	7.4	354.9
UNITED KINGDOM	235.6	736.1	80.8	0.0	98.4	1,150.9	17.0	87.8	5.4	110.2	1,261.1
URUGUAY	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.6	0.6	0.6
USA	392.2	1,096.1	0.0	80.1	0.0	1,568.4	34.6	449.9	10.5	495.0	2,063.4
VENEZUELA	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.0	1.0	1.0
YUGOSLAVIA	0.0	0.0	0.0	0.0	0.0	0.0	1.4	0.0	0.0	1.4	1.4
SUB-TOTAL	1,367.8	3,300.8	178.6	549.1	322.9	5,719.2	265.9	792.5	225.7	1,284.1	7,003.3
International Organizations											
ASIAN DEV. BANK	0.0	0.0	0.0	80.0	0.0	80.0	0.0	0.0	0.0	0.0	80.0
CEC	0.0	0.0	74.7	0.0	0.0	74.7	1.0	0.0	1.0	2.0	76.7
ESCAP	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	3.3	3.3	3.3
UNDP	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	6.3	6.3	6.3
WHO	0.0	0.0	0.0	0.0	0.0	0.0	6.0	0.0	0.0	6.0	6.0
SUB-TOTAL	0.0	0.0	74.7	80.0	0.0	154.7	7.0	0.0	10.6	17.6	172.3
GRAND TOTAL	1,367.8	3,300.8	253.3	629.1	322.9	5,873.9	272.9	792.5	236.3	1,301.7	7,175.6

B. Assistance for activities where donor is recipient

(in thousands of dollars)

Donor	Project Title	Project	Equipment	Fellowships	Sub-contracts	Total
CHILE	IMPURITIES IN URANIUM COMPOUNDS	CHI/3/008	9.8	0.0	0.0	9.8
	APPLICATION OF TOMOGRAPHY IN NUCLEAR MEDICINE	CHI/6/011	55.0	0.0	0.0	55.0
COLOMBIA	UPGRADING OF RESEARCH REACTOR INSTRUMENTATION	COL/4/009	18.5	0.0	0.0	18.5
	UPGRADING OF RESEARCH REACTOR INSTRUMENTATION (PHASE II)	COL/4/011	1.8	0.0	0.0	1.8
GHANA	MINIATURE NEUTRON SOURCE REACTOR	GHA/1/010	81.7	0.0	0.0	81.7
	TRAINING IN NUCLEAR INSTRUMENTATION	GHA/4/008	8.1	0.0	0.0	8.1
IRAN, I.R.	RADIOISOTOPE PRODUCTION	IRA/2/004	32.6	0.0	0.0	32.6
	REVIEW OF THE BUSHEHR NUCLEAR POWER PLANT	IRA/9/011	3.8	0.0	0.0	3.8
LIBYAN A.J.	ERADICATION OF MEDITERRANEAN FRUIT FLY	LIB/5/003	0.0	4.5	0.0	4.5
MALAYSIA	NITROGEN-15 FERTILIZER STUDIES	MAL/5/018	0.5	0.0	0.0	0.5
NIGERIA	STRENGTHENING THE FEDERAL RADIATION PROTECTION SERVICE	NIR/9/005	0.1	0.0	0.0	0.1
PAKISTAN	CONTROL AND INSTRUMENTATION	PAK/4/027	0.4	0.0	0.0	0.4
	SAFE OPERATION OF THE KARACHI NUCLEAR POWER PLANT	PAK/9/010	0.0	0.0	28.5	28.5
PORTUGAL	RESEARCH REACTOR MODERNIZATION	POR/4/012	0.1	0.0	0.0	0.1
SYRIAN A.R.	PROCUREMENT ASSISTANCE	SYR/0/005	46.4	0.0	0.0	46.4
U.A. EMIRATES	RADIOACTIVE ENVIRONMENTAL AND FOOD CONTAMINATION	UAE/9/003	173.7	0.0	0.0	173.7
YUGOSLAVIA	PROCUREMENT ASSISTANCE	YUG/9/023	39.3	0.0	0.0	39.3
	OPERATIONAL NUCLEAR SAFETY	YUG/9/025	12.0	0.0	0.0	12.0
TOTAL			483.8	4.5	28.5	516.8

ANNEX II

TRAINING COURSES: 1992

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 THE ENPEP PACKAGE, INT/0/054/001	ARGONNE, IL,USA 14 SEPTEMBER - 6 NOVEMBER	AGENCY	37	0	0	290,838 (CC)
INTERREGIONAL TRAINING COURSE ON EXPERIMENTAL NUCLEAR SPECTROSCOPY, INT/1/048/001	ARGONNE, IL,USA 24 FEBRUARY - 27 MARCH	AGENCY	19	0	0	135,326 (CC)
INTERREGIONAL TRAINING COURSE ON NUCLEAR DATA AND MEASUREMENT TECHNIQUES IN NUCLEAR REACTOR AND PERSONAL NEUTRON DOSIMETRY, INT/1/049/001	OBNINSK,RUSSIAN FEDERATION 15 JUNE - 10 JULY	AGENCY	18	0	0	102,081 (CC) 674 (NCC)
INTERREGIONAL TRAINING COURSE ON DOSIMETRY CALIBRATION PROCEDURES, INT/1/050/001	HELSINKI,FINLAND 1 JUNE - 13 JUNE STOCKHOLM,SWEDEN 14 JUNE - 19 JUNE	AGENCY	21	9	0	87,277 (CC)
INTERREGIONAL TRAINING COURSE ON QUALITY ASSURANCE IN NUCLEAR POWER PLANT OPERATION AND MAINTENANCE, INT/4/109/001	TRNAVA, CZECH AND SLOVAK FED. REP. 14 SEPTEMBER - 15 OCTOBER	AGENCY	22	0	3	76,796 (CC) 85,589 (NCC)
INTERREGIONAL TRAINING COURSE ON QUALIFICATION OF NUCLEAR POWER PLANT OPERATIONS PERSONNEL, INT/4/110/001	KARLSRUHE,GERMANY 27 APRIL - 27 MAY	AGENCY	23	0	0	138,615 (CC)
INTERREGIONAL TRAINING COURSE ON QUALITY ASSURANCE/QUALITY CONTROL IN WATER REACTOR FUEL DEVELOPMENT AND MANUFACTURING, INT/4/111/001	GIF-SUR-YVETTE,FRANCE 5 OCTOBER - 23 OCTOBER	AGENCY	25	0	0	136,032 (CC)
INTERREGIONAL TRAINING COURSE ON NUCLEAR ELECTRONICS, INT/4/112/001	MEXICO CITY,MEXICO 20 JANUARY - 17 APRIL	AGENCY	17	0	4	250,761 (CC) 1,561 (NCC)
INTERREGIONAL TRAINING COURSE ON INTERFACING IN NUCLEAR EXPERIMENTS, INT/4/113/001	JAKARTA,INDONESIA 3 AUGUST - 2 OCTOBER	AGENCY	18	0	2	209,026 (CC)
INTERREGIONAL TRAINING COURSE ON THE USE OF ISOTOPE AND RADIATION TECHNIQUES IN STUDIES OF BIOLOGICAL NITROGEN FIXATION, INT/5/124/001	SEIBERSDORF,AUSTRIA 1 JUNE - 3 JULY	AGENCY	20	0	0	149,638 (CC)
INTERREGIONAL TRAINING COURSE ON INDUCTION AND USE OF MUTATIONS IN PLANT BREEDING, INT/5/125/001	SEIBERSDORF,AUSTRIA 22 APRIL - 29 MAY	AGENCY	20	0	0	152,561 (CC) 654 (NCC)
INTERREGIONAL TRAINING COURSE ON THE USE OF RADIATION AND ISOTOPES IN INSECT CONTROL AND ENTOMOLOGY, INT/5/126/001	GAINESVILLE, FL,USA 3 MAY - 13 JUNE	AGENCY	20	1	0	122,172 (CC)
INTERREGIONAL TRAINING COURSE ON ADVANCED SINGLE PHOTON EMISSION COMPUTERIZED TOMOGRAPHY WITH EMPHASIS IN BRAIN AND HEART STUDIES, INT/6/041/001	PISA,ITALY 26 OCTOBER - 6 NOVEMBER	AGENCY	27	1	3	99,703 (CC)
INTERREGIONAL TRAINING COURSE ON USE OF PSA IN THE OPERATION OF NUCLEAR POWER PLANTS; RISK-BASED PRIORIZATION OF OPERATIONAL TASKS, INT/9/125/001	ARGONNE, IL,USA 27 JANUARY - 14 FEBRUARY	AGENCY	23	5	0	111,654 (CC) 4,516 (NCC)
INTERREGIONAL TRAINING COURSE ON SAFETY ASPECTS OF AGEING AND MAINTENANCE IN NUCLEAR POWER PLANT OPERATION, INT/9/126/001	ARGONNE, IL,USA 6 APRIL - 1 MAY	AGENCY	26	3	0	123,224 (CC) 4,956 (NCC)
INTERREGIONAL TRAINING COURSE ON SAFE OPERATION AND UTILIZATION OF RESEARCH REACTORS, INT/9/127/001	GIF-SUR-YVETTE,FRANCE 2 NOVEMBER - 27 NOVEMBER	AGENCY	22	1	0	121,139 (CC)
INTERREGIONAL TRAINING COURSE ON PLANNING, ORGANIZATION AND IMPLEMENTATION OF RADIATION PROTECTION ON A NATIONAL LEVEL, INT/9/129/001	ARGONNE, IL,USA 11 MAY - 29 MAY	AGENCY	32	1	0	142,060 (CC)
REGIONAL TRAINING COURSE ON THE USE OF PERSONAL COMPUTERS IN THE ANALYSIS OF ANIMAL PRODUCTION DATA, RAF/5/006/002	ADDIS ABABA,ETHIOPIA 9 MARCH - 20 MARCH	AGENCY	13	0	1	45,919 (CC)
REGIONAL AFRICA TECHNICIANS' WORKSHOP ON THE USE OF EMISSION SPECTROMETRY IN N-15 ANALYSIS, RAF/5/010/003	LEGON-ACCRA,GHANA 3 AUGUST - 14 AUGUST	AGENCY	11	0	1	26,404 (CC)
REGIONAL TRAINING COURSE ON THE USE OF IRRADIATION TO REDUCE POST-HARVEST FOOD LOSSES, RAF/5/023/001	LEGON-ACCRA,GHANA 9 NOVEMBER - 4 DECEMBER	AGENCY	14	0	2	66,248 (CC)
REGIONAL TRAINING COURSE ON BULK REAGENT METHODOLOGY, REAGENT PREPARATION AND QUALITY CONTROL FOR RIA OF THYROID RELATED HORMONES, RAF/6/007/002	TUNIS,TUNISIA 24 FEBRUARY - 6 MARCH	AGENCY FRANCE	13	0	4	23,680 (CC) 12,960 (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 DATA PROCESSING IN RADIOIMMUNOASSAY, RAF/6/007/003	ALGIERS,ALGERIA 28 NOVEMBER - 9 DECEMBER	AGENCY FRANCE	14	0	6	19,121 (CC) 14,000 (CC)
REGIONAL WORKSHOP ON X-RAY FLUORESCENCE LABORATORY NETWORK IN AFRICA, RAF/8/015/001	NAIROBI,KENYA 31 AUGUST - 4 SEPTEMBER	AGENCY	14	0	2	23,895 (CC)
REGIONAL MEETING ON CO-OPERATION IN RADIATION PROTECTION IN AFRICA, RAF/9/005/008	ARUSHA,U. R. TANZANIA 10 MARCH - 13 MARCH	AGENCY	10	0	1	11,893 (CC)
REGIONAL TRAINING COURSE ON RADIATION PROTECTION IN MEDICAL PRACTICES, RAF/9/008/001	RABAT,MOROCCO 2 NOVEMBER - 20 NOVEMBER	AGENCY	13	0	13	81,547 (CC)
REGIONAL TRAINING COURSE ON CONTROL AND SAFE USE OF RADIATION SOURCES, RAF/9/009/001	NAIROBI,KENYA 28 SEPTEMBER - 23 OCTOBER	AGENCY	8	7	4	88,280 (CC)
REGIONAL TRAINING COURSE ON RADIOACTIVE WASTE MANAGEMENT: A SYSTEMS APPROACH, RAF/9/010/001	CAIRO,EGYPT 17 OCTOBER - 4 NOVEMBER	AGENCY	14	0	5	57,520 (CC)
REGIONAL TRAINING COURSE ON ELECTRIC SYSTEM EXPANSION PLANNING, RAS/0/013/006	LAHORE,PAKISTAN 26 APRIL - 4 JUNE	AGENCY ASIAN DEV. BANK	18	7	5	67,298 (CC) 80,000 (CC)
REGIONAL WORKSHOP ON NEUTRON TRANSMUTATION DOPING TECHNOLOGY, RAS/0/015/009	BEIJING,CHINA 5 OCTOBER - 10 OCTOBER	AGENCY CHINA	10	0	3	15,656 (CC) 18,915 (GIK)
REGIONAL TRAINING COURSE ON ADVANCED MUTATION BREEDING OF TROPICAL CROP PLANTS, RAS/0/015/011	BOMBAY,INDIA 16 NOVEMBER - 27 NOVEMBER	AGENCY INDIA	11	0	4	2,284 (CC) 25,390 (GIK)
REGIONAL WORKSHOP ON NUCLEONIC CONTROL SYSTEMS IN THE STEEL INDUSTRY, RAS/0/015/012	SHANGHAI,CHINA 8 JUNE - 12 JUNE	AGENCY CHINA	11	0	4	8,541 (CC) 19,618 (GIK)
REGIONAL TRAINING COURSE ON NDT AND EVALUATION IN NUCLEAR POWER PLANTS, RAS/0/015/014	TAEJEON, CHUNG-NAM, KOREA, REPUBLIC OF 7 OCTOBER - 27 OCTOBER	AGENCY KOREA, R.	9	0	1	4,014 (CC) 30,757 (GIK)
REGIONAL TRAINING COURSE ON DETERMINATION OF RADIONUCLIDES IN FOOD AND ENVIRONMENTAL SAMPLES, RAS/2/004/001	TOKYO,JAPAN 2 MARCH - 31 MARCH	AGENCY	14	0	0	111,405 (CC)
REGIONAL TRAINING COURSE ON MEASUREMENT OF BASIC PARAMETERS OF RESEARCH REACTORS, RAS/4/011/004	JAKARTA,INDONESIA 3 AUGUST - 21 AUGUST	AGENCY	9	0	4	41,293 (CC)
REGIONAL TRAINING COURSE ON SAFETY DOCUMENTATION FOR RESEARCH REACTORS, RAS/4/011/005	DHAKA,BANGLADESH 12 OCTOBER - 22 OCTOBER	AGENCY	11	4	2	36,509 (CC)
REGIONAL TRAINING COURSE ON MATERIALS CHARACTERIZATION USING LOW AND MEDIUM NEUTRON FLUX REACTORS, RAS/4/011/006	BEIJING,CHINA 26 OCTOBER - 13 NOVEMBER	AGENCY	13	0	2	36,128 (CC) 11,311 (NCC)
REGIONAL TRAINING COURSE ON MAINTENANCE AND REPAIR OF MCA CARDS, RAS/4/012/003	JOHOR BAHARU,MALAYSIA 11 MAY - 5 JUNE	AGENCY	10	3	1	39,076 (CC) 993 (NCC)
REGIONAL WORKSHOP ON FOOD IRRADIATION PROCESS CONTROL, RAS/5/020/006	SHANGHAI,CHINA 31 AUGUST - 11 SEPTEMBER	UNDP	8	6	9	28,257 (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/5/021/005	HARBIN,CHINA 13 JULY - 17 JULY	UNDP	16	0	3	28,772 (CC)
REGIONAL TRAINING COURSE ON NUCLEAR AND ASSOCIATED TECHNIQUES FOR PESTICIDE RESEARCH, RAS/5/024/001	BANGKOK,THAILAND 3 FEBRUARY - 6 MARCH	AGENCY	15	0	5	85,043 (CC)
REGIONAL TRAINING COURSE ON THE USE OF COMPUTERS IN NUCLEAR MEDICINE, RAS/6/016/003	SYDNEY-CAMPERDOWN, AUSTRALIA 9 MARCH - 16 APRIL	AGENCY AUSTRALIA	10	0	0	21,795 (CC) 65,885 (CC)
REGIONAL TRAINING COURSE ON APPLICATION OF RECENT NUCLEAR TECHNIQUES IN THE DIAGNOSIS OF COMMUNICABLE DISEASES, RAS/6/019/001	BANGKOK,THAILAND 21 SEPTEMBER - 9 OCTOBER	AGENCY	14	0	2	60,393 (CC)
REGIONAL TRAINING COURSE ON THE PREPARATION AND QUALITY CONTROL OF RADIOPHARMACEUTICALS, RAS/6/020/001	BEIJING,CHINA 17 AUGUST - 5 SEPTEMBER	AGENCY	15	0	2	65,804 (CC) 17,546 (NCC)
REGIONAL TRAINING COURSE ON RADIATION STERILIZATION OF TISSUE GRAFTS WITH EMPHASIS ON CLINICAL AND STERILITY QUALITY ASSURANCE CRITERIA, RAS/7/003/004	TAIYUAN, SX,CHINA 1 SEPTEMBER - 12 SEPTEMBER	AGENCY	16	0	4	42,621 (CC) 8,391 (NCC)
REGIONAL WORKSHOP ON IMAGE PROCESSING IN MATERIALS SCIENCE AND IN NON-DESTRUCTIVE TESTING, RAS/8/062/034	BOMBAY,INDIA 13 JANUARY - 24 JANUARY	INDIA	10	2	5	28,500 (GIK)

