

THE AGENCY'S TECHNICAL CO-OPERATION ACTIVITIES IN 1990

Report by the Director General

GC(XXXV)/INF/294

Printed by the
International Atomic Energy Agency
in Austria - August 1991



INTERNATIONAL ATOMIC ENERGY AGENCY

CONTENTS

LIST OF ABBREVIATIONS	vii
INTRODUCTION AND GLOSSARY	x
I. EXECUTIVE SUMMARY	1
II. REVIEW OF THE AGENCY'S TECHNICAL CO-OPERATION ACTIVITIES	3
A. Overview	3
1. General Issues	3
(a) In-house developments.....	3
(b) External developments	4
2. Resources and Delivery.....	5
3. Evaluation.....	7
B. Review by Field of Activity and Division	10
1. Field of activity	10
2. Division.....	10
C. Review by Area.....	13
1. Africa	13
2. Asia and the Pacific	14
3. Latin America	15
4. The Middle East and Europe	17
5. Global and Interregional.....	18
D. Review by Component.....	18
1. Experts	18
2. Equipment.....	20
3. Fellowships	21
4. Training Courses.....	21
5. Sub-contracts.....	22

E. Review by Fund	23
1. Technical Assistance and Co-operation Fund.....	23
2. Extrabudgetary Resources.....	25
3. UNDP.....	26
4. Assistance in kind	27
III. A PROFILE OF TECHNICAL CO-OPERATION ACTIVITIES IN THE MIDDLE EAST AND EUROPE.....	29
Afghanistan	30
Albania	31
Bulgaria	32
Cyprus.....	35
Czech and Slovak Federal Republic.....	36
Greece.....	37
Hungary	40
Iceland.....	42
Islamic Republic of Iran	44
Ireland	47
Iraq	48
Jordan.....	49
Poland	51
Portugal.....	55
Romania	57
Saudi Arabia.....	60
Spain	61
Syrian Arab Republic.....	62
Turkey	64
United Arab Emirates.....	67
Yugoslavia.....	68
Regional activities.....	71
IV. PROJECTS CONCLUDED DURING 1990: ACHIEVEMENTS	76
IMPLEMENTATION SUMMARIES, STATISTICAL FIGURES, TABLES AND ANNEXES.....	133
Implementation Summary I: All Funds.....	133
Implementation Summary II: Technical Assistance and Co-operation Fund.....	134
Implementation Summary IIIA: All Funds by Department and Division	135
Implementation Summary IIIB: Implementation against Future Years, All Funds by Department and Division	136
FIGURES.....	137
Explanatory Notes to Figures	137
1. Resources available for Agency technical co-operation programmes: 1984-1990.....	139
2. Disbursements by AAPC: 1990	140
3. Disbursements by component: 1981-1990.....	141

4. Technical co-operation personnel services by region: 1990	142
5. Distribution of equipment disbursements by region: 1990	143
6. Summary data on training programmes: 1990	144
7. Technical Assistance and Co-operation Fund disbursements by type of currency and region: 1990.....	145
8. Distribution of technical co-operation disbursements by AAPC and region: 1990	146
9. Distribution of technical co-operation disbursements by source and region: 1990	147
10. Utilization of the Technical Assistance and Co-operation Fund	148
TABLES	149
Explanatory Notes to Tables	149
1. Available resources: 1981-1990	151
2. Technical Assistance and Co-operation Fund: 1981-1990	152
3A. Project personnel by place of origin: 1990	153
3B. Trainees in the field by place of study: 1990.....	156
4. Distribution of technical co-operation disbursements by type: 1986-1990.....	158
5. Extrabudgetary funds for technical co-operation activities by donor as at 31 December 1990.....	159
6A. Technical co-operation personnel services: 1990	160
6B. Recipients of training abroad: 1990.....	161
7. Financial summary: 1990	163
8. Financial summary: 1958-1990	165
9. Women's participation in technical co-operation.....	167
ANNEXES	168
Explanatory Notes to Annexes.....	168
I. Disbursement of extrabudgetary and in-kind contributions: 1990	170
A. Assistance for activities where donor is not recipient.....	170
B. Assistance for activities where donor is recipient.....	171
II. Training courses: 1990	172
III. Published reports: 1990	178

IV. Voluntary contributions pledged and paid to the Technical Assistance and Co-operation Fund for 1990	179
V. Cost-free fellowships offered and awarded: 1990.....	181
VI. Approved and on-going UNDP projects as at 31 December 1990	182
VII. Footnote-a/ projects made operational or extended during 1990	184
VIII. Approvals against the Reserve Fund in 1990.....	186
A. New projects.....	186
B. Supplementary assistance to existing projects	186
IX. Net programme changes by recipient: 1990.....	187
X. Net rephasings undertaken during 1990	194
XI. Extrabudgetary contributions for activities relating to technical co-operation not included in the technical co-operation programme: 1990	197

LIST OF ABBREVIATIONS

AAPC	Agency's Area of Activity/Project Codes
ADBFB	Division of Budget and Finance, IAEA
AEOI	Atomic Energy Organization of Iran
AFRA	African Regional Co-operative Agreement for Research, Development and Training
Agency	International Atomic Energy Agency
ALASBIMN	Latin American Societies of Nuclear Biology and Medicine
ARCAL	Regional Co-operative Arrangements for the Promotion of Nuclear Science and Technology in Latin America
CC	Convertible currency
CEC	Commission of the European Communities
ELISA	Enzyme-linked immunosorbent assay
ENDF	Evaluated Nuclear Data File
ENEA	National Committee for Nuclear Energy and Alternative Research (Italy)
ESR-ENDOR	Electron spin resonance - electron nuclear double resonance
ETI Bank	National Enterprise for Exploration (Turkey)
FAO	Food and Agriculture Organization of the United Nations
IAEA	International Atomic Energy Agency
IBRD	International Bank for Reconstruction and Development (World Bank)
ICRP	International Commission on Radiological Protection
ICRU	International Commission on Radiation Units and Measurements
IDESSA	Institut des Savannes (Côte d'Ivoire)
INIS	International Nuclear Information System
INP	Institute of Nuclear Physics (Albania)
INSAAR	Integrated Safety Assessment of Research Reactors
INRNE	Institute for Nuclear Research and Nuclear Energy (Bulgaria)
LAN	Local area network
LDAC	Least-developed Arab country
LNETI	National Laboratory of Engineering and Industrial Technology (Portugal)
MDP	Methylene diphosphonate
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

NPP	Nuclear power plant
NRTC	Nuclear Research and Training Centre (Turkey)
OSART	Operational Safety Review Team
PAEC	Pakistan Atomic Energy Commission
PAEC	Philippine Atomic Energy Commission (now the Philippine Nuclear Research Institute)
PC	Personal computer
PIXE	Proton-induced X-ray emission
PNPP-1	First nuclear power plant in the Philippines
PNRI	Philippine Nuclear Research Institute
PWR	Pressurized water reactor
QA	Quality assurance
RAPAT	Radiation Protection Advisory Team
RCA	Regional Co-operative Agreement for Research, Development and Training Related to Nuclear Science and Technology
RENEL SA	Regia Nationala de Electricitate (Romania)
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
SAEC	Syrian Atomic Energy Commission
TACC	Technical Assistance and Co-operation Committee
TACF	Technical Assistance and Co-operation Fund
TAEA	Turkish Atomic Energy Authority
TC	Department of Technical Co-operation, IAEA
TCDC	Technical co-operation among developing countries
TCMS	Technical Co-operation Management System
TCPM	Division of Technical Co-operation Programmes
TSH	Thyroid-stimulating hormone
UN	United Nations
UNDP	United Nations Development Programme
UNDP-IPF	UNDP Indicative Planning Figure
UNESCO	United Nations Educational, Scientific and Cultural Organization
UNFSTD	United Nations Fund for Science and Technology for Development
UNTCD	Department of Technical Co-operation for Development, United Nations
WAMAP	Waste Management Advisory Programme

WHO	World Health Organization
WWER	Pressurized water-cooled and water-moderated power reactor
XRF	X-ray fluorescence

COUNTRY ABBREVIATIONS

Byelorussian SSR	Byelorussian Soviet Socialist Republic
Dem. Kampuchea	Democratic Kampuchea
Dem. P.R. Korea	Democratic People's Republic of Korea
German D.R.	German Democratic Republic
Germany, F.R.	Federal Republic of Germany
Iran, I.R.	Islamic Republic of Iran
Korea, R.	Republic of Korea
Libyan A.J.	Libyan Arab Jamahiriya
St. Christopher	St. Christopher-Nevis
Syrian A.R.	Syrian Arab Republic
Ukrainian SSR	Ukrainian Soviet Socialist Republic
USSR	Union of Soviet Socialist Republics
U.A. Emirates	United Arab Emirates
UK	United Kingdom of Great Britain and Northern Ireland
U.R. Tanzania	United Republic of Tanzania
USA	United States of America

AAPC PROGRAMME-LEVEL CODES

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

INTRODUCTION AND GLOSSARY

INTRODUCTION

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

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

Sections III and IV focus on results achieved. With a profile of the technical co-operation activities in the Middle East and Europe in Section III, all four regions have now been highlighted in this manner in successive reports since 1987. Section IV provides a summary of the accomplishments of each project completed during 1990. In-depth assessments of the qualitative aspects and achievements of Agency technical co-operation continue to be provided through evaluation reports.