Project title and code	Place(s) and dates	Source of Funds	Participation [a]			Amount(s) expended [b] ($)
			(1)	(2)	(3)	
REGIONAL WORKSHOP ON DEVELOPMENT OF TRAINING TECHNIQUES AND METHODS OF INSTRUCTION IN RADIATION PROTECTION, RAS/9/006/005	SYDNEY-MENAI,AUSTRALIA 17 FEBRUARY - 28 FEBRUARY	AUSTRALIA	11	3	0	56,741 (CC)
REGIONAL WORKSHOP ON COMPUTER-ASSISTED PLANNING AND DOSIMETRY FOR CARCINOMA OF THE CERVIX, RAS/9/006/009	BOMBAY,INDIA 1 JUNE - 5 JUNE	JAPAN	7	2	1	21,828 (CC)
REGIONAL TRAINING COURSE ON DOSIMETRIC ASSESSMENT OF INTERNAL CONTAMINATION, RAS/9/012/001	SYDNEY-MENAI,AUSTRALIA 2 NOVEMBER - 20 NOVEMBER	AGENCY	16	2	0	74,492 (CC)
REGIONAL TRAINING COURSE ON BIDDING, EVALUATION PROCEDURE, CONTRACTING AND FINANCING OF NPPS, RER/0/006/001	MADRID,SPAIN 26 OCTOBER - 13 NOVEMBER	AGENCY	20	1	0	94,456 (CC)
REGIONAL WORKSHOP ON EDDY CURRENT INSPECTIONS OF WWER NUCLEAR POWER PLANTS, RER/4/003/004	KOZLODUY,BULGARIA 25 FEBRUARY - 27 FEBRUARY	AGENCY	8	0	0	21,203 (CC)
REGIONAL WORKSHOP ON THE USE OF NUCLEAR & RELATED TECHNIQUES IN PLANT NUTRIENT & WATER BALANCE STUDIES IN RAIN-FED LEGUME-CEREAL CROP ROTATION SYSTEMS & IRRIGATED AGRICULTURE AREAS, RER/5/004/002	ANKARA,TURKEY 7 SEPTEMBER - 11 SEPTEMBER	AGENCY	10	0	0	13,487 (CC)
REGIONAL TRAINING COURSE ON ISOTOPE TECHNIQUES IN ANIMAL NUTRITION AND REPRODUCTION RESEARCH, RER/5/005/001	NICOSIA,CYPRUS 21 SEPTEMBER - 16 OCTOBER	AGENCY	13	0	3	88,648 (CC)
REGIONAL TRAINING COURSE ON THE REGULATORY CONTROL OF FOOD IRRADIATION, RER/5/006/001	BUDAPEST,HUNGARY 8 JUNE - 26 JUNE	AGENCY	10	2	2	29,182 (CC)
REGIONAL WORKSHOP ON QUALITY CONTROL IN HOSPITAL RADIOPHARMACY, RER/6/002/008	DUBAI,UNITED ARAB EMIRATES 15 APRIL - 30 APRIL	AGENCY	14	0	0	37,930 (CC)
REGIONAL WORKSHOP ON INDUSTRIAL APPLICATIONS OF ISOTOPES AND RADIATION, RER/6/002/009	JEDDAH,SAUDI ARABIA 14 NOVEMBER - 9 DECEMBER	AGENCY	6	0	20	30,418 (CC)
REGIONAL TRAINING COURSE ON REGULATORY PRACTICES FOR RADIATION SAFETY, RER/9/007/004	DUBAI,UNITED ARAB EMIRATES 21 NOVEMBER - 2 DECEMBER	AGENCY	9	0	0	19,433 (CC)
REGIONAL TRAINING COURSE ON FIRE PROTECTION AND PREVENTION IN NUCLEAR POWER PLANTS, RER/9/013/001	MADRID,SPAIN 16 NOVEMBER - 3 DECEMBER	AGENCY	12	2	1	59,966 (CC)
REGIONAL TRAINING COURSE ON WASTE MANAGEMENT - A SYSTEMS APPROACH, RER/9/014/001	TRNAVA, CZECH AND SLOVAK FED. REP. 18 MAY - 5 JUNE	AGENCY	18	0	5	24,874 (CC) 36,067 (NCC)
REGIONAL TRAINING COURSE FOR LIBRARIANS AND INFORMATION SPECIALISTS ON MANAGEMENT AND PROMOTION, RLA/0/009/008	RIO DE JANEIRO,BRAZIL 17 AUGUST - 28 AUGUST	AGENCY	11	0	2	24,658 (CC)
REGIONAL TRAINING COURSE ON THE USE OF ISOTOPE TECHNIQUES IN ENVIRONMENTAL STUDIES OF THE HYDROSPHERE AND ATMOSPHERE, RLA/1/009/001	PIRACICABA,BRAZIL 6 JULY - 31 JULY	AGENCY	14	0	4	100,854 (CC)
REGIONAL WORKSHOP ON COLLECTION STRATEGIES AND PREPARATION OF SAMPLES IN ENVIRONMENTAL PROBLEMS, RLA/2/003/013	SANTIAGO,CHILE 9 MARCH - 20 MARCH	AGENCY GERMANY CHILE	10	0	3	4,799 (CC) 30,967 (CC) 6,000 (CC)
REGIONAL TRAINING COURSE ON APPLICATION OF FIA IN STUDIES OF ENVIRONMENTAL AND GEOLOGICAL SAMPLES, RLA/2/003/014	PIRACICABA,BRAZIL 5 OCTOBER - 16 OCTOBER	AGENCY	12	0	0	24,294 (CC)
FIRST REGIONAL WORKSHOP ON ENVIRONMENTAL STUDIES USING NUCLEAR TECHNIQUES, RLA/2/006/001	QUITO,ECUADOR 25 MAY - 29 MAY	AGENCY GERMANY	4	0	2	13,127 (CC) 7,676 (CC)
REGIONAL ADVANCED WORKSHOP ON THE SYNTHESIS OF MODERN RADIOPHARMACEUTICALS, RLA/2/007/001	BUENOS AIRES,ARGENTINA 2 MARCH - 27 MARCH	AGENCY	8	0	2	42,401 (CC)
REGIONAL WORKSHOP ON PRODUCTION AND CONTROL OF RADIOPHARMACEUTICAL KITS, RLA/2/007/002	BOGOTA,COLOMBIA 23 NOVEMBER - 4 DECEMBER	AGENCY	10	0	1	18,916 (CC)
REGIONAL TRAINING COURSE ON APPLICATION OF TRANSDUCERS TO NUCLEAR INSTRUMENTATION, RLA/4/008/005	QUITO,ECUADOR 18 MAY - 5 JUNE	AGENCY	10	0	7	35,877 (CC)
REGIONAL TRAINING COURSE ON MAINTENANCE OF COMPUTERS AND INTERCONNECTED SYSTEMS, RLA/4/008/006	MONTEVIDEO,URUGUAY 4 MAY - 15 MAY	AGENCY GERMANY	10	0	5	44,187 (CC) 5,863 (CC)
REGIONAL WORKSHOP ON NUCLEAR INSTRUMENTS IN INDUSTRY, RLA/4/008/007	SANTIAGO,CHILE 23 NOVEMBER - 27 NOVEMBER	GERMANY CHILE	11	0	0	13,153 (CC) 4,000 (CC)
REGIONAL TRAINING COURSE ON ANIMAL HEALTH, RLA/5/028/002	BOGOTA, COLOMBIA 23 NOVEMBER - 28 NOVEMBER	AGENCY	24	0	1	37,990 (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 THE USE OF ISOTOPES AND RADIATION TECHNIQUES IN STUDIES OF SOIL/PLANT PRODUCTIVITY WITH THE AIM OF INCREASING FOOD AND FODDER PRODUCTION, RLA/5/029/001	SANTIAGO,CHILE 23 MARCH - 24 APRIL	AGENCY	14	0	1	105,655 (CC)
REGIONAL WORKSHOP ON TECHNO-ECONOMIC FEASIBILITY OF FOOD IRRADIATION, RLA/5/030/001	MEXICO CITY,MEXICO 18 MAY - 29 MAY	AGENCY	5	0	4	12,259 (CC)
REGIONAL WORKSHOP ON SPECT QUALITY CONTROL, RLA/6/006/001	TARRAGONA,SPAIN 1 JUNE - 3 JUNE	AGENCY	4	0	0	2,992 (CC)
REGIONAL WORKSHOP ON NUCLEAR CARDIOLOGY, RLA/6/006/002	GRANADA,SPAIN 1 JUNE - 3 JUNE	AGENCY	4	0	0	2,992 (CC)
REGIONAL WORKSHOP ON DATA PROCESSING AND EXTERNAL QUALITY ASSESSMENT IN RIA, RLA/6/016/005	ASUNCION,PARAGUAY 28 SEPTEMBER - 9 OCTOBER	AGENCY	16	0	1	43,361 (CC)
REGIONAL TRAINING COURSE ON ADVANCES IN HOSPITAL RADIOPHARMACY, RLA/6/017/001	MADRID,SPAIN 27 APRIL - 22 MAY	AGENCY	15	0	3	103,829 (CC)
REGIONAL TRAINING COURSE ON STRATEGIES AND METHODOLOGIES FOR APPLIED MARINE RADIOACTIVITY STUDIES, RLA/7/005/001	CUERNAVACA,MEXICO 23 NOVEMBER - 4 DECEMBER	AGENCY	15	0	10	91,621 (CC)
REGIONAL COORDINATOR'S MEETING AT THE 13TH WORLD CONFERENCE ON NON-DESTRUCTIVE TESTING, RLA/8/006/017	SAO PAULO,BRAZIL 18 OCTOBER - 23 OCTOBER	UNFSTD	17	2	1	22,981 (CC)
REGIONAL TRAINING COURSE ON SAFE OPERATION OF RADIATION FACILITIES-REGULATORY RESPONSIBILITIES, RLA/8/016/001	QUITO,ECUADOR 20 JULY - 31 JULY	AGENCY	13	0	2	37,505 (CC)
REGIONAL WORKING GROUP MEETING ON QUALITY ENGINEERING, RLA/8/017/013	BUENOS AIRES,ARGENTINA 16 MARCH - 20 MARCH	AGENCY GERMANY	15	0	1	26,398 (CC) 8,746 (CC)
REGIONAL WORKSHOP ON NDT FOR INDUSTRIAL QUALITY, RLA/8/017/016	SANTIAGO,CHILE 24 FEBRUARY - 28 FEBRUARY	AGENCY GERMANY	13	0	0	53 (CC) 22,943 (CC)
REGIONAL WORKSHOP ON QUALITY IMPROVEMENT IN METAL-MECHANICAL INDUSTRY BY EDDY CURRENT, RLA/8/017/034	SANTIAGO,CHILE 21 SEPTEMBER - 25 SEPTEMBER	AGENCY GERMANY	13	0	0	19,512 (CC) 7,308 (CC)
REGIONAL WORKING GROUP ON CRITERIA FOR A SURVEY ON QUALITY ASSURANCE IN THE REGION, RLA/8/017/071	LIMEIRA,BRAZIL 12 OCTOBER - 16 OCTOBER	AGENCY GERMANY	14	0	1	18,343 (CC) 3,918 (CC)
REGIONAL TRAINING COURSE ON ESTABLISHMENT OF A PROGRAMME ON OCCUPATIONAL MONITORING, RLA/9/011/006	SAO PAULO,BRAZIL 9 NOVEMBER - 20 NOVEMBER	AGENCY FRANCE	19	0	5	60,530 (CC) 4,793 (CC)
REGIONAL TRAINING COURSE ON MEASUREMENT OF ENVIRONMENTAL SAMPLES, RLA/9/011/007	BUENOS AIRES,ARGENTINA 16 NOVEMBER - 27 NOVEMBER	AGENCY FRANCE	16	0	0	53 (CC) 30,180 (CC)
REGIONAL WORKSHOP ON CO-ORDINATED STUDIES IN INTERCOMPARISON OF LOW ENERGY PERSONNEL DOSIMETRY, RLA/9/011/009	RIO DE JANEIRO,BRAZIL 21 SEPTEMBER - 25 SEPTEMBER	AGENCY	10	0	0	21,279 (CC)
REGIONAL TRAINING COURSE ON MANAGEMENT OF SPENT RADIATION SOURCES, RLA/9/013/001	BELO HORIZONTE,BRAZIL 3 AUGUST - 21 AUGUST	AGENCY	19	0	3	104,459 (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.

ANNEX III

PUBLISHED REPORTS: 1992

Recipient	Subject of report	Project code	Author(s) / Corporate Author	Reference no.
ALGERIA	COUNTRY PROGRAMME SUMMARIES, 1982-1992		EVALUATION SECTION, DEPT. OF TC, IAEA	IAEA-CPS-92/14
ARGENTINA	COUNTRY PROGRAMME SUMMARIES, 1982-1992		EVALUATION SECTION, DEPT. OF TC, IAEA	IAEA-CPS-92/26
BRAZIL	COUNTRY PROGRAMME SUMMARIES, 1982-1992		EVALUATION SECTION, DEPT. OF TC, IAEA	IAEA-CPS-92/25
BULGARIA	SEISMIC SAFETY REVIEW MISSION TO ASSIST IN THE EVALUATION OF THE DESIGN OF SEISMIC UPGRADING FOR KOZLODUY N.P.P.	BUL/9/012	MA, DAVID C. GODOY, ANTONIO RAMON PRATO, CARLOS A.	IAEA-TA-2459
	SEISMIC SAFETY REVIEW MISSION FOR THE FOLLOW UP OF THE SEISMIC UPGRADING FOR KOZLODUY N.P.P.	BUL/9/012	GODOY, ANTONIO RAMON DAVID, MILAN STEVENSON, JOHN DAVID GURPINAR, AYBARS SHIBATA, HEKI	IAEA-TA-2460
CAMEROON	COUNTRY PROGRAMME SUMMARIES, 1982-1992		EVALUATION SECTION, DEPT. OF TC, IAEA	IAEA-CPS-92/18
CHILE	COUNTRY PROGRAMME EVALUATION, 1981-1991		EVALUATION SECTION, DEPT. OF TC, IAEA	IAEA-CPE-92/01
CHINA	FOOD IRRADIATION PROCESS CONTROL AND ACCEPTANCE RPFI - PHASE III	RAS/5/020	GIDDINGS, GEORGE GOSSELIN	IAEA/UNDP-RAS/89/044-01
	MAN POWER DEVELOPMENT FOR NUCLEAR POWER PROGRAMME (PROJECT FINDINGS AND RECOMMENDATIONS)	CPR/4/003	CSIK, BELA JOSE	IAEA/UNDP-CPR/85/085-TR
COSTA RICA	COUNTRY PROGRAMME SUMMARIES, 1982-1992		EVALUATION SECTION, DEPT. OF TC, IAEA	IAEA-CPS-92/01
COTE D'IVOIRE	COUNTRY PROGRAMME SUMMARIES, 1982-1992		EVALUATION SECTION, DEPT. OF TC, IAEA	IAEA-CPS-92/19
CUBA	COUNTRY PROGRAMME SUMMARIES, 1982-1992		EVALUATION SECTION, DEPT. OF TC, IAEA	IAEA-CPS-92/02
EGYPT	COUNTRY PROGRAMME SUMMARIES, 1982-1992		EVALUATION SECTION, DEPT. OF TC, IAEA	IAEA-CPS-92/09
ETHIOPIA	COUNTRY PROGRAMME SUMMARIES, 1982-1992		EVALUATION SECTION, DEPT. OF TC, IAEA	IAEA-CPS-92/20
GHANA	COUNTRY PROGRAMME SUMMARIES, 1982-1992		EVALUATION SECTION, DEPT. OF TC, IAEA	IAEA-CPS-92/08
GUATEMALA	COUNTRY PROGRAMME REVIEW	INT/0/053	DEPT. OF TECHNICAL CO-OPERATION, IAEA	IAEA-TC-PM-005
	COUNTRY PROGRAMME SUMMARIES, 1982-1992		EVALUATION SECTION, DEPT. OF TC, IAEA	IAEA-CPS-92/05
HUNGARY	STRENGTHENING OF AN ADVANCED AUTOMATED RADIATION LABORATORY PROJECT FINDINGS AND RECOMMENDATIONS	HUN/1/008	HUNGARIAN ACADEMY OF SCIENCES	IAEA/UNDP-HUN/86/004-TR
INDIA	FOOD IRRADIATION PILOT SCALE STUDIES AND MARKET TESTING RPFI-PHASE III	RAS/5/020	GIDDINGS, GEORGE GOSSELIN	IAEA/UNDP-RAS/89/044-02
INDONESIA	ELISA FOR EPIDEMIOLOGY OF BRUCELLOSIS	INS/5/021	SUTHERLAND, S.S.	IAEA/UNDP-INS/88/013-16
	CONTROLLED RELEASE PESTICIDE FORMULATIONS	INS/5/021	VOLLNER, LAJOS	IAEA/UNDP-INS/88/013-17
	NUTRITIONAL STRATEGIES FOR RUMINANTS FED ON LOCAL FEED SUPPLEMENTED WITH MOLASSES MULTI-NUTRIENT BLOCKS	INS/5/021	NOLAN, J.V.	IAEA/UNDP-INS/88/013-18
	METHODS FOR INCREASING RUMINANT PRODUCTION FROM AVAILABLE FEED RESOURCES IN INDONESIA. NUTRITION-REPRODUCTION INTERACTIONS	INS/5/021	ENTWISTLE, K.W.	IAEA/UNDP-INS/88/013-19
	INSECT ECOLOGY STUDIES AND INSECT PEST CONTROL	INS/5/021	BUTT, BILLY ARTHUR	IAEA/UNDP-INS/88/013-20
	NATIONAL TRAINING COURSE ON ELISA FOR SERODIAGNOSIS OF ANIMAL DISEASES (IV)	INS/5/021	SPENCER, T.	IAEA/UNDP-INS/88/013-21
	NATIONAL TRAINING COURSE ON ELISA FOR SERODIAGNOSIS OF ANIMAL DISEASES (V)	INS/5/021	RICHARD H. JACOBSON	IAEA/UNDP-INS/88/013-22
	IMPLEMENTATION OF ELISA FOR BRUCELLOSIS AT DGLS LABORATORIES IN INDONESIA	INS/5/021	BARRY PATTEN	IAEA/UNDP-INS/88/013-23