Some Member States had expressed the wish that activities financed from extrabudgetary resources which are of particular relevance to developing countries should be included in reports on Agency technical co-operation even if such activities were not initiated by or implemented through the Agency's Department of Technical Co-operation. A new table is therefore provided in Annex XI which contains this information.

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 definitions of terms and concepts used in the report as applied in respect of the 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.

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

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

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

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

UNDP Programme — projects executed by the Agency on behalf of UNDP and its associated funds, including UNFSTD.

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

- The first two-year technical co-operation programme was concluded in 1990. The experience with and the advantages/disadvantages of a two-year cycle will be the subject of a specific evaluation to be submitted to the Technical Assistance and Co-operation Committee in December. It may already be stated that for staff of the Secretariat involved in technical co-operation activities the experience has been a positive one.
- Helped by the advantages of the two-year cycle and by the various measures taken in the past few years to increase efficiency, the implementation rate for all funds rose significantly in 1990 (from 56.5% to 67.8%) and even more sharply for the TACF, (from 58.0% to 71.3%).
- No further decline in the percentage of the target met through pledges occurred in 1990 as 85.3% of the \$45.5 million target was met.
- The devaluation of the rouble, the major non-convertible currency in the technical co-operation programme, caused a book-keeping loss of \$8.5 million, severely distorting comparison with tables, graphs and statistics of prior years based on financial figures as these now include NCC at the new exchange rate.
- New resources for technical co-operation available in 1990 amounted to \$44.6 million; without NCC devaluation they would have stood at \$53.1 million. The Technical Assistance and Co-operation Fund (TACF) accounted for 77.8% of all resources, extrabudgetary funds for 10.8%; 6.4% was derived from UNDP and 5% from assistance in kind.
- The optimum distribution of resources amongst project components is determined by the objectives of the individual projects and is not set in advance for the programme as a whole. Nevertheless, a greater balance emerged in 1990 for the overall programme: equipment accounting for 37.7%, fellowships and training for 30.9% and expert services for 28%.
- Overprogramming, a means used to attain higher resource utilization, has been discontinued. The 1990 programme was kept strictly within the financial parameters upon which it was originally based. As resources were higher than forecast, a programme surplus of \$1.2 million in CC and \$0.8 million in NCC prevailed at year-end.

- A total of 1057 projects were operational during 1990, of which 159 were completed; 108 regional and interregional training courses and 89 national group training events were held. A total of 2415 persons received 4595 months of training abroad and 2221 experts/lecturers assignments were undertaken delivering 1217 months of expertise.
- The regional co-operative agreement for Member States in Africa came into force. Ten Member States have acceded to it so far.
- Discussion within the UN System concerning the successor arrangements to the present UNDP Executing agency support cost system continued.
- Computerization proceeded with new software developments. The Expert Post Control System became fully operational and led to distinct productivity gains. The Department's local area network (LAN) expanded by some 20%.
- In addition to two sectoral evaluations and a mid-term evaluation of a large-scale UNDP project, two other major evaluations were carried out in 1990 while work continued on the development of a non-financial project implementation reporting system.

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 conclusion of the first ever biennial programme for the Agency's technical co-operation activities. A detailed evaluation will be prepared in 1991, but it is felt that the two-year cycle has been of genuine assistance to the Secretariat in its efforts to cope with a growing technical co-operation programme. Certain findings during the first two-year cycle may prove to be characteristic for a biennial programme as such. Amongst these are that implementation perceptibly increases during the second year, as most of the preparatory work which may not have been completed at the start of the new programme is carried out during the course of the first year. It is noteworthy that this increase occurs in the second year notwithstanding the fact that during that year the heavy workload of preparing the new biennial programme also has to be borne.
2. Pre-project assistance activities continued with 67 missions to 39 countries. The results of missions which took place early in the year could still be incorporated in the 1991-1992 programme, which was formulated during the year. Later missions focused on forward planning for the next cycle as well as on concrete advice on work plans and implementation strategies for projects included in the 1991-1992 programme, which was submitted to and approved by the Board in December.
3. Quite apart from specific programming, pre-project assistance and review missions, every effort was made to intensify contacts with recipient governments and counterparts through missions in Vienna, and directly through modalities such as the regular provision of project status information to the field and the project implementation reporting system, which furnishes feedback from the field.
4. At the request of the Division of Technical Co-operation Programmes, an evaluation was carried out of the Department's initial experience with formal Project Management Plans. The evaluation confirmed that the use made of these plans and the benefit accruing from them was not as high as expected. Weaknesses were identified, and several recommendations were made — including a better designed form and a clearer assignment of responsibilities within the Department for ensuring fuller use of Project Management Plans. Upon approval of the recommendations, a revised Project Management Plan was introduced in connection with the 1991-1992 programme.
5. The Department was closely involved in the preparation of the Agency's Medium-term Plan. As a technical co-operation programme has to be geared to the needs of Member States and has to be responsive to Member States' requests, this involvement focused on providing inputs to the technical Departments — based on past and more recent experience — to ensure that cognizance is taken in the Agency's Medium-term plan of the areas of concern to developing Member States. These areas are most likely to receive emphasis in future requests for technical co-operation.
6. With highly appreciated assistance of the United Kingdom, a further TC Management Development Workshop was organized in 1990 in which ten staff members of the TC Department as well as four technical officers and one staff member from ADBF

participated. During the course, one of the teams developed ideas for a project for the enhancement of information flows to counterparts in major recipient countries. Preparatory work proceeded during the year and the project will be launched in 1991.

7. As will be described in para. 37 below, Project Management and Evaluation courses were also organized in the field for government staff and national counterparts.

8. During 1990 a number of software developments were undertaken to improve both reporting and productivity in the TC Department. The computerized Expert Post Control System (EPCS) became operational in 1990. This system is fully integrated with the day-to-day work of the Expert Section and is used to record all recruitment and assignment actions for each TC expert job. This LAN-based system receives and sends information to the computerized Technical Co-operation Management System (TCMS) so that duplication of data is completely eliminated. It is this program package which will be the model on which other systems for the automation of work-flow in the Fellowships, Training Courses and Field Procurement Sections will be based.

9. In addition, the equipment module of TCMS was expanded to include all equipment purchased in connection with Training Courses.

10. In 1990, the Department's local area network (LAN) expanded by approximately 20%, some 100 staff members now being able to access common databases and applications. Efforts continued throughout the year to enhance LAN-based programme planning and project management tools, as well as to establish improved and more comprehensive basic services.

11. As noted in last year's report, however, workloads associated with maintenance and backstopping have increased; at the same time, the expanded hardware base has generated demands for accelerated applications development which cannot be satisfied with existing staff resources. In consequence, a review of departmental information systems was undertaken by a cost-free expert during the course of the year. He concluded that, while the efforts made to date were indeed laudable, LAN-based applications development and user support would have to be strengthened if the automation potential offered by the LAN were to be exploited to the fullest degree. Meanwhile, the expert's report has been submitted to management for appropriate review and action.

(c) External developments

12. The African Regional Co-operative Agreement for Research, Development and Training related to Nuclear Science and Technology (AFRA) entered into force on 4 April 1990. Ten African Member States have so far acceded to it. As a result of the meeting of AFRA's technical working group in September, the first AFRA Programme, containing seven regional activities, was formulated in time for inclusion in the 1991-92 programme.

13. The political situation in the Gulf Region had a noticeable impact on the delivery of expert services in the last quarter of 1990. This was not limited to assignments to the countries in the area as general travel restrictions and apprehensions concerning travel affected missions to other areas as well.

14. The drastic devaluation of the rouble towards the end of 1990 not only caused distortions in financial statistics based on dollar figures but also necessitated adjustments to all unliquidated obligations and the careful scrutiny of all projects for which it was intended to utilize this currency so that corresponding adjustment could be made to earmarkings. While the devaluation, as such, did not effect programme implementation, economic restructuring in the USSR and elsewhere in Eastern

Europe began to have repercussions on programme delivery since several firms had difficulties in complying with old contracts. Problems in programming major non-convertible currencies will undoubtedly increase.

15. Within the UN System, the Agency remained closely involved in deliberations concerning successor arrangements of the present system of UNDP support costs. During its June 1990 Session, the Governing Council of UNDP adopted resolution 90/26, which explicitly confirmed that the basic elements of the current regime would continue for smaller agencies. For the IAEA, this meant that the present level and method of reimbursement of support costs — 22% of the value of assistance delivered under UNDP-financed projects and payment from central UNDP resources in New York — would be maintained.