Recipient	Subject of report	Project code	Author(s) / Corporate Author	Reference no.
INDONESIA	VALIDATION OF THE ELISA TECHNIQUE FOR THE DIAGNOSIS OF BOVINE BRUCELLOSIS AND IN THE USE OF COMPUTER PROGRAMS FOR RECORDING AND ANALYZING ELISA DATA	INS/5/021	EISLER, M.C.	IAEA/UNDP-INS/88/013-24
	SOURCES AND SINKS OF NITROGEN -E PHOSPHORUS-BASED NUTRIENTS IN CROPPING SYSTEMS	INS/5/021	WETSELAAR, R.	IAEA/UNDP-INS/88/013-25
	AGRICULTURAL PRODUCTION, PHASE II PROJECT FINDINGS AND RECOMMENDATIONS	INS/5/21	INTERNATIONAL ATOMIC ENERGY AGENCY	IAEA/UNDP-INS/88/013-TR
	FOOD IRRADIATION PROCESS CONTROL, MARKET TESTING AND ECONOMIC FEASIBILITY RPFI-PHASE III	RAS/5/020	GIDDINGS, GEORGE GOSSELIN	IAEA/UNDP-RAS/89/044-03
KENYA	COUNTRY PROGRAMME SUMMARIES, 1982-1992		EVALUATION SECTION, DEPT. OF TC, IAEA	IAEA-CPS-92/15
	FATE OF TRYPANOCIDAL DRUGS IN CATTLE	KEN/5/012	KRATZER, R.	IAEA/UNDP-KEN/90/023-TR
KOREA, REP. OF	ISOTOPES AND RADIATION IN AGRICULTURAL RESEARCH, PROJECT FINDINGS AND RECOMMENDATIONS	ROK/5/025	INTERNATIONAL ATOMIC ENERGY AGENCY	IAEA/UNDP-ROK/84/003-TR
	FOOD IRRADIATION PROCESS CONTROL AND ACCEPTANCE RPFI-PHASE III	RAS/5/020	GIDDINGS, GEORGE GOSSELIN	IAEA/UNDP-RAS/89/044-05
MADAGASCAR	COUNTRY PROGRAMME SUMMARIES, 1982-1992		EVALUATION SECTION, DEPT. OF TC, IAEA	IAEA-CPS-92/16
MALI	COUNTRY PROGRAMME SUMMARIES, 1982-1992		EVALUATION SECTION, DEPT. OF TC, IAEA	IAEA-CPS-92/17
MEXICO	COUNTRY PROGRAMME SUMMARIES, 1982-1992		EVALUATION SECTION, DEPT. OF TC, IAEA	IAEA-CPS-92/24
MONGOLIA	COUNTRY PROGRAMME REVIEW	INT/0/053	DEPT. OF TECHNICAL CO-OPERATION, IAEA	IAEA-TC-PM-004
NIGER	COUNTRY PROGRAMME SUMMARIES, 1982-1992		EVALUATION SECTION, DEPT. OF TC, IAEA	IAEA-CPS-92/21
NIGERIA	COUNTRY PROGRAMME SUMMARIES, 1982-1992		EVALUATION SECTION, DEPT. OF TC, IAEA	IAEA-CPS-92/10
PERU	COUNTRY PROGRAMME SUMMARIES, 1982-1992		EVALUATION SECTION, DEPT. OF TC, IAEA	IAEA-CPS-92/03
PHILIPPINES	FOOD IRRADIATION PROCESS CONTROL, REGULATION AND ACCEPTANCE RPFI-PHASE III	RAS/5/020	GIDDINGS, GEORGE GOSSELIN	IAEA/UNDP-RAS/89/044-04
REGIONAL	MANPOWER DEVELOPMENT IN AFRICA AND THE REGIONAL MANPOWER DEVELOPMENT PROJECT (SPECIAL EVALUATION)	RAF/0/003	EVALUATION SECTION, DEPT. OF TC, IAEA	IAEA-SE-92/02
	A DESK EVALUATION REVIEW OF THE REGIONAL (ASIA AND THE PACIFIC) PROJECT IN RADIOIMMUNOASSAY OF THYROID HORMONES	RAS/6/011	EVALUATION SECTION, DEPT. OF TC, IAEA	IAEA-PDE-92/01
	INDUSTRIAL APPLICATION OF ISOTOPES AND RADIATION TECHNOLOGY (PHASE I)	RAS/8/061	INTERNATIONAL ATOMIC ENERGY AGENCY	IAEA/UNDP-RAS/79/061-TR
	INDUSTRIAL APPLICATION OF ISOTOPES AND RADIATION TECHNOLOGY (PHASE II)	RAS/8/061	INTERNATIONAL ATOMIC ENERGY AGENCY	IAEA/UNDP-RAS/86/073-TR
	THE ARCAL PROGRAMME (A SPECIAL EVALUATION)		EVALUATION SECTION, DEPT. OF TC, IAEA	IAEA-SE-92/01
ROMANIA	DEFECTIVE FUEL PERFORMANCE EVALUATION	ROM/9/004	LEWIS, B.J.	IAEA/UNDP-ROM/87/002-03
SENEGAL	COUNTRY PROGRAMME SUMMARIES, 1982-1992		EVALUATION SECTION, DEPT. OF TC, IAEA	IAEA-CPS-92/07
SIERRA LEONE	COUNTRY PROGRAMME SUMMARIES, 1982-1992		EVALUATION SECTION, DEPT. OF TC, IAEA	IAEA-CPS-92/22
SRI LANKA	FOOD IRRADIATION PROCESS CONTROL, REGULATION AND ACCEPTANCE RPFI-PHASE II	RAS/5/020	GIDDINGS, GEORGE GOSSELIN	IAEA/UNDP-RAS/89/044-06
SUDAN	COUNTRY PROGRAMME SUMMARIES, 1982-1992		EVALUATION SECTION, DEPT. OF TC, IAEA	IAEA-CPS-92/11
TANZANIA, U. R.	COUNTRY PROGRAMME REVIEW	INT/0/053	CUARON, A. HANCE, R. YURTSEVER, Y. MAUDARBOCUS,Y.	IAEA-TC-PM-003
	COUNTRY PROGRAMME SUMMARIES, 1982-1992		EVALUATION SECTION, DEPT. OF TC, IAEA	IAEA-CPS-92/06

Recipient	Subject of report	Project code	Author(s) / Corporate Author	Reference no.
THAILAND	BREEDING FOR RESISTANCE TO DISEASES IN COTTON	THA/5/031	TED P. WALLACE	IAEA/UNDP-THA/85/004-23
	BREEDING FOR SOYBEAN RESISTANCE TO ANTHRACNOSE DISEASE	THA/5/031	PAUL A. BACKMAN	IAEA/UNDP-THA/85/004-24
	SCREENING PLANTS FOR DISEASE RESISTANCE	THA/5/031	GARY A. STROBEL	IAEA/UNDP-THA/85/004-25
	IMPROVING FOOD AND AGRICULTURAL PRODUCTION. (PROJECT FINDINGS AND RECOMMENDATIONS)	THA/5/031	INTERNATIONAL ATOMIC ENERGY AGENCY	IAEA/UNDP-THA/85/004-TR
	ROOD IRRADIATION PROGRAMME PLANNING FACILITY OPERATIONS AND PILOT SCALE STUDIES RPFI-PHASE III	RAS/5/020	GIDDINGS, GEORGE GOSSELIN	IAEA/UNDP-RAS/89/004-07
TURKEY	DEVELOPING OF NONDESTRUCTIVE TESTING TERMINAL REPORT	TUR/8/010	ALAT, ALI ZATOLOKIN, BORIS	IAEA/UNDP-TUR/87/016-TR
UGANDA	COUNTRY PROGRAMME SUMMARIES, 1982-1992		EVALUATION SECTION, DEPT. OF TC, IAEA	IAEA-CPS-92/23
URUGUAY	COUNTRY PROGRAMME SUMMARIES, 1982-1992		EVALUATION SECTION, DEPT. OF TC, IAEA	IAEA-CPS-92/04
VENEZUELA	CENTRE FOR NUCLEAR AGRICULTURE	VEN/5/009	GIL, J. L.	IAEA-TA-2458
VIET NAM	FOOD IRRADIATION PROGRAMME PLANNING FACILITY OPERATION AND PILOT SCALE STUDIES RPFI-PHASE III	RAS/5/020	GIDDINGS, GEORGE GOSSELIN	IAEA/UNDP-RAS/89/044-08
ZAIRE	COUNTRY PROGRAMME SUMMARIES, 1982-1992		EVALUATION SECTION, DEPT. OF TC, IAEA	IAEA-CPS-92/12
ZAMBIA	COUNTRY PROGRAMME SUMMARIES, 1982-1992		EVALUATION SECTION, DEPT. OF TC, IAEA	IAEA-CPS-92/13

ANNEX IV

VOLUNTARY CONTRIBUTIONS PLEDGED AND PAID TO THE TECHNICAL ASSISTANCE AND CO-OPERATION FUND FOR 1992
(as at 31 December 1992)

Member State	Base rate %	Share of $52.5 million target for voluntary contributions for 1992 using base rate[a/]	Pledged	Paid
Afghanistan	0.01	5,250	0	0
Albania	0.01	5,250	0	0
Algeria	0.15	78,750	0	0
Argentina	0.65	341,250	252,525	252,525
Australia	1.55	813,750	820,313	820,313
Austria	0.73	383,250	383,250	383,250
Bangladesh	0.01	5,250	5,250	5,250
Belarus	0.33	173,250	0	0
Belgium	1.16	609,000	127,796	0
Bolivia	0.01	5,250	0	0
Brazil	1.43	750,750	265,000	0
Bulgaria	0.15	78,750	10,000	9,939
Cambodia	0.01	5,250	0	0
Cameroon	0.01	5,250	5,250	0
Canada	3.06	1,606,500	1,050,395	1,050,395
Chile	0.08	42,000	42,000	540
China	0.78	409,500	409,500	409,500
Colombia	0.14	73,500	50,000	0
Costa Rica	0.02	10,500	0	0
Côte d'Ivoire	0.02	10,500	0	0
Cuba	0.09	47,250	47,250	47,250
Cyprus	0.02	10,500	9,800	9,800
Czech & Slovak F.R.	0.65	341,250	341,250	341,250
Dem. P.R. Korea	0.05	26,250	26,250	0
Denmark	0.68	357,000	357,000	357,000
Dominican Republic	0.03	15,750	0	0
Ecuador	0.03	15,750	0	0
Egypt	0.07	36,750	0	0
El Salvador	0.01	5,250	0	0
Ethiopia	0.01	5,250	0	0
Finland	0.50	262,500	262,500	262,500
France	6.19	3,249,750	3,249,750	3,249,750
Gabon	0.03	15,750	0	0
Germany	9.27	4,866,750	4,866,750	4,866,750
Ghana	0.01	5,250	0	0
Greece	0.39	204,750	204,750	204,750
Guatemala	0.02	10,500	0	0
Haiti	0.01	5,250	0	0
Holy See	0.01	5,250	2,625	2,625
Hungary	0.21	110,250	122,829	122,829
Iceland	0.03	15,750	15,750	15,750
India	0.37	194,250	194,250	194,250
Indonesia	0.15	78,750	39,000	39,000

Member State	Base rate %	Share of $52.5 million target for voluntary contributions for 1992 using base rate[a]	Pledged	Paid
Iran, I. R.	0.68	357,000	0	0
Iraq	0.12	63,000	0	0
Ireland	0.18	94,500	20,000	20,000
Israel	0.21	110,250	0	0
Italy	3.95	2,073,750	0	0
Jamaica	0.01	5,250	0	0
Japan	11.26	5,911,500	5,911,500	5,911,500
Jordan	0.01	5,250	0	0
Kenya	0.01	5,250	5,250	0
Korea, Rep. of	0.22	115,500	115,500	115,500
Kuwait	0.29	152,250	0	0
Lebanon	0.01	5,250	0	0
Liberia	0.01	5,250	0	0
Libyan A. J.	0.28	147,000	0	0
Liechtenstein	0.01	5,250	5,250	5,250
Luxembourg	0.06	31,500	0	0
Madagascar	0.01	5,250	0	0
Malaysia	0.11	57,750	57,750	57,750
Mali	0.01	5,250	0	0
Mauritius	0.01	5,250	0	0
Mexico	0.93	488,250	488,250	488,250
Monaco	0.01	5,250	0	0
Mongolia	0.01	5,250	5,250	0
Morocco	0.04	21,000	21,640	21,640
Myanmar	0.01	5,250	0	0
Namibia	0.01	5,250	0	0
Netherlands	1.63	855,750	855,750	855,750
New Zealand	0.24	126,000	0	0
Nicaragua	0.01	5,250	0	0
Niger	0.01	5,250	0	0
Nigeria	0.20	105,000	105,000	105,000
Norway	0.54	283,500	283,500	283,500
Pakistan	0.06	31,500	31,500	31,500
Panama	0.02	10,500	0	0
Paraguay	0.03	15,750	0	0
Peru	0.06	31,500	0	0
Philippines	0.09	47,250	5,376	5,376
Poland	0.55	288,750	288,750	181,165
Portugal	0.18	94,500	94,500	94,500
Qatar	0.05	26,250	0	0
Romania	0.19	99,750	0	0
Russian Federation	9.89	5,192,250	66,470	66,470
Saudi Arabia	1.01	530,250	0	0
Senegal	0.01	5,250	0	0
Sierra Leone	0.01	5,250	0	0
Singapore	0.11	57,750	0	0
South Africa	0.44	231,000	0	0
Spain	1.93	1,013,250	339,623	180,000

Member State	Base rate %	Share of $52.5 million target for voluntary contributions for 1992 using base rate[a/]	Pledged	Paid
Sri Lanka	0.01	5,250	0	0
Sudan	0.01	5,250	0	0
Sweden	1.20	630,000	630,000	630,000
Switzerland	1.07	561,750	561,750	561,750
Syrian A. R.	0.04	21,000	0	0
Thailand	0.10	52,500	52,500	52,500
Tunisia	0.03	15,750	0	0
Turkey	0.32	168,000	168,000	168,000
Uganda	0.01	5,250	0	0
Ukraine	1.24	651,000	0	0
U. A. Emirates	0.19	99,750	0	0
United Kingdom	4.81	2,525,250	2,525,250	2,525,250
U. R. Tanzania	0.01	5,250	5,250	0
USA	25.00	13,125,000	11,500,000	11,214,262
Uruguay	0.04	21,000	15,000	0
Venezuela	0.56	294,000	0	0
Viet Nam	0.01	5,250	5,250	5,250
Yugoslavia	0.45	236,250	236,250	0
Zaire	0.01	5,250	1,500	0
Zambia	0.01	5,250	5,250	5,250
Zimbabwe	0.02	10,500	0	0
Sub-total	100.00	52,500,000	37,567,892	36,230,629
New Members				
Estonia[b/]	0.07	36,750	0	0
Slovenia[c/]	0.09	47,250	47,250	0
Sub-total	0.16	84,000	47,250	0
Grand Total	100.16	52,584,000	37,615,142	36,230,629

a/ As recommended in GC(V)/RES/100 and amended in GC(XV)/RES/286.

b/ Estonia became a Member of the Agency on 31 January 1992.

c/ Slovenia became a Member of the Agency on 21 September 1992.

ANNEX V

COST-FREE FELLOWSHIPS: 1992

Donor	Number of fellowships offered in months	Number of fellows placed	Number of months placed	Number of fellows trained	Number of months of training
Austria	a	1	1	1	1
Belgium	a	-	-	1	11
Denmark	a	2	4	2	4
France	a	12	32	14	23
Germany	a	5	13	13	37
India	a	1	3	3	6
Israel	45	1	1	2	2
Italy	a	1	6	1	6
Spain	78	5	27	5	14
United Kingdom	a	4	36	6	35
USA	b	27	147	37	131

a No formal offer made however type II fellowships have been accepted.
b A specific amount of money was made available ($1,250,000) for administration and placement of fellows rather than a given number of months.

ANNEX VI

APPROVED AND ON-GOING UNDP PROJECTS AS AT 31 DECEMBER 1992

(in thousands of dollars)

Recipient	Short title	Project code	Total amount approved	Prior to 1992	Approved budgets		
					1992	1993	1994
A. Projects executed by the IAEA							
ALBANIA	STRENGTHENING OF NUCLEAR TECHNIQUES APPLICATIONS USING RESEARCH REACTOR	ALB87001	2,000	1,372	338	215	75
BRAZIL	NUCLEAR TECHNIQUES IN AGRICULTURE	BRA91008	17	17	0	0	0
CHINA	MANPOWER DEVELOPMENT FOR NUCLEAR POWER PROGRAMME	CPR85085	1,748	1,709	39	0	0
EGYPT	NATIONAL CENTRE FOR RADIATION TECHNOLOGY, PHASE III	EGY89015	331	255	76	0	0
INDONESIA	AGRICULTURAL PRODUCTION, PHASE II	INS88013	465	425	40	0	0
ROMANIA	NUCLEAR SAFETY	ROM87002	579	413	60	106	0
THAILAND	IMPROVING FOOD AND AGRICULTURAL PRODUCTION	THA85004	1,500	1,479	21	0	0
TURKEY	INDUSTRIAL STERILIZATION OF MEDICAL SUPPLIES	TUR88040	700	617	60	23	0
VENEZUELA	CENTRE FOR NUCLEAR AGRICULTURE	VEN86007	268	259	9	0	0
REGIONAL ASIA	INDUSTRIAL APPLICATION OF ISOTOPES AND RADIATION TECHNOLOGY	RAS86073	3,270	3,245	25	0	0
	FOOD IRRADIATION PROCESS CONTROL AND ACCEPTANCE	RAS89044	650	307	170	173	0
	INCREASING THE CAPABILITIES OF COMMON GRAIN LEGUMES	RAS89045	970	456	236	204	74
REGIONAL LATIN AMERICA	NON-DESTRUCTIVE TESTING IN QUALITY CONTROL PROGRAMMES	RLA92021	27	0	27	0	0
	NON-DESTRUCTIVE TESTING NETWORK	RLA84T01	1,611	1,588	23	0	0
Sub-total			14,136	12,142	1,124	721	149
B. Projects for which IAEA is associated agency							
CHINA	NUCLEAR SAFETY ADMINISTRATION	CPR85067	617	544	73	0	0
INTER-REGIONAL	ENVIRONMENTAL REHABILITATION OF LAKE MANZALA IN EGYPT	INT91G31	58	0	58	0	0
REGIONAL ARAB STATES	TRAINING OF TECHNICIANS IN WATER RESOURCES USE IN LEAST DEVELOPED ARAB COUNTRIES (LDAC)	RAB86008	21	17	4	0	0
	PROJECT FORMULATION MISSION FOR UNDP PROJECT SYR/92/005	RAB92002	10	0	10	0	0
Sub-total			706	561	145	0	0
TOTAL			14,842	12,703	1,269	721	149

ANNEX VII

FOOTNOTE-a/ PROJECTS MADE OPERATIONAL OR EXTENDED DURING 1992

Recipient	Project title and code	Expert services (months)	Equipment ($)	Fellowships ($)	Training courses ($)	Source[a)]
BRAZIL	Radiation protection in medical practice, BRA/9/035	2	0	0	0	GFR
	Tropical radioecology, BRA/9/040	1	0	9,900	0	FRA
COLOMBIA	Upgrading of research reactor instrumentation (Phase II), COL/4/011	1	35,000	0	0	USA
COSTA RICA	Production of DNA probes, COS/5/013	1	35,700	0	0	USA
CZECH & SLOVAK F.R.	Use of burnable absorbers in WWER-type reactors, CZE/4/003	1	10,000	29,700	0	FRA
	Assessment of environmental risks in the North Bohemia, CZE/9/007	1	0	6,600	0	FRA
ECUADOR	Study of sedimentation using nuclear techniques, ECU/8/015	2	6,000	0	0	UK
EGYPT	Training in solid physics, EGY/1/021	0	85,000	0	0	UK
	Personnel dosimetry, EGY/9/026	3	55,000	0	0	USA
	Radiological emergency preparedness, EGY/9/028	3	20,000	0	0	USA
GHANA	Nuclear instruments and computer interfacing, GHA/4/009	4	85,000	0	0	USA
	Genetic improvement of cocoa and coffee, GHA/5/016	1	25,000	3,300	0	UK
	Non-destructive testing (NDT), GHA/8/005	1	27,000	0	0	USA
GUATEMALA	Nuclear medicine, GUA/6/010	2	100,000	0	0	USA
HUNGARY	Establishing university courses in nuclear engineering, HUN/0/002	1	50,000	0	0	USA
INDONESIA	Uranium exploration and development, INS/3/009	3	10,000	13,200	0	FRA
	Establishment of a radioimmunoassay laboratory, INS/6/009	1	30,000	0	0	USA
	Internal dosimetry service, INS/9/018	2	50,000	0	0	USA
JORDAN	Upgrading radiotherapy at Al Bashir Hospital, JOR/6/008	3	15,000	19,800	0	UK
	Radioactivity in ground and drinking water, JOR/9/004	4	30,000	9,900	0	UK
KENYA	Nitrogen fixation by multipurpose tree species, KEN/5/015	2	60,000	18,000	0	UK
	Pesticide research, KEN/5/016	2	30,000	0	0	USA
MALAYSIA	Nuclear Instrumentation centre, MAL/4/006	1	40,000	0	0	USA
MEXICO	National nuclear training centre, MEX/0/009	1	80,000	0	0	USA
	Quality control applied to the use of ionizing radiation, MEX/1/017	0	150,000	0	0	USA
	Improvement of plant species, MEX/5/017	3	68,000	19,800	0	UK
	Isotopic studies on groundwater resources, MEX/8/018	1	0	19,800	0	UK
NIGER	Upgrading the radiation protection inspectorate, NER/9/006	1	40,000	0	10,000	FRA
NIGERIA	Environmental monitoring of radionuclides, NIR/9/006	4	30,000	0	0	USA