16. Unfortunately, the matter seems not to have ended with this resolution. Recently (March 1991) the smaller agencies were informed that, during discussions at the special UNDP Governing Council session in February 1991, several delegations had indicated that reimbursements to agencies not subject to the new regime of support costs should be charged to the Indicative Planning Figures of the countries involved. The smaller agencies are unanimous in their views that this would be contrary to the decision taken in the June Council and that it would be harmful to the development of the sectors/technologies they deal with at the country level. As individual country UNDP-IPF resources would be charged with the support costs, governments may be reluctant to see agencies execute a project and may, for this reason only, opt for government execution. As it is precisely in the more sophisticated technical fields — which the smaller agencies cover — where agency know-how is most likely to be required and beneficial, such decisions may be to the ultimate detriment of the country concerned.

17. UNDP has been apprised of these views, and further developments will depend on the outcome of the next session of the Governing Council in June 1991.

2. Resources and Delivery

Total new resources	\$44.6 million
Adjusted current year programme.....	\$62.6 million
New obligations (current year).....	\$42.4 million
Implementation rate.....	67.8%
Disbursements and assistance in kind	\$49.4 million

18. Total new resources available for Agency technical co-operation amounted to \$44.6 million, decreasing by \$5.5 million (or 11.1%) over the previous year. This was solely due to the devaluation of the USSR rouble, which caused a loss on exchange of \$8.5 million in December of 1990. This single fact distorts any analysis, table or graph dealing with or based on financial aspects of the technical co-operation programme as a whole and of the TACF and extrabudgetary resources parts of it in particular. It is stressed therefore that the exchange loss in the NCC components with all its attendant effects on statistics, is in fact a book-keeping loss: neither the amount of convertible currency available to the TC programme nor the amount of available roubles has changed. It is important to bear this in mind, since otherwise erroneous conclusions may be drawn on resource and programme trends in 1990 where overall dollar amounts have been quoted. Without this anomaly, the dollar value of overall resources would have shown an *increase* of 5.9%, reaching \$53.1 million.

19. The exchange rate losses led to a 7.1% decrease in the TACF and contributed significantly to a 34.6% decrease in extrabudgetary resources. The relative weights of the various sources of funds for the Agency's technical co-operation activities did not change much: the TACF grew to 77.8% of total resources and extrabudgetary funds declined to 10.8%. The shares of UNDP (representing 6.4% of resources) and

assistance in kind (5%) increased slightly. Figure 1 provides information on the development of these resources over the past seven years and also illustrates the impact of the rouble adjustments in 1990.

20. The total value of all technical co-operation activities approved for a given calendar year plus the value of all approved but as yet unimplemented assistance brought forward from previous years (and adjusted during the year owing to cancellations, rephasings and additions) constitutes the "adjusted programme". In 1990, the value of the current-year adjusted programme decreased by \$4.1 million (or 6.2%) to \$62.6 million. An additional \$12.7 million had been approved for future year activities.

21. Implementation actions during 1990 resulted in new obligations valued at \$42.4 million, a figure which is significantly higher than that for 1989 (\$37.7 million). The volume of technical assistance set in motion during 1990 includes additionally \$1.2 million against the future-year programme.

22. 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
	(%)	(%)	(%)	(%)	(%)
1986	75.7	68.7	32.2	83.7	67.6
1987	67.0	55.0	37.5	77.7	61.3
1988	65.0	25.6	56.5	82.8	64.1
1989	58.0	44.1	46.7	70.2	56.5
1990	71.3	35.6	50.4	88.6	67.8

23. As is evident from the table, implementation was higher in respect of all funds except funds in trust. As this category of funds represents only 1.2% of the adjusted programme, its impact on the overall implementation rate is negligible. Total implementation from all funds in 1990 reached the highest rate so far, with substantial increases in all major funds, especially the TACF. The performance of each of the funds is discussed separately, in Part E of this Section, and a detailed and comprehensive overview of the status of the total programme at end 1990 is given in Implementation Summaries I and II.

24. The significant increase in implementation rates achieved during the year under review would indicate that the various measures taken by the TC Department to provide an optimum framework for the delivery of technical assistance have indeed led to tangible improvements. At the same time all indications are that in a two-year cycle a pattern of higher implementation in the second year might establish itself.

25. Disbursements, which, after declining in 1988, had risen by \$4 million to \$41 million in 1989, again rose considerably in 1990 (by \$8 million) to \$49 million.

26. At the beginning of 1990, 966 projects were operational. In addition to authorizing new provisions for on-going projects, the Board also approved 12 new projects as well as the upgrading of 15 footnote-a/ projects from TACF resources so that there were 993 projects financed from all sources and in various stages of implementation on the books on 1 January 1990. During the year, 40 training courses were approved, 6 footnote-a/ projects were upgraded, 16 Reserve Fund projects were created and 2 new UNDP projects became operational. These 64 additional projects brought the total number of operational projects in 1990 to 1057. (1989: 1135)

27. In the course of the year, 159 projects were completed, of which 34 were training courses. At the end of the year, 898 projects were still operational. Projects ranged in size from one month of expert services valued at \$8400 to multi-year projects with 1990 budgets around the \$1 million mark.

28. A total of 448 reports were produced for submission to national authorities in Member States. Listed in Annex III are the 25 reports which were published.

3. Evaluation

29. The Agency's project implementation reporting system, which covers all TC projects, continues to be the major instrument by means of which national counterparts report on the progress of projects, on difficulties and achievements, and make recommendations for additional actions required to advance project implementation. The reports, about 600 during 1990, provide Agency support staff with up-to-date information on implementation, so that early corrective action can be taken to overcome reported delays and difficulties. The information in these reports assists the Secretariat in selecting issues for in-depth evaluation.

30. Action was undertaken to develop the project reporting system as a tool for providing implementation rate information of a non-financial type. A database and coding system were designed and are being implemented on a test basis. After project implementation reports have been assessed by Agency area and technical staff, they are rated "excellent", "average" or "below average" as an adjunct to the traditional measure of implementation based on expenditure. This system becomes fully operational in 1991, and the resulting data will be reported to the Board.

31. Interim project implementation reports completed this year indicate a generally satisfactory record. Most implementation problems reported are rooted in inadequate project preparation and design, particularly where a substantial national budgetary commitment is required for Agency assistance to be effective. Assumptions made at the time of project approval as to the scheduling of the Agency inputs are often too optimistic so that equipment either cannot be ordered according to the original timetable or substantial storage costs are charged by suppliers. Steps to provide greater assistance to Member States with project design and review need to be vigorously pursued. A second issue that hinders effective implementation is the excessive number of very small projects. Such projects very often prove difficult and expensive to implement because they do not receive the same careful technical and management review as larger projects.

32. A major sectoral evaluation was completed in 1990 on animal production and health projects in Latin America. This evaluation was given high priority by the Department of Technical Co-operation as the strategy of integrating TC project funds with Regular Budget and bilateral donor support has allowed an innovative approach to Latin America animal production and disease problems. This approach focused on the creation of mutually supporting networks using ARCAL as a pivot. Lessons learned might be significant for other regional activities of the Agency. The evaluation concluded that the animal production and health programme contributed significantly to the development of the scientific infrastructure required for the application of nuclear and related techniques in the animal production sector, and in particular, to the establishment of RIA (radioimmunoassay) laboratories and the development of scientific staff throughout the region. The Agency assisted in the establishment of an infrastructure which has supported the successful introduction of nuclear and related techniques to improve livestock productivity in Latin America. A major achievement, particularly within the context of ARCAL, is the regionalization of activities; through the programme, scientists have become aware of, and more interested in, activities in other countries, and some important collaborative links have been established. As can be expected in a programme as challenging as this, implementation has not been easy or successful in every case. Factors were identified which, on occasion, prevented full utilization of the assistance being provided. Although these constraints were serious in some individual projects, it was concluded that they had not prevented overall successful implementation of the programme.

33. In conformity with UNDP procedures, a mid-term evaluation was undertaken to assess the performance of the large-scale Asian project on industrial applications of isotopes and radiation technology. In addition to an examination with project staff of all available background material, a field mission — composed of two external experts and one evaluation staff member — reviewed project activities in six countries and, with a specially convened group of regional experts, reviewed the project as a whole. The overall assessment was that the basic approach of the second phase i.e. large reliance on regional training and information exchange, together with continuation of the demonstration activities initiated during the first phase is a generally sound way of catalyzing technology transfer. The momentum of the first phase is being maintained. Substantial differences between countries as regards needs, level of technological advancement, commercialization of nuclear applications, and adaptability of the specific technologies to local conditions have been coped with fairly effectively. There is evidence of wide regional participation and of the substantial contribution that the TCDC approach is making to increasing the resources available. The project has mobilized additional resources from Australia and Japan (two regional donors which are not recipient States), Indonesia (the project host country) and China (support of a 1989 workshop).

34. Regional projects are an integral part of the Agency's TC programme, addressing shared concerns in a given region. The share of regional projects in the assistance provided to Africa was minimal up to the end of 1983 (about 1.5 per cent). It went from 3.1 per cent in 1984 to 11.3 per cent in 1988, when the African Section requested that an evaluation be undertaken of the way in which the Secretariat was planning and implementing the African regional programme. The request was given high priority as the African Regional Co-operative Agreement (AFRA) had just been concluded. The evaluation concluded that the projects in Africa fulfil the most important functions of regional projects — namely, to co-ordinate the assistance provided to individual countries in the light of the requirements for overall regional development; to co-ordinate the activities and resources available under various Agency programmes; and to increase the opportunities for professional contacts across national borders between scientists in the region.

35. The expertise and the infrastructure required for the adequate management and disposal of radioactive waste exist to only a very limited extent in many developing countries, most of which lack integrated waste management strategies and policies. Waste management is generally not given as high a priority by developing Member States submitting TC project proposals as other nuclear-energy-related subjects. The Agency's Radioactive Waste Management Advisory Programme (WAMAP) was established in 1987 with financial support provided through an interregional TC project (INT/9/081). WAMAP's primary objective is to assist developing Member States in the practical implementation of radioactive waste management and disposal programmes; in particular, national waste management requirements are assessed. WAMAP promotes the practical development and implementation of safe waste management options. Like the Radiation Protection Advisory Team (RAPAT) programme, it involves expert missions to Member States. As of March 1990, the budget of this multi-year project included provision for 66 man-months of expert services (including the services of the WAMAP Co-ordinator) — 15 man-months each in 1987 and 1988 and 18 man-months each in 1989 and 1990 — at a total cost of \$516,250, which is being provided from the Technical Assistance and Co-operation Fund (TACF). Between the beginning of 1987 and November 1989 — the period examined in the evaluation — 23 Agency Member States were visited by WAMAP missions. The potential waste management concerns of these 23 States can be gathered from the following: six have only isotope application programmes; six have uranium or mon-oxide mining/processing facilities; twelve have research reactors; and eight have nuclear power plants either operational or under construction. The purpose of the evaluation was to assess the efficiency and effectiveness of WAMAP and the extent to which there has been effective follow-up on recommendations. The evaluation indicated that actual experience with WAMAP had been less satisfactory than expected,

e.g. WAMAP reporting procedures were unsatisfactory; in seven of the ten cases reviewed there were delays of five months or more between the conclusion of the mission and the issuance of a report, and in one case no report was sent to the government concerned. None of the ten governments indicated their response to the recommendations made. No mechanism had been created within the Secretariat for determining whether any follow-up action was being taken as a result of WAMAP recommendations. The recommendations made to overcome the problems identified in this evaluation are currently under review.

36. It was decided to update the financial analysis carried out in 1988 in a study of the structure and functioning of RCA and ARCAL (see GOV/INF/573, paras 44-45). Although there are many differences between the funding arrangements, they share a substantial dependence upon the resources of the TACF. In the period 1983-90, ARCAL had \$4.57 million budgeted from TACF and RCA had \$3.0 million. In the case of ARCAL, TACF support has grown in the last two years at an annual rate of almost 20 per cent — significantly above the growth rate of the TC programme as a whole and of TACF-supported national programmes. Although the growth rate has been lower in the case of RCA, TACF support has increased by more than support from other funding sources during three of the last four years. Neither RCA nor ARCAL has yet demonstrated the ability to operate without considerable support from TACF and the research contracts programme. Current expenditure patterns suggest that Agency support for RCA and ARCAL is increasing relatively and that this support remains essential to their existence. The evaluation emphasizes that, if the further growth of RCA and ARCAL is to be ensured, there is a need for greater effort and imagination to secure extrabudgetary funds from countries both within and outside the two regions. There is nothing to suggest that the dependence of AFRA on TACF will be any less.

37. During the 1988 meetings of TACC, it was suggested that the Secretariat consider organizing national and regional courses on project evaluation. This matter has been pursued by several Member States, and in 1990 three such courses were held — a national course (in Pakistan) and two regional courses (one in Indonesia and one in Mexico). The regional courses lasted two weeks and, at the suggestion of the Division of Technical Co-operation Programmes, covered not only project evaluation but also project management; they were considered by the participants to have been very useful. Regional courses can play a valuable role in ensuring that national liaison staff fully understand the policies and procedures of the Agency's TC programme, and the Secretariat's view is that such courses should be given in each region approximately once every three years. National courses permit much greater in-depth examination with national project counterparts of issues of project design, management and evaluation and are expected to have a more direct impact on national programmes. Steps are under way to organize regional courses in Africa in 1991.

38. In 1989, TACC requested that annual evaluation reports present a projection of the major evaluation activities of the coming year, the benefits expected and the priorities to be assigned; the following section is a response to that request. Deviations from projections will be explained to TACC in the annual evaluation reports. The principal areas of evaluation activity for 1991 are expected to be: Monitoring activities; Training activities; a review of the operation of the system of two-year TC programmes; an evaluation of Agency efforts in the waste management and radiation protection areas; an evaluation will be undertaken of the problems associated with equipment purchased with non-convertible currencies; two country programme evaluations, one in Africa and one in Latin America, and five country programme reviews are planned; an evaluation of RCA activities in support of thyroid RIA.

B. Review by Field of Activity and Division

1. Field of Activity

39. During the year under review, on the basis of disbursement figures, programme activity G, "Physical and Chemical Sciences", received the largest share 24.9%, followed by activity D, "Food and Agriculture", with 19.7%. These areas had also placed first and second during the previous year. Programme activities H and I, "Radiation Protection" and "Safety of Nuclear Installations" together accounted for 15.9%, up from 13.6% in 1989 and assumed third place.

40. As the programme in the years 1989 and 1990 constituted part of the first biennial programme, which was conceived as a whole, trends and directions in the fields of activity cannot meaningfully be obtained from comparisons between these two years but will become discernible during future programmes. It is indeed the approved programmes to be financed from the TACF in subsequent biennia which should be compared in this respect, in addition to comparisons based on disbursements from all funds.

41. The distribution of disbursements by AAPC and region, as illustrated in Figures 2 and 8, nevertheless provides an overview with certain pronounced characteristics. The emphasis on particular areas of activity varies widely between regions. Whereas, for instance, close to 20% of all disbursements were devoted to activity D, "Agriculture", these activities accounted for 32.9% of all disbursements in Africa; by contrast, in Europe only 9% and in the Middle East only 4.8% went for this field of activity. On the other hand, in the Middle East 55.5% of all disbursements were for activities in the fields of "Radiation Protection" and "Safety of Nuclear Installations" (H and I) against 14.1% in Africa. For all regions together, these fields accounted for 15.9%.

42. It is of interest that agricultural activities absorbed nearly 24% of the value of all expert services provided in 1990, followed by "Industry and Earth Sciences" (F), accounting for 16% of all expertise provided. A different picture obtains for the equipment component: almost 32% of all equipment pertained to activities in "Physical and Chemical Sciences" and only 18% for "Agriculture". Although less pronounced, a similar emphasis also exists in the training component, where 21% of the resources went for training in "Physical and Chemical Sciences", followed by agricultural training with 20%.

2. Division

43. Early in 1990, meetings were held between the Department of Technical Co-operation and the Department of Nuclear Energy and Safety to determine actions to be taken to strengthen collaboration in respect of technical co-operation. As a result of these meetings it was decided that, on a trial basis, project requests for the 1991-92 TC programme in NE's area from 11 countries (Mexico, Brazil, Peru, China, Indonesia, Bangladesh, Poland, Turkey, Egypt, Algeria and Zambia), after initial approval by NE and TC staff, would be subject to a joint review by both Departments to ensure complete agreement between Technical Officers and Project Officers as to priorities and approaches to be taken. It was found that there were few problems with the formulation of appropriate projects as such, but manpower constraints within the NE Department were again identified as a bottleneck to the provision of adequate backstopping during implementation. During 1990, the 67 technical officers in NE (42% of the total number of technical officers) supported 289 projects, representing 27% of all projects, and 27.5% of the adjusted programme. They evaluated 33% of all the fellowship applications received.

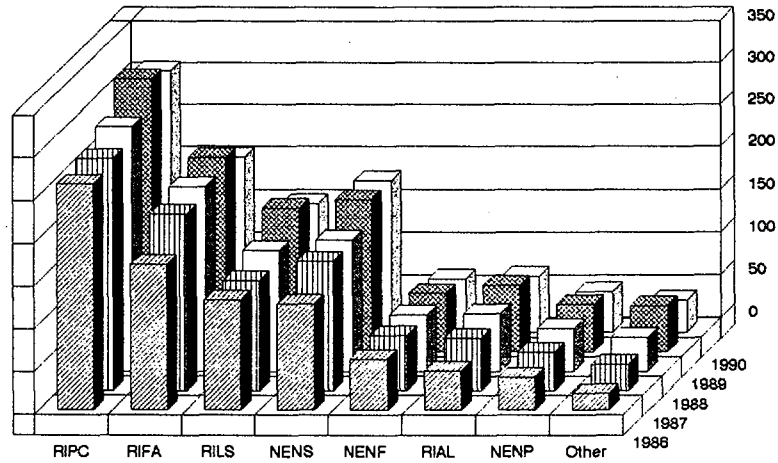
44. As a further result of the TC/NE meetings, a joint review was carried out in the waste management sector which led to the establishment of agreed procedures for the implementation of the Agency's Radioactive Waste Management Advisory Programme, (WAMAP).