Recipient	Project title and code	Expert services (months)	Equipment ($)	Fellowships ($)	Training courses ($)	Source[a]
PERU	Energy and power assessment programme, PER/0/019	2	0	0	0	USA
	Methods for neutron activation analysis, PER/2/012	2	75,000	0	0	UK
	Central computer facility, PER/4/015	2	60,000	0	0	USA
PHILIPPINES	Impact of pesticides on the ecosystem, PHI/5/021	1	30,000	0	0	USA
	Applications of X-ray analysis, PHI/8/017	1	50,000	0	0	USA
PORTUGAL	Training on radiation protection, POR/9/010	1	10,500	0	0	FRA
ROMANIA	Radioimmunoassay standardization and quality control, ROM/6/010	1	50,000	0	0	USA
THAILAND	Establishment of a new gamma greenhouse, THA/5/039	1	195,000	0	0	UK
	Food irradiation on commercial scale, THA/5/040	2	0	19,800	0	UK
TUNISIA	Advanced non-destructive testing techniques in industry, TUN/8/010	2	55,000	0	0	FRA
URUGUAY	Maintenance and repair of nuclear instrumentation, URU/4/009	2	40,000	0	0	USA
REGIONAL AFRICA	Local preparation of radioimmunoassay reagents (AFRA V), RAF/6/007	2	55,500	0	25,000	FRA
	Non-destructive testing techniques (AFRA VI), RAF/8/017	2	17,800	0	15,000	TACF
REGIONAL ASIA & PACIFIC	Radioisotopes in industry (RCA), RAS/8/062	13	0	0	163,300	JPN
	Marine contaminant and sediment transport, RAS/8/065	5	25,000	0	0	USA
	Strengthening of radiation protection infrastructures (RCA), RAS/9/006	2	0	0	25,000	JPN
REGIONAL LATIN AMERICA	Immunoassay in animal production and health (ARCAL III), RLA/5/028	6	0	0	0	SWE
	Radiation protection - Phase II (ARCAL I), RLA/9/011	0	20,000	0	60,000	FRA

[a] Explanation of abbreviations: FRA = France; GFR = Federal Republic of Germany; JPN = Japan; SWE = Sweden
TACF = Technical Assistance and Co-operation Fund; UK = United Kingdom; USA = United States of America.

ANNEX VIII

APPROVALS AGAINST THE RESERVE FUND IN 1992

Recipient	Project title and number	Expert M/D	Expert $	Equipment	Other $	Total $
A. New Projects						
Bolivia	Brachytherapy service, BOL/6/017	1/00	9,300	40,700	0	50,000
Bulgaria	Nuclear safety and radiation protection standards, BUL/9/013	0/00	0	50,000	0	50,000
Ecuador	Application of nuclear techniques in environmental studies, ECU/7/004	0/27	20,000	0	0	20,000
Egypt	Upgrading of an electron beam accelerator, EGY/8/011	0/00	0	45,000	0	45,000
Hungary	Spent fuel storage technology, HUN/4/010	1/00	9,300	0	0	9,300
Lebanon	Radiation protection, LEB/9/002	3/00	27,900	10,000	9,000[a]	46,900
Namibia	Nuclear law and radiation safety, NAM/0/002	3/00	27,900	0	0	27,900
Pakistan	Site evaluation of Chasma Nuclear Power Plant, PAK/9/013	3/00	50,000	0	0	50,000
Philippines	Workshop on the management and evaluation of TC projects, PHI/0/008	1/15	18,000	0	0	18,000
Poland	Health effects of ionizing radiation, POL/9/016	0/25	23,000	0	0	23,000
Turkey	Rinderpest seromonitoring, TUR/5/017	0/15	4,650	19,650	0	24,300
Ukraine	Operational safety missions to nuclear power plants, UKR/9/003	4/00	42,120	0	0	42,120
Sub-total		16/82	232,170	165,350	9,000	406,520
B. Supplementary assistance to existing projects						
Bangladesh	Food irradiation, BGD/5/010	0/00	0	30,000	0	30,000
Brazil	Safety review - Angra I, BRA/9/041	0/19	18,000	0	0	18,000
Bulgaria	Upgrading of INIS system in Bulgaria, BUL/0/003	0/00	0	4,300	0	4,300
	Radiation technology, BUL/8/009	0/00	0	47,403	0	47,403
	OSART Missions to Kozloduy and Belene NPP's, BUL/9/011	0/28	6,408	0	0	6,408
Chile	Radiation protection, CHI/9/013	0/26	8,060	16,240	0	24,300
China	In-Core PWR fuel management, CPR/4/009	0/00	0	50,000	0	50,000
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	1/00	9,300	0	0	9,300
Romania	Environmental radiation monitoring, ROM/9/010	1/10	12,430	20,000	16,550[a]	48,980
Sub-total		2/83	54,198	217,943	16,550	288,691
TOTAL		19/65	286,368	383,293	25,550	695,211

[a] Approval for fellowship.

ANNEX IX

NET PROGRAMME CHANGES BY RECIPIENT: 1992

Recipient	Component	Existing Approval	Net change
AFGHANISTAN	EXPERTS (M/D)	6/00	-1/18
ALBANIA	EXPERTS (M/D)	3/15	-0/20
	EQUIPMENT (CC)	608,623	17,300
	FELLOWSHIPS (CC)	30,740	13,080
ALGERIA	EXPERTS (M/D)	23/23	-4/03
	EQUIPMENT (CC)	712,863	81,042
	EQUIPMENT (NCC)	284,600	-32,283
	FELLOWSHIPS (CC)	71,800	-17,913
ARGENTINA	EQUIPMENT (CC)	73,500	9,900
	FELLOWSHIPS (CC)	102,900	37,600
BANGLADESH	EXPERTS (M/D)	24/12	-2/12
	EQUIPMENT (CC)	1,375,782	80,348
	EQUIPMENT (NCC)	1,093,643	-128,885
	FELLOWSHIPS (CC)	273,580	-56,216
BOLIVIA	EXPERTS (M/D)	31/24	-4/04
	EQUIPMENT (CC)	595,365	30,976
	EQUIPMENT (NCC)	2,583	-2,541
	FELLOWSHIPS (CC)	46,578	23,522
	TRAINING COURSES (CC)	11,938	10,300
BRAZIL	EXPERTS (M/D)	203/22	-10/18
	EQUIPMENT (CC)	2,444,609	-9,030
	FELLOWSHIPS (CC)	407,057	-11,298
	FELLOWSHIPS (NCC)	0	3,400
BULGARIA	EXPERTS (M/D)	18/00	-0/11
	EXPERTS (M/D) (NCC)	0	0/28
	EQUIPMENT (CC)	910,649	62,753
	EQUIPMENT (NCC)	1,275,488	-115,280
	FELLOWSHIPS (CC)	107,150	7,590
	FELLOWSHIPS (NCC)	10,105	-195
	SUB-CONTRACTS (CC)	42,480	-2,000
CAMEROON	EXPERTS (M/D)	20/01	-6/29
	EQUIPMENT (CC)	117,500	12,050
	EQUIPMENT (NCC)	5,000	-5,000
	FELLOWSHIPS (CC)	54,000	-24,996

Recipient	Component	Existing Approval	Net change
CHILE	EXPERTS (M/D)	27/10	-6/19
	EQUIPMENT (CC)	1,221,518	50,821
	EQUIPMENT (NCC)	49,000	-1,610
	FELLOWSHIPS (CC)	183,290	69,853
CHINA	EXPERTS (M/D)	44/28	-5/06
	EQUIPMENT (CC)	1,492,474	139,004
	EQUIPMENT (NCC)	10,000	-1,240
	FELLOWSHIPS (CC)	713,895	-9,913
	FELLOWSHIPS (NCC)	11,000	-6,856
	SUB-CONTRACTS (CC)	9,510	-9,510
COLOMBIA	EXPERTS (M/D)	20/04	-4/24
	EQUIPMENT (CC)	1,608,079	31,146
	FELLOWSHIPS (CC)	124,000	-33,876
COSTA RICA	EXPERTS (M/D)	29/21	-9/09
	EQUIPMENT (CC)	393,080	162,558
	FELLOWSHIPS (CC)	73,150	-28,887
COTE D'IVOIRE	EXPERTS (M/D)	12/01	-1/16
	EQUIPMENT (CC)	238,943	9,145
	EQUIPMENT (NCC)	116,830	-5,857
CUBA	EXPERTS (M/D)	30/12	-7/06
	EQUIPMENT (CC)	1,364,705	84,568
	EQUIPMENT (NCC)	471,229	-330,895
	FELLOWSHIPS (CC)	177,709	-4,307
	FELLOWSHIPS (NCC)	8,860	9,831
CYPRUS	EXPERTS (M/D)	3/25	-0/28
	EQUIPMENT (CC)	472,584	19,736
	EQUIPMENT (NCC)	25,000	-25,000
	FELLOWSHIPS (CC)	70,350	3,261
CZECH AND SLOVAK FEDERAL REPUBLIC	MISCELLANEOUS (CC)		2,550
	EXPERTS (M/D)	10/00	3/01
	EQUIPMENT (CC)	58,730	22,660
	FELLOWSHIPS (CC)	60,585	1,280
	SUB-CONTRACTS (CC)	32,000	-32,000