45. Similar intra-departmental discussions were also held with the Department of Research and Isotopes. It was agreed that particular attention should be paid to familiarizing new Research and Isotope staff members with technical co-operation aspects of their work. The Department of Research and Isotopes is heavily involved in technical co-operation matters. The 70 technical officers (44% of the total) supported 731 projects, or 69% of all on-going projects, representing 63.3% of the value of the total adjusted programme. They also evaluated nearly 65% of all fellowship applications received. It was agreed that, in principle, technical officers, while having to undertake travel in relation to technical co-operation projects for planning, troubleshooting or review purposes, should not be expected to undertake field expert assignments. In the year under review, considerable demands were made — and met — in this respect. The Department of Nuclear Energy provided over 46 months of services through assignment of staff members as experts or lecturers, and the Department of Research and Isotopes over 90 months. It should, however, be noted that a number of technical staff stationed in Vienna were financed from technical co-operation project funds as their main activities were project related. No changes occurred in the average number of projects handled by each technical officer; it remained at 6.6.

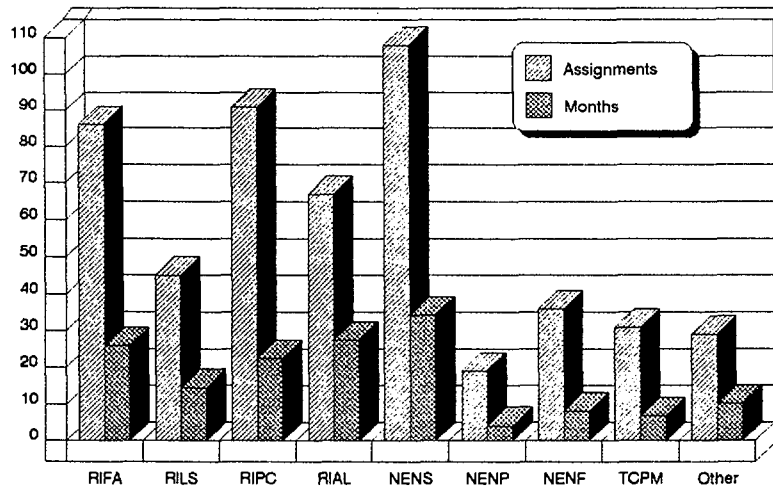
46. The following table and bar charts provide detailed information on the involvement of the various Divisions in the technical co-operation programme.

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	25	205	204	86	25/27
RILS	14	151	147	45	14/17
RIPC	17	308	308	91	22/14
RIAL	14	67	88	67	27/13
Sub-total	70	731	747	289	90/11
Nuclear Energy					
NENS	40	178	226	108	34/05
NENP	13	48	91	19	4/06
NENF	14	63	71	36	8/05
Sub-total	67	289	388	163	46/16
Other	22	38	26	60	16/29
Total	159	1058	1161	512	153/26

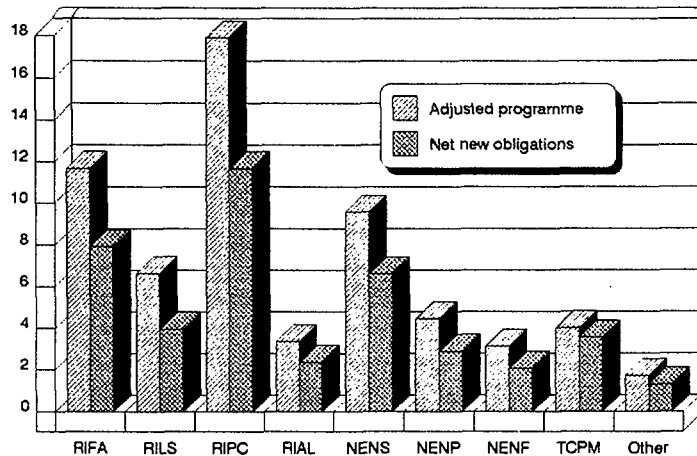
PROJECT WORKLOADS BY DIVISION: 1986 - 1990
(number of projects)



TECHNICAL SUPPORT FOR PROJECTS: 1990
EXPERT AND LECTURER ASSIGNMENTS



IMPLEMENTATION BY DIVISION: 1990
(IN MILLIONS OF DOLLARS)



C. Review by Area

1. Africa

47. The growing emphasis given to Africa, as evident in the project assistance approved from the TACF, has found its reflection in the share for Africa in the total adjusted programme, which, in 1990, rose to 22.5%. With a much higher implementation rate during 1990 (69.2% against 53.4% in 1989), Africa's portion of the total assistance set in motion during 1990 increased to almost 23%, against 18% in the previous year.

48. As in the past, activities in the Africa region have consistently focused on agriculture, 32.9% of all disbursements in the region being made in this field.

49. In respect of nuclear safety, much emphasis has been placed on upgrading radiation protection services. RAPAT and WAMAP missions were undertaken to the Libyan Arab Jamahiriya. A pre-project mission visited Madagascar to assist in reviewing requests for assistance in radiation protection and environmental monitoring. Temporary dosimetry services were provided to technical co-operation projects in Côte d'Ivoire, Nigeria and Sierra Leone, and equipment items, such as thermoluminescence badges, were provided to Ethiopia, Ghana, Mali, Uganda, Tanzania and Zambia. Training of radiation protection officers and technicians played a crucial role in the improvement of radiation protection services. A regional training course for radiation protection officers was held in Tunisia for 21 participants from eight African countries, and a regional workshop on basic radiation protection and development of national infrastructure for radiation safety took place in Nigeria in which 18 representatives of 11 countries participated.

50. In general, the African programme continues to be characterized by the importance given to manpower development in all fields, through individual fellowships training courses, workshops and project co-ordination meetings. In most of these activities the regional dimension is particularly pronounced.

51. Regional training courses were hosted by Ghana, Côte d'Ivoire, Morocco and Ethiopia in the fields of nuclear medicine, preventive maintenance, animal science, mutation breeding and tsetse control through sterile-insect techniques. A regional workshop on hydrosedimentology took place in Mali, attended by participants from Sahelian countries and Cameroon. Plans for future activities in animal science were the subject of a co-ordination meeting held in Côte d'Ivoire.

52. The regional programme in Africa was the subject of a special evaluation review in 1990. The recommendations resulting from this review will provide guidance for improving the effectiveness of the programme and for consolidating further its role as a promotor of co-operation amongst the countries in the region.

53. Such regional co-operation and the Agency's role in it was a major theme of discussion during the seminar on "Africa's role in nuclear science for peace and development", organized by the Organization of African Unity in Kampala, Uganda, with technical support and participation by the Agency.

54. The awareness of African Member States of the benefits that can be derived from collaborating with one another was demonstrated by the conclusion, in 1990, of the African Regional Co-operative Agreement for Research, Development and Training (AFRA) in which ten countries are now participating. Substantial technical and administrative support was provided by the Agency, which helped to organize the first Technical Working Group Meeting of AFRA Member States in Cairo, Egypt. During this meeting AFRA national co-ordinators selected seven regional projects which were subsequently included in the approved Agency programme.

55. During the year under review, steps were already taken to prepare for the next programming cycle, 1993-1994. On the spot appraisals of project proposals or assistance in project formulation was carried out through missions to Algeria, Cameroon, Egypt, Ethiopia, Ghana, Madagascar, Mali, Nigeria, Sierra Leone, Tanzania and Zaire.

56. Special attention was paid in this respect to the Least Developed Countries (LDC), as illustrated by a programme review mission to Sierra Leone which analysed on-going activities and proposed actions aimed at integrating nuclear techniques in endeavours aimed at achieving the country's development objectives.

2. Asia and the Pacific

57. The 1990 programme for the region accounted for 26.6% of the total adjusted TC programme financed from all sources of funds. Although this is below the 1989 figure of 28.6%, Asia and the Pacific still retains the largest share of the programme. With implementation figures up from 56.3% to 67.7%, the volume of the programme delivered to the region accounted for 26.6% of total programme delivery.

58. The UNDP component of the adjusted programme amounted to nearly twice that of all the other regions combined. Nine of the 23 on-going UNDP projects, including the largest, for which the Agency is either the executing or an associated agency were carried out in Asia and the Pacific region.