Recipient	Component	Existing Approval	Net change
DEM. P.R. KOREA	MISCELLANEOUS (NCC)	10,000	9,384
	EXPERTS (M/D)	8/23	-1/27
	EQUIPMENT (CC)	1,358,722	43,023
	EQUIPMENT (NCC)	2,375,568	-167,238
	FELLOWSHIPS (CC)	96,000	-25,353
	FELLOWSHIPS (NCC)	13,012	-12,779
DOMINICAN REPUBLIC	EXPERTS (M/D)	12/11	-2/03
	EQUIPMENT (CC)	364,950	37,731
	EQUIPMENT (NCC)	4,945	-4,855
	FELLOWSHIPS (CC)	92,564	-5,501
ECUADOR	EXPERTS (M/D)	32/06	-1/08
	EQUIPMENT (CC)	1,842,216	69,101
	EQUIPMENT (NCC)	70,122	-738
	FELLOWSHIPS (CC)	146,785	15,328
	FELLOWSHIPS (NCC)	12,500	-3,703
EGYPT	EXPERTS (M/D)	24/06	-5/11
	EQUIPMENT (CC)	1,770,947	72,856
	EQUIPMENT (NCC)	2,700,000	-2,091,321
	FELLOWSHIPS (CC)	90,050	-25,555
	SUB-CONTRACTS (NCC)	6,700	-135
EL SALVADOR	EXPERTS (M/D)	17/18	-2/29
	EQUIPMENT (CC)	522,878	25,080
	EQUIPMENT (NCC)	10,000	-4,885
ETHIOPIA	EXPERTS (M/D)	40/04	-16/15
	EQUIPMENT (CC)	337,300	135,440
	EQUIPMENT (NCC)	320,000	-314,400
	FELLOWSHIPS (CC)	20,000	-4,000
GABON	EXPERTS (M/D)	4/27	-2/05
	EQUIPMENT (CC)	34,265	-1,318
GHANA	EXPERTS (M/D)	34/15	-3/25
	EQUIPMENT (CC)	638,348	21,040
	EQUIPMENT (NCC)	261,870	-108,058
	FELLOWSHIPS (CC)	51,600	5,000
GREECE	EXPERTS (M/D)	3/00	-0/08
	EQUIPMENT (CC)	50,000	10,111
	EQUIPMENT (NCC)	571,409	-560,082
	FELLOWSHIPS (CC)	31,500	-7,631

Recipient	Component	Existing Approval	Net change
GUATEMALA	EXPERTS (M/D)	11/26	-1/17
	EQUIPMENT (CC)	781,369	-16,072
	EQUIPMENT (NCC)	22,952	-14,056
	FELLOWSHIPS (CC)	149,355	-26,943
HAITI	EXPERTS (M/D)	5/13	-4/12
	EQUIPMENT (CC)	137,165	-46,071
	EQUIPMENT (NCC)	7,970	-4,659
HUNGARY	EXPERTS (M/D)	10/19	-0/04
	EQUIPMENT (CC)	273,663	3,763
	FELLOWSHIPS (CC)	15,682	2,820
INDONESIA	EXPERTS (M/D)	99/10	0/26
	EQUIPMENT (CC)	1,413,347	18,285
	EQUIPMENT (NCC)	130,000	-13,172
	FELLOWSHIPS (CC)	455,426	-33,935
	FELLOWSHIPS (NCC)	0	12,077
	SUB-CONTRACTS (CC)	8,000	5,000
INTERREGIONAL	EXPERTS (M/D)	451/06	-28/25
	EQUIPMENT (NCC)	77,363	-1,249
IRAN, ISLAMIC REPUBLIC OF	EXPERTS (M/D)	50/11	1/26
	EQUIPMENT (CC)	1,560,735	34,540
	EQUIPMENT (NCC)	1,212,500	-180,073
	FELLOWSHIPS (CC)	557,821	350
	FELLOWSHIPS (NCC)	25,026	-1,052
IRAQ	EXPERTS (M/D)	49/21	-4/09
	EQUIPMENT (CC)	10,000	-10,000
	EQUIPMENT (NCC)	800,000	-800,000
	FELLOWSHIPS (CC)	13,200	-13,200
	FELLOWSHIPS (NCC)	2,000	-304
JAMAICA	EQUIPMENT (CC)	120,000	-1,300
	FELLOWSHIPS (CC)	39,800	-24,448
JORDAN	EXPERTS (M/D)	52/20	-7/29
	EQUIPMENT (CC)	518,182	16,712
	EQUIPMENT (NCC)	56,056	-1,764
	FELLOWSHIPS (CC)	137,582	23,607
KENYA	EXPERTS (M/D)	15/08	-5/01
	EQUIPMENT (CC)	896,886	58,560
	EQUIPMENT (NCC)	15,000	-1,894
	FELLOWSHIPS (CC)	163,500	-11,750

Recipient	Component	Existing Approval	Net change
KOREA, REPUBLIC OF	EXPERTS (M/D)	49/24	-0/16
	FELLOWSHIPS (CC)	407,000	-5,270
LIBYAN ARAB JAMAHIRIYA	EXPERTS (M/D)	68/21	-2/22
	EQUIPMENT (CC)	447,130	18,290
	FELLOWSHIPS (CC)	401,800	-140,195
MADAGASCAR	EXPERTS (M/D)	8/12	-2/03
	EQUIPMENT (CC)	277,730	-158
	EQUIPMENT (NCC)	22,450	-1,066
	FELLOWSHIPS (CC)	3,000	17,738
MALAYSIA	EXPERTS (M/D)	48/15	-2/28
	EQUIPMENT (CC)	447,000	25,208
	FELLOWSHIPS (CC)	302,248	-6,918
MALI	EXPERTS (M/D)	6/00	-2/00
	EQUIPMENT (CC)	224,444	-2,165
	FELLOWSHIPS (CC)	39,600	-25,135
	SUB-CONTRACTS (CC)	25,000	-15,000
MAURITIUS	EXPERTS (M/D)	10/09	-0/14
	EQUIPMENT (CC)	291,650	-7,660
	EQUIPMENT (NCC)	32,922	-17,502
MEXICO	EXPERTS (M/D)	57/22	-2/08
	EQUIPMENT (CC)	963,074	5,782
	EQUIPMENT (NCC)	810,760	-749,197
	FELLOWSHIPS (CC)	212,585	17,208
	FELLOWSHIPS (NCC)	24,700	-9,057
	SUB-CONTRACTS (CC)	172,700	-3,500
MONGOLIA	EXPERTS (M/D)	9/19	1/09
	EQUIPMENT (CC)	724,230	95,807
	EQUIPMENT (NCC)	293,876	-21,808
	FELLOWSHIPS (CC)	307,657	-77,897
	FELLOWSHIPS (NCC)	62,672	-12,073
	SUB-CONTRACTS (CC)	36,895	-30,000
MOROCCO	EXPERTS (M/D)	54/17	-11/24
	EQUIPMENT (CC)	847,411	54,332
	FELLOWSHIPS (CC)	405,032	-7,738
MYANMAR	EXPERTS (M/D)	9/00	0/26
	EQUIPMENT (CC)	194,947	30,640
	EQUIPMENT (NCC)	59,600	-6
	FELLOWSHIPS (CC)	133,300	-6,490

Recipient	Component	Existing Approval	Net change
NAMIBIA	EXPERTS (M/D)	2/00	1/00
NICARAGUA	EXPERTS (M/D)	19/00	-11/19
	EQUIPMENT (CC)	381,560	218,423
	EQUIPMENT (NCC)	473,244	-365,764
	FELLOWSHIPS (CC)	159,950	-114,234
NIGER	EXPERTS (M/D)	25/20	-9/28
	EQUIPMENT (CC)	228,911	-17,640
	EQUIPMENT (NCC)	42,426	-1,935
	FELLOWSHIPS (CC)	86,500	-39,300
	TRAINING COURSES (CC)	10,000	-10,000
NIGERIA	EXPERTS (M/D)	42/25	-7/01
	EQUIPMENT (CC)	1,244,593	-6,230
	EQUIPMENT (NCC)	417,371	-412,123
	FELLOWSHIPS (CC)	215,368	14,307
	SUB-CONTRACTS (CC)	220,000	55,000
PAKISTAN	EXPERTS (M/D)	68/11	-15/00
	EQUIPMENT (CC)	1,481,250	120,042
	EQUIPMENT (NCC)	139,031	-13,201
	FELLOWSHIPS (CC)	326,663	-73,300
	FELLOWSHIPS (NCC)	0	5,350
	TRAINING COURSES (CC)	0	48,600
	SUB-CONTRACTS (CC)	52,078	55,800
PANAMA	EXPERTS (M/D)	7/00	-1/15
	EQUIPMENT (CC)	370,032	4,360
	FELLOWSHIPS (CC)	62,300	-5,530
PARAGUAY	EXPERTS (M/D)	12/00	-0/20
PERU	EXPERTS (M/D)	50/01	-11/07
	EQUIPMENT (CC)	1,116,030	395,696
	EQUIPMENT (NCC)	746,345	-193,701
	FELLOWSHIPS (CC)	176,170	-89,720
PHILIPPINES	EXPERTS (M/D)	7/01	0/12
	EQUIPMENT (CC)	1,123,645	57,910
	FELLOWSHIPS (CC)	239,052	-41,330
POLAND	EXPERTS (M/D)	8/28	-3/16
	EQUIPMENT (CC)	894,630	62,351
	EQUIPMENT (NCC)	945,772	-305,292
	FELLOWSHIPS (CC)	125,560	-29,491

Recipient	Component	Existing Approval	Net change
PORTUGAL	EXPERTS (M/D)	18/08	-2/20
	EQUIPMENT (CC)	652,242	-11,014
	EQUIPMENT (NCC)	1,009,921	-368,866
	FELLOWSHIPS (CC)	70,201	-12,132
REGIONAL AFRICA	EXPERTS (M/D)	378/08	26/21
	EQUIPMENT (CC)	1,605,646	106,066
	EQUIPMENT (NCC)	5,064	-1,863
	FELLOWSHIPS (CC)	4,384,215	252,577
	FELLOWSHIPS (NCC)	485,324	-62,231
	TRAINING COURSES (CC)	972,160	-129,156
	SUB-CONTRACTS (CC)	20,000	6,000
REGIONAL ASIA AND PACIFIC	EXPERTS (M/D)	290/14	-12/13
	EQUIPMENT (CC)	1,116,967	-41,300
	FELLOWSHIPS (CC)	4,130,222	-136,472
	FELLOWSHIPS (NCC)	1,379,958	-690,919
	TRAINING COURSES (CC)	1,219,892	200,797
	TRAINING COURSES (NCC)	3,684	22,494
REGIONAL EUROPE	MISCELLANEOUS (CC)	1,000	113
	MISCELLANEOUS (NCC)	2,850	10,123
	EXPERTS (M/D)	224/08	31/22
	EQUIPMENT (CC)	988,329	-110,058
	EQUIPMENT (NCC)	291,935	-25,500
	FELLOWSHIPS (CC)	3,110,204	-91,654
	FELLOWSHIPS (NCC)	328,351	-140,681
	TRAINING COURSES (CC)	674,894	-121,231
	TRAINING COURSES (NCC)	13,005	-8,736
	SUB-CONTRACTS (CC)	378,262	38,877
	SUB-CONTRACTS (NCC)	40,000	-773
REGIONAL LATIN AMERICA	MISCELLANEOUS (CC)	0	100
	EXPERTS (M/D)	294/04	7/02
	EQUIPMENT (CC)	2,379,239	236,039
	FELLOWSHIPS (CC)	1,352,928	-113,811
	FELLOWSHIPS (NCC)	326,811	-164,170
	TRAINING COURSES (CC)	3,946,583	-36,529
	TRAINING COURSES (NCC)	58,586	-396
	SUB-CONTRACTS (CC)	54,870	-6,486

Recipient	Component	Existing Approval	Net change
ROMANIA	EXPERTS (M/D)	28/16	4/00
	EQUIPMENT (CC)	584,988	49,737
	EQUIPMENT (NCC)	55,658	-3,131
	FELLOWSHIPS (CC)	202,403	25,617
	FELLOWSHIPS (NCC)	6,857	-17
	TRAINING COURSES (CC)	72,345	-72,345
SAUDI ARABIA	EXPERTS (M/D)	17/19	-0/29
	EQUIPMENT (CC)	15,080	31,423
	FELLOWSHIPS (CC)	14,250	6,200
SENEGAL	EXPERTS (M/D)	10/00	-2/25
	EQUIPMENT (CC)	232,500	-12,250
	EQUIPMENT (NCC)	10,000	-10,000
	FELLOWSHIPS (CC)	39,600	-39,600
SIERRA LEONE	EXPERTS (M/D)	13/24	-5/15
	EQUIPMENT (CC)	270,786	60,000
	EQUIPMENT (NCC)	220,000	-23,239
	FELLOWSHIPS (CC)	336,300	-83,208
	FELLOWSHIPS (NCC)	0	3,500
SINGAPORE	EXPERTS (M/D)	1/23	1/00
	EQUIPMENT (CC)	115,000	3,382
	FELLOWSHIPS (CC)	84,660	-34,777
SRI LANKA	EXPERTS (M/D)	14/04	-1/15
	EQUIPMENT (CC)	1,112,078	13,670
	EQUIPMENT (NCC)	63,950	-2,049
	FELLOWSHIPS (CC)	83,950	-10,100
SUDAN	EXPERTS (M/D)	30/21	-1/09
	EQUIPMENT (CC)	1,025,534	5,365
	EQUIPMENT (NCC)	55,300	-266
	FELLOWSHIPS (CC)	225,650	1,261
SYRIAN ARAB REPUBLIC	EXPERTS (M/D)	36/22	-5/26
	EQUIPMENT (CC)	1,785,941	95,550
	EQUIPMENT (NCC)	915,993	-544,659
	FELLOWSHIPS (CC)	138,924	34,751
	FELLOWSHIPS (NCC)	1,400	8,062
	TRAINING COURSES (CC)	22,000	-22,000
	SUB-CONTRACTS (CC)	7,602	-7,602

Recipient	Component	Existing Approval	Net change
THAILAND	EXPERTS (M/D)	41/22	-6/06
	EQUIPMENT (CC)	1,382,322	43,820
	EQUIPMENT (NCC)	272,000	-2,675
	FELLOWSHIPS (CC)	307,960	-23,534
	FELLOWSHIPS (NCC)	5,250	-235
TUNISIA	EXPERTS (M/D)	12/29	-3/05
	EQUIPMENT (CC)	457,155	3,075
	FELLOWSHIPS (CC)	34,161	-14,600
TURKEY	EXPERTS (M/D)	21/24	-1/27
	EQUIPMENT (CC)	668,588	44,250
	EQUIPMENT (NCC)	165,400	-74,208
	FELLOWSHIPS (CC)	106,113	-16,080
	FELLOWSHIPS (NCC)	0	19,000
UGANDA	EXPERTS (M/D)	21/04	-7/19
	EQUIPMENT (CC)	495,475	191,991
	EQUIPMENT (NCC)	750,000	-736,875
	FELLOWSHIPS (CC)	233,100	-43,000
UK (HONG KONG)	EXPERTS (M/D)	7/19	0/24
	FELLOWSHIPS (CC)	88,000	-56,055
UKRAINE	EXPERTS (M/D)	1/00	-0/08
	EQUIPMENT (CC)	75,350	-727
	FELLOWSHIPS (CC)	6,000	6,307
UNITED ARAB EMIRATES	EXPERTS (M/D)	12/06	-1/20
	EQUIPMENT (CC)	924,183	6,200
U.R. TANZANIA	EXPERTS (M/D)	42/18	4/20
	EQUIPMENT (CC)	625,245	5,550
	EQUIPMENT (NCC)	25,395	-14,539
	FELLOWSHIPS (CC)	162,093	-7,450
	FELLOWSHIPS (NCC)	300	-151
URUGUAY	EXPERTS (M/D)	12/01	-0/20
	EQUIPMENT (CC)	529,616	12,710
	EQUIPMENT (NCC)	5,500	-300
	FELLOWSHIPS (CC)	58,086	185
VENEZUELA	EXPERTS (M/D)	18/13	-2/29
	EQUIPMENT (CC)	416,079	46,517
	FELLOWSHIPS (CC)	75,726	-12,327

Recipient	Component	Existing Approval	Net change
VIET NAM	EXPERTS (M/D)	17/13	-0/14
	EQUIPMENT (CC)	1,489,574	193,988
	EQUIPMENT (NCC)	2,299,014	-506,079
	FELLOWSHIPS (CC)	492,139	-39,277
	FELLOWSHIPS (NCC)	62,985	-35,277
	TRAINING COURSES (CC)	0	620
YUGOSLAVIA	EXPERTS (M/D)	33/21	-10/00
	EQUIPMENT (CC)	768,408	-144,131
	EQUIPMENT (NCC)	2,391,821	-475,576
	FELLOWSHIPS (CC)	9,000	-9,000
ZAIRE	EXPERTS (M/D)	36/10	-14/15
	EQUIPMENT (CC)	169,360	19,717
	EQUIPMENT (NCC)	1,300,000	-1,300,000
	FELLOWSHIPS (CC)	234,587	-107,479
ZAMBIA	EXPERTS (M/D)	56/14	-6/16
	EQUIPMENT (CC)	1,839,115	54,959
	EQUIPMENT (NCC)	147,928	-14,028
	FELLOWSHIPS (CC)	122,619	-7,450
	SUB-CONTRACTS (CC)	10,000	-10,000
ZIMBABWE	EXPERTS (M/D)	10/02	-1/11
	EQUIPMENT (CC)	120,360	13,568
	EQUIPMENT (NCC)	5,021	-1,548
	FELLOWSHIPS (CC)	12,000	-858
TOTALS	MISCELLANEOUS (CC)	1,000	2,763
	MISCELLANEOUS (NCC)	12,850	19,507
	EXPERTS (M/D)	3,703/14	-244/17
	EXPERTS ($)	29,831,230	-2,002,738
	EXPERTS ($) (NCC)	114,600	116,647
	EQUIPMENT (CC)	59,423,422	3,249,554
	EQUIPMENT (NCC)	25,942,837	-11,104,052
	FELLOWSHIPS (CC)	24,276,533	-1,307,701
	FELLOWSHIPS (NCC)	2,767,113	-1,078,486
	TRAINING COURSES (CC)	6,929,812	-130,944
	TRAINING COURSES (NCC)	75,275	13,361
	SUB-CONTRACTS (CC)	1,069,399	44,578
	SUB-CONTRACTS (NCC)	46,700	-908
	TOTAL ALLOTTED	150,490,771	-12,178,419

ANNEX X

NET REPHASINGS UNDERTAKEN DURING 1992

Recipient	Project component	Net allotted/ Net rephased	Current year	1993
BOLIVIA	EQUIPMENT	ALLOTTED	212,907	60,000
	(CC)	REPHASED	16,000	-16,000
PERU	EQUIPMENT	ALLOTTED	29,195	5,000
	(CC)	REPHASED	5,000	-5,000
PORTUGAL	EQUIPMENT	ALLOTTED	282,195	120,000
	(CC)	REPHASED	30,000	-30,000
TOTALS	EQUIPMENT	ALLOTTED	524,297	185,000
	(CC)	REPHASED	51,000	-51,000
	TOTAL ALLOTTED		524,297	185,000
	TOTAL REPHASED		51,000	-51,000

ANNEX XI

EXTRABUDGETARY CONTRIBUTIONS FOR ACTIVITIES RELATING TO TECHNICAL CO-OPERATION WHICH ARE NOT INCLUDED IN THE TECHNICAL CO-OPERATION PROGRAMME: 1992

Donor	Activity	Funds Received $
AUSTRIA	RESEARCH AND DEVELOPMENT IN SUPPORT OF NEW WORLD SCREWWORM ERADICATION FROM NORTH AFRICA	310,200
BRAZIL	INTERNATIONAL CENTRE FOR THEORETICAL PHYSICS, TRIESTE	16,000
CYPRUS	INTERNATIONAL CENTRE FOR THEORETICAL PHYSICS, TRIESTE	500
IRAN, I.R.	INTERNATIONAL CENTRE FOR THEORETICAL PHYSICS, TRIESTE	7,800
ITALY	INTERNATIONAL CENTRE FOR THEORETICAL PHYSICS, TRIESTE	28,438,000
	IMPROVEMENT OF BASIC FOOD CROPS IN AFRICA THROUGH PLANT BREEDING INCLUDING THE USE OF INDUCED MUTATIONS	305,000
	DEVELOPMENT AND FIELD APPLICATION OF NUCLEAR TECHNIQUES FOR MALARIA RESEARCH AND CONTROL	105,000
JAMAICA	INTERNATIONAL CENTRE FOR THEORETICAL PHYSICS, TRIESTE	1,000
JAPAN	NUCLEAR MEDICINE	48,000
	RADIATION THERAPY	33,900
	RADIATION PROTECTION	50,000
	INTERNATIONAL CENTRE FOR THEORETICAL PHYSICS, TRIESTE	39,100
KUWAIT	INTERNATIONAL CENTRE FOR THEORETICAL PHYSICS, TRIESTE	26,700
LIBYAN A.J.	NUCLEAR DESALINATION PROJECT	53,100
NETHERLANDS	IMMUNOASSAY TECHNIQUES TO IMPROVE THE REPRODUCTIVE EFFICIENCY AND HEALTH STATUS OF INDIGENOUS AFRICAN LIVESTOCK	450,900
NORWAY	INTERNATIONAL CENTRE FOR THEORETICAL PHYSICS, TRIESTE	15,300
	AGRICULTURAL COUNTERMEASURES FOLLOWING ACCIDENTAL RELEASE OF RADIOACTIVE MATERIAL IN THE ENVIRONMENT	150,000
QATAR	INTERNATIONAL CENTRE FOR THEORETICAL PHYSICS, TRIESTE	1,300
SPAIN	INTERNATIONAL CENTRE FOR THEORETICAL PHYSICS, TRIESTE	15,000
	ASSISTANCE IN THE IMPLEMENTATION OF THE NEXT NUCLEAR POWER PLANT IN THE CSFR	151,700
SWEDEN	INTERNATIONAL CENTRE FOR THEORETICAL PHYSICS, TRIESTE	568,600
	IMMUNOASSAY AND DNA PROBE METHODS FOR SEROSURVEILLANCE OF RINDERPEST IN AFRICA AND FOR THE DIAGNOSIS AND CONTROL OF ANIMAL DISEASES IN LATIN AMERICA	349,500
	ADVERSE SIDE EFFECTS ON FLORA AND FAUNA FROM THE USE OF ORGANOCHLORINE PESTICIDES ON THE AFRICAN CONTINENT	354,600
	INCREASING AND STABILIZING PLANT PRODUCTIVITY IN LOW PHOSPHATE AND SEMI-ARID AND SUB-HUMID SOILS OF THE TROPICS AND SUB-TROPICS	89,900
SWITZERLAND	INTERNATIONAL CENTRE FOR THEORETICAL PHYSICS, TRIESTE	10,400
UK	INTERNATIONAL CENTRE FOR THEORETICAL PHYSICS, TRIESTE	34,000
OTHER DONORS a/	INTERNATIONAL CENTRE FOR THEORETICAL PHYSICS, TRIESTE	765,900
	ERADICATION PROGRAMME OF THE TSETSE FLY IN ZANZIBAR	50,000
TOTAL		32,441,400

a/ Includes contributions from various international organizations and national institutes.