59. Applications of isotopes and radiation in hydrology and industry continued to be the most important area of technical co-operation in the region. Operational projects covered general isotope hydrology investigations (Mongolia, Pakistan, Sri Lanka, Viet Nam), use of tracers in sediment transport (Bangladesh, China, Malaysia, Singapore, Viet Nam), and the use of isotope techniques in geothermal hydrology (the Philippines and Indonesia). Among industrial applications, non-destructive testing, the use of radioisotopes as tracers and of radiation for cross-linking of natural rubber latex and the sterilization of medical products through radiation were the most important activities. Much of this programme was stimulated by the highly successful RCA/UNDP project being executed by the Agency.

60. Thirteen of the 15 recipient Member States in the region had at least one operational project covering one or more aspects of nuclear applications in agriculture, adding up to over 40 technical co-operation projects, including three large-scale UNDP projects in China, Indonesia and Thailand, and a large multi-disciplinary project in Malaysia. The most important fields covered in the projects included plant nutrition studies, animal production and health, mutation breeding and food irradiation. After delays caused by a number of factors, Bangladesh and Viet Nam are now ready to receive cobalt 60-sources for loading of their semi-pilot-scale food irradiation facilities provided under the technical assistance programme.

61. Ten of the 15 recipient Member States in the region have at least one research reactor. Activities were carried out in seven of these Member States and included reactor utilization for research purposes, isotope production and reactor renovation/upgrading.

62. Countries with nuclear power programmes, namely China, Pakistan and the Republic of Korea, were provided assistance which focused on the development of infrastructure for the safe operation of nuclear power plants.

63. Assistance was also furnished in connection with fuel fabrication, and quality assurance. With the announcement by Indonesia of its plan to have a first nuclear power plant operational by the year 2005, it is expected that the focus of activities in Indonesia will also shift to nuclear power. At the front end of the fuel cycle, there was considerable activity relating to prospecting for uranium in half of the region's Member States.

64. Activities in the health sector included assistance in up-grading facilities for diagnostics and treatment, and in the training of medical physicists and nuclear medicine practitioners employed at nuclear medical centres. Assistance was also provided for radioimmunoassay reagents production and for the quality assurance of radiopharmaceutical kits.

65. A RAPAT mission to Sri Lanka and a WAMAP mission to Pakistan took place during 1990. Site safety review missions to Pakistan for a proposed nuclear power plant at Chasma and to Thailand to determine a suitable site for a proposed new nuclear research centre were arranged. A pre-OSART mission to Guangdong nuclear power plant was fielded at the request of the Chinese Government. Several project requests for 1991-92 programme were evaluated through pre-project missions. A total of 22 such missions were fielded in order to assist Member States in improving the formulation of their project requests. All project requests relating to radiation protection and waste management were evaluated in connection with the recommendations of the RAPAT and WAMAP missions.

66. Technical co-operation activities in the region reflected a strong emphasis on human resources development, although the amount of funds that could be allocated fell far short of the training needs of growing programmes in several Member States. To strengthen this important aspect of the programme, additional resources and TCDC inputs were mobilized.

67. The first national workshop on TC Project Management and Evaluation was held in March at the request of the Government of Pakistan. The experiment was considered to be successful in improving, at the counterpart level, the understanding of TC procedures and practices. It appears that the idea is catching on, and requests are being received from other Member States for similar workshops. A regional training course on project design, management and evaluation was also held in June 1990 in Jakarta in which TC liaison officers and some project counterparts from the region participated. Such workshops should go a long way in improving both the quality and timeliness of the programme delivered by the Agency. Efforts continue to strengthen collaboration among institutes within each country and among Member States engaged in similar technical co-operation projects. Particular attention is being given to identifying areas where the technical co-operation activities of the Agency can be co-ordinated with those of UNDP and those of other members of the UN family.

3. Latin America

68. The worsening economic difficulties faced by many Latin American countries, together with the change of leadership that took place in several nuclear organizations, have continued to hinder the provision of planned assistance by delaying counterpart contributions to projects. Nevertheless, the implementation rate of the technical co-operation programme in the region in 1990 was, as in the previous year, the highest of all areas, reaching the 70.5% for the total programme and the 76.0% of that part of the programme funded from the TACF.

69. With reference to the adjusted programme, the region ranked second, with a share of 23.8%, which is slightly above the figure of 22.7% attained for the previous year. Likewise, nearly a quarter of the total assistance set in motion in 1990 from all sources of funding went to Latin America.

70. RAPAT missions to Bolivia and Uruguay were carried out, as were WAMAP missions to Brazil and Guatemala. Programming of technical co-operation for 1991-92 was assisted by pre-project missions to several countries. As a result of a programming mission, a project was created from the Reserve Fund with the purpose of providing information to the relevant institutions of Jamaica on the application of nuclear techniques in the areas of agriculture, animal science and food irradiation.

71. In order to improve the design, management and evaluation of projects, a workshop attended by participants (mainly liaison officers) from 15 Latin American countries and Agency staff members was held in Mexico.

72. Support to activities related to nuclear medicine continued in many countries. A gamma camera provided to Cuba under a UNDP-funded, IAEA-executed project was installed in June and is being extensively used for the diagnosis of several diseases. In addition, within the framework of this project, nine training courses took place and 18 physicians and a medical physicist were trained. In El Salvador, the Agency provided a gamma camera and expert advice to a public hospital with the purpose of upgrading diagnostic services for low-income patients. With the assistance of the Agency, activities relating to the production of radiopharmaceuticals were resumed in Ecuador; a laboratory for the dispensing of radioisotopes was installed and local staff were trained to begin the distribution of iodine-131 to Ecuadorian nuclear medicine centres.

73. In the field of nuclear power, significant technical assistance was provided to Mexico relating to the safe operation of the Laguna Verde Nuclear Power Plant and to probabilistic risk analysis for the installation.

74. Radiation protection activities were supported in several countries. Implementation continued in Brazil of an extrabudgetary project to establish (a) a national system of basic radiation protection in the medical field and (b) a national inventory and control system for radiation sources. Extrabudgetary contributions also permitted the execution of a project aimed at the installation of a secondary dosimetry laboratory in Guatemala.

75. The commissioning and inauguration of an electron beam accelerator at the National Polytechnic School in Quito brought to a successful conclusion the largest project in terms of financing and technical support that the Agency has ever provided to Ecuador. The accelerator is being used for research and development in industrial applications, mainly for the radiation curing of coatings, the radiation processing of plastics and fabrics, and the radiosterilization of medical supplies.

76. Agency support in connection with the use of nuclear techniques in hydrology-related fields continued as in previous years. A hydrochemical laboratory in Guatemala was completed; it is expected that, through the analysis of samples, it will contribute to the study of the availability of ground water, the interchange of water between aquifers, and geothermal sources of energy. Within the framework of the project on the Brazilian Amazon Basin, special emphasis was placed in 1990 on the assessment of hydrological parameters so as to obtain data for the development of resource utilization policies.

77. During 1990, a number of ARCAL projects came to an end. In the first phase of the project on animal sciences activities relating to reproductive efficiency were completed. Improved methods in this respect were developed which are to be applied by all participating laboratories in the region. A new phase has been initiated with a double aim: to develop nutritional strategies available to the smallholder farm aimed at improving animal productivity and to develop standardized tests for use in disease diagnosis, control and surveillance programmes.

78. The project on research reactors concluded with a symposium that was attended by scientists working on research reactor design and operation. After five years of activities, strong groups for calculation on reactor physics and thermohydraulics have been established. Bilateral research efforts are emerging amongst research reactor groups in the region.

79. The first phase of a project on radioimmunoassay for thyroid-related hormones concluded. A regional capability was attained in relation to production of all reagents for T3 and T4 kits, and significant progress was made in relation to production of TSH reagents. An important aspect of the project was the introduction of quality assur-

ance programmes in relation to RIA procedures. During a new phase of the project, TSH reagents production will be completed and production of T3, T4 and TSH kits at a regional level organized.

80. An increasing number of spare parts continued to be provided under a project on nuclear instrumentation, representing an important savings to the region by helping to keep in operation costly equipment used in nuclear technology applications.

81. Under the regional non-destructive testing (NDT) project, the training of technicians continued at different levels in the five most widely used NDT techniques. Formally, 1990 was to be the last year of this project, which had been supported through extrabudgetary contributions made by several Member States and UN agencies. However, some activities were deferred until the first half of 1991. After June 1991, responsibility for project execution will pass to the recently established Latin American NDT Federation. The Agency will start a follow-up project on the use of NDT technologies in quality control programmes.

4. The Middle East and Europe

82. In Section III of this report, a profile is provided of the recent Agency's technical co-operation activities in the countries of the Middle East and Europe. As regards 1990, the Middle East and Europe's share of the total adjusted programme stood at 17.6%, down from 21.3% in the previous year. As the programme for this region accounts for more than half of all the programmed non-convertible currency funds, devaluations which occurred in the major constituent currency in this category and increased difficulties in fully utilizing it had a significant impact on the figures pertaining to this region. Notwithstanding these problems, implementation rose from 46.2% in 1989 to 51.5% in 1990, the region accounting for 13.3% of total programme delivery in the year under review.

83. The onset of the Gulf crisis during the last quarter of 1990 had a very perceptible impact on the Agency's activities in the region as experts declined assignments and, in line with UN advisory notes, all travel to the area had to be postponed. All affected missions and projects will receive priority attention for implementation as soon as circumstances permit.

84. Activities relating to the safety analysis of WWERs, which mainly involve reactors in operation in Eastern European countries, continued throughout 1990. Workshops and other activities focused on the review of accident sequences, on the use of dual-processor PCs for calculations and on the development of software for design-basis accidents analysis; on-the-job training activities relating to in-service inspection also continued during 1990.

85. Other regional activities in the Middle East dealt with the establishment of Early Warning Environmental Radiation Monitoring Systems (EWERMS). A training workshop was organized by the Agency and WHO on radiation protection relating to medical applications of ionizing radiation. In other areas, co-ordination meetings and workshops were held on radioimmunoassay techniques and on generator-produced radiopharmaceuticals. Agency experts also followed up on planned programmes for isotope hydrology in arid zones.

86. National projects in most countries dealt with similar subjects and, particularly in Eastern Europe, the emphasis on nuclear power and related safety issues became pronounced. Preparatory work for the construction of a small research reactor in Albania, for which financing is available from UNDP resources, continued throughout the year. Unfortunately, owing to circumstances beyond the Secretariat's control, the start of actual implementation, which had been foreseen for December 1990, had again to be postponed.

87. Unforeseen requests from Eastern Europe countries in connection with their nuclear power programmes continued to be received in 1990, including some from countries which had so far not been recipients of Agency technical assistance. During the current programme cycle such requests have to be met from the limited resources of the Reserve Fund, through readjustments in the country programmes concerned or through identification of possible additional extrabudgetary resources. In the next biennial TACF programme, assistance in nuclear safety for the countries concerned will, in all likelihood, make a greater claim on resources.

5. Global and Interregional

88. As in the past, the bulk of the Agency's technical co-operation resources were allocated to projects in a particular country or region, so that in 1990 only 9.5% of the adjusted programme was intended for global and interregional activities. The global component, included in the above, amounts to only 0.7% of the programme. It is, in fact, an administrative category from which miscellaneous expenditures for the programme are covered. By contrast, the interregional component, which accounts for 8.8% of the programme, wholly consists of approved project activities. It represents the Agency's training courses programme as well as specific interregional projects such as preparatory assistance and country review projects.

89. As compared with 1989 figures, a substantially higher implementation rate prevailed in 1990 for interregional projects (87.3% against 58.9%). This is a result of a more comprehensive financial obligation policy which was introduced in 1990 in respect of training courses. The figures for this component now reflect delivery more accurately than was possible in the past. The total delivery under the global and interregional heading thus accounted for 12.4% of all technical assistance provided in 1990.

D. Review by Component

1. Experts

90. The increase in the expert component's share of the overall programme which occurred in 1989, after several year of decline, continued, rising in 1990 above the traditional average of one quarter of the adjusted programme to 28%. The value of the expert services delivered during 1990 constituted 23.6% of the value of the total delivered programme.

91. The following table, providing a five-year perspective on the delivery of expert services, illustrates several noteworthy trends in this programme component.

Year	Adjusted programme	New obligations	Implementation rate	Earmarkings
	\$ millions	\$ millions	%	\$ millions
1986	13.2	7.3	55.1	5.9
1987	14.4	8.0	55.6	6.4
1988	14.3	7.7	54.1	6.6
1989	16.1	7.8	48.2	8.3
1990	17.6	10.0	57.0	7.6

Year	Number of persons	Number of assignments	Number of months	Months per assignment
1986	1168	1930	1516	0.79
1987	1100	1808	1356	0.75
1988	1263	2023	1239	0.61
1989	1337	2144	1246	0.58
1990	1414	2221	1217	0.55
Increase over five years (%)	21.0	15.0	(20.0)	

92. As shown, the implementation rate rose from 48.2% to 57% against an adjusted programme which was \$1.5 million, or over 9%, higher than the previous year. This meant that for the first time since 1986 the earmarkings for experts — in other words the value of the backlog of expert services still to be delivered — declined to \$7.5 million.

93. The decline in the average duration of assignments, which has continued virtually unabated for ten years, again occurred in 1990. Fewer expert months were delivered (2.4% less) than in 1989, although nearly 6% more persons were recruited and 3.6% more assignments were carried out. The Expert Section is now handling 21% more recruitments per year than five years ago.

94. The increased number of persons and assignments handled by the Expert Section gains added perspective when account is taken of the political situation prevailing in the Gulf region during the latter part of 1990, which particularly impacted the expert component of the programme. Not only had missions to the most directly affected countries to be suspended, but several experts withdrew from assignments to neighboring countries or postponed travel altogether out of concern for personal safety. The fact that the heavy additional workload caused by these factors did not lead to a decrease in total recruitment actions shows that productivity gains were achieved through a number of steps.

95. A reorganization of the Expert Section was completed during the year. All the functions of recruitment are now combined and performed by each recruitment clerk. Thus the continuity involved in handling the requests for expert services and the subsequent recruitment, placement, contracting and administration of the expert is considerably strengthened. In addition, four geographical units have been created paralleling the area organization in TCPM. This has led to a considerable increase in interaction between project officers and recruitment personnel. No direct costs or additional personnel were involved in the reorganization.

96. As noted earlier, the Section considerably strengthened its computerized expert post control system (EPCS) to meet the growing information needs within and outside the Section.

97. These changes prepared the way for more efficient and effective recruitment procedures which should have a lasting and positive impact not only on the quantity but also on the quality of the expert component.

98. Additional information on the expert component appears in Table 3A and Figure 4, which show, inter alia, where the experts provided in 1990 came from and to which regions they went. In Table 3A, all experts, including Agency staff on expert assignments, are shown by nationality. Table 6A provides a further breakdown by recipient country.

2. Equipment

99. Although equipment remains the largest component of Agency's technical assistance, the adjusted programme for 1990 showed a more balanced relationship between the various components, with equipment dropping further to 37.7% of the overall programme. A virtually identical percentage pertained for equipment financed from the TACF.

100. Disbursements for equipment again rose sharply, from \$19 million in 1989 to \$24 million in 1990. At the same time, the monetary value of equipment assistance set in motion during 1990 as reflected by the volume of new obligations, declined further from \$17.6 million in 1989 to \$15.6 million in 1990.

101. It must be stressed that the anomalies in this year's overall figures caused by the drastic devaluation of a major non-convertible currency, referred to in paragraph 123 below, are particularly pronounced in respect of the equipment component since virtually all NCC is programmed for equipment.

102. In addition to the administrative/statistical problems caused by the devaluation of NCC currencies, the actual utilization of these currencies became more difficult in 1990 owing to other events.

103. Several projects had been planned for implementation in GDR marks in the second half of the year. The changes in June 1990 rendered this impossible and necessitated, in some cases programme changes into convertible currency, so that approved project inputs could be delivered.

104. Although nearly all roubles had been obligated by year-end, problems were encountered through delays in receiving offers from USSR firms which were in the throes of restructuring and privatization. Many such firms were no longer interested in conducting business in currencies other than convertible ones. Further difficulties were encountered by the continuing and increasing reluctance of transport companies in the USSR to handle and deliver radioactive sources.

105. The following table provides a five-year perspective on the work of the Field Procurement Section. It should again be noted that the drastic decline in the value of the adjusted programme and in earmarkings was caused by the devaluation of most of the NCC part of the programme. Further information on equipment delivery is given in Figure 5, which shows where the equipment was procured and to which regions it went.

Year	Adjusted programme	New obligations	Implementation rate	Earmarkings	Disbursements	Number of purchase orders ^a
	\$ millions	\$ millions	%	\$ millions	\$ millions	
1986	26.7	18.1	67.9	8.6	18.1	3,738
1987	28.2	16.2	57.5	12.0	23.0	3,701
1988	29.8	19.9	66.9	9.9	16.1	3,386
1989	30.5	17.6	57.7	12.9	18.7	3,894
1990	23.5	15.6	66.4	7.9	23.7	3,763

^a Including training course equipment and research contract orders.

106. The computerized database of vendors and potential suppliers is being continually updated and expanded in the Section. This system will allow quotations/bids to be received from a wide range of international suppliers, including those in under-utilized major donor and developing countries. An additional 430 new suppliers were added to this database in 1990, reflecting an increase of 11.9% over the previous year's entries (3,620 potential suppliers).

3. Fellowships

107. Provisions for fellowships increased to 15.5% of the total adjusted programme for 1990 and to 18.1% of that part of the programme financed from the TACF. Corresponding figures in 1989 were 14.4 and 16.3%

108. Implementation, expressed in monetary terms, increased from 62.4% in 1989 to 69.9% in 1990, representing an actual increase of 14.4% in the combined number of fellowships and scientific visits from 924 to 1057. This is the highest number in any one year in the history of the fellowship programme. An additional positive development is noted in respect of the number of months of fellowship training actually provided. Whereas this number had been declining for two years — from 1987 to 1989 — a significant recovery took place in 1990, during which 3260 months of fellowship training were provided. This represents an increase of 20% over 1989. As a consequence, the decline in average duration of training received per fellow, which has been noticeable for several years, was arrested. In 1990, an average of 4 months of training were provided for each fellow, against 3.7 months in 1989. As a result of this development, there was a decrease in the average cost per month of fellowship training from \$2342 to \$2231.

109. The following table illustrates developments in the fellowship component during the past five years. Additional information on fellowship training is given in Figure 6 and in Tables 3B and 6B, which show the place of study and the country of origin of fellowship holders.

Year	Adjusted programme	New obligations	Implementation rate	Earmarkings	Number of fellows	Number of fellowship months	Number of visiting scientists	Number of visiting scientist months
	\$ millions	\$ millions	%	\$ millions				
1986	6.4	5.0	78.3	1.4	734	3610	203	137
1987	7.8	6.5	83.1	1.3	870	4437	160	101
1988	7.7	5.3	68.3	2.4	682	3056	156	88
1989	9.6	6.0	62.4	3.6	732	2713	192	129
1990	9.7	6.8	69.9	2.9	814	3260	243	148
Increase over five years (%)					11	(10)	20	8

110. The management of increasing numbers of fellows will necessitate the expansion of office automation to include the fellowship programme. Meanwhile, the Fellowship Section endeavours to optimize the use of its internal resources. Various modalities to facilitate implementation of the programme, such as group training, have been introduced. The basic principle remains to provide training which, in type and duration, is as responsive as possible to the needs of the country. Technical officers carefully evaluate progress reports submitted by IAEA fellows, and their evaluations play a decisive role in determining whether any requests for extensions of individual fellowships — which are made frequently — are justified and essential to achieving the training objectives.

4. Training Courses

111. The training course programme continued its steady expansion during 1990. The number of courses (regional and interregional) increased to 108, the number of participants more than 7% (from 1265 to 1358), and the number of months of training provided by 9% (from 1090 to 1188). In addition to these courses, 89 national group training activities were held.

112. The table below provides an overview of the programme during the past five years. It should be noted that with the fuller financial obligation procedures introduced during 1990, the implementation rate for the training courses programme more accurately reflects the true picture than was the case during the past few years.

Year	Adjusted programme	New obligations	Implementation rate	Earmarkings	Number of courses	Number of participants	Number of months
	\$ millions	\$ millions	%	\$ millions			
1986	4.6	4.3	93.5	0.3	71	972	992
1987	4.5	2.9	65.4	1.5	64	945	915
1988	6.9	4.5	65.0	2.4	88	1109	958
1989	8.3	5.0	60.2	3.3	106	1265	1090
1990	9.6	8.3	86.6	1.3	108	1358	1188

113. Of the 108 regional and interregional training events, 86 took place in developing Member States. Annex II provides details concerning the subject and location of these events.

114. The regional training course programme is mainly developing within the framework of specific regional agreements, such as RCA (for Asia and the Pacific), ARCAL (for Latin America), the regional NDT project for Latin America and the Caribbean, and the newly created AFRA (for Africa).

115. Within the RCA and the regional Asian programme, the UNDP/RCA Industrial project constitutes the largest single component, with 14 regional training courses out of a total of 31. Additionally, 17 national courses were organized as part of this project.

116. In the ARCAL courses, both regional and national ones, increasing participation of lecturers from the Latin America region was observed. Many of these training events were of a "train-the-trainers" nature so that a multiplying effect was achieved. The NDT project for Latin America and the Caribbean continued its vigorous operation, the total number of professionals and technicians trained during the eight years of the project's existence having exceeded 22,000 by the end of the year.

117. One of the major thrusts of the AFRA programme is expected to be the creation of capabilities that address important problems common to its Member States. Manpower development through training will therefore be emphasized, and regional training courses will represent an important means for attaining this goal. The first AFRA programme includes three regional training courses out of seven programme activities formulated by the Technical Working Group during its first meeting in Cairo. These training courses will be in the fields of food preservation, radiation technology and waste management. It is envisaged that the training courses will be followed by other activities in these fields under future AFRA programmes in which the training provided will be applied. Regional courses within the AFRA framework, in addition to providing the required technical training for manpower development, have the added advantage of strengthening collaboration and promoting the exchange of technical expertise within the region. The courses will be designed to meet the specific needs of African countries and will be conducted in Africa.

118. Although most of the training courses programme is still financed from the TACF, many of the events are made possible through extrabudgetary contributions from Member States, in particular from Argentina, Australia, Chile, China, Colombia, Cuba, Germany, India, Italy, Japan, the Republic of Korea, Mexico, and the United States of America.

5. Sub-contracts

119. The sub-contract component is of a different character from the major programme components reviewed above. Whereas expertise, equipment and training (fellowships and training courses) are the major types of technical assistance input provided to Member States, sub-contracts are an administrative vehicle through which any or all of these major types of assistance can be delivered.

120. The share of sub-contracts in the overall adjusted programme for 1990 remained at the same level as for 1989 (2.5%). The following table illustrates the fluctuations that occur in implementation from year to year.

Year	Adjusted programme	New obligations	Implementation rate	Earmarkings
	\$ millions	\$ millions	%	\$ millions
1986	1.2	0.5	41.2	0.7
1987	0.9	0.5	60.8	0.4
1988	0.9	0.7	81.1	0.2
1989	1.7	0.8	48.8	0.0
1990	1.5	1.1	72.6	0.4

121. Nearly all subcontracts are placed with governmental and academic institutions. The major subcontracts usually involve a package through which expertise as well as training and equipment are provided. Smaller subcontracts are largely oriented to applied research.

E. Review by Fund

1. Technical Assistance and Co-operation Fund

Resources	\$34.7 million (77.8% of total)
Adjusted programme	\$46.9 million (74.9% of total)
New obligations	\$33.4 million (78.8% of total)
Implementation rate	71.3%
Disbursements	\$36.7 million (74.4% of total)

122. The Technical Assistance and Co-operation Fund (TACF) remains the chief source of funding for the Agency's technical co-operation activities. For a number of years, concern had been expressed about the gradual decline in the percentage of the annual target for this fund that was actually met by pledges. However, notwithstanding the fact that the target for 1990 was set at \$45.5 million — up from \$42 million in 1989 — pledges accounted for \$38,797,255, or 85.3%, of the target, the first slight improvement after seven years of decline. In addition, substantial amounts of additional income were received: \$1,651,199 in assessed programme costs and \$1,689,658 in interest income.

123. In spite of these positive developments, the figure for available TACF resources in 1990 was well below that obtained in 1989 (\$34,660,000 vs. \$37,312,000). This anomaly is solely due to a massive loss on exchange which occurred early in December when the USSR rouble was devalued from \$1.65 to \$0.56. This led to a loss of \$6,779,569 against NCC holdings. As exchange losses are booked against the miscellaneous income category of the TACF, total resources for the TACF in 1990 amounted to \$34.7 million. Had the devaluation not occurred, they would have stood at \$41.4 million, representing 91% of the target, whereas in 1989 only 88.8% of the target was attained. The miscellaneous income category normally assures that the income as per cent of the target is above the percentage of the target obtained through pledges. By absorbing the exchange losses in 1990, the miscellaneous income category became a negative figure, reducing the income as per cent of the target to 76.2%, which is below the percentage received in pledges. The situation is illustrated in Figure 1 and in Tables 1 and 2.

124. As a logical concomitant to the lower dollar figure representing the available NCC resources, the dollar equivalent of all unliquidated obligations in roubles (outstanding bills) had to be reduced similarly, as had to be done also for all earmarkings for

projects for which implementation was foreseen in roubles. Whereas the drop in exchange rate had major repercussions on overall statistics expressed in dollars, it did not actually affect the implementation of the programme and had, obviously, no effect on the convertible currency portion of the programme.

125. As the following table shows, the aim of reducing overprogramming to zero by the end of the second cycle was fully met. Anticipated resources for 1990 were conservatively estimated, and prudence was exercised throughout the year: any essential project budget increases were balanced with corresponding savings. Moreover, through budget revisions resulting from the mid-year review, an amount of \$1,780,620 was rephased into 1991-92. In addition, both the assessed programme cost and interest income were substantially above what had been anticipated.

Resources available and programme commitments by year-end

Year	Available financial resources			Programme			Balance		
	CC	NCC	Total	CC	NCC	Total	CC	NCC	Total
1981	11,336	3,721	15,057	11,277	3,843	15,120	59	(122)	(63)
1982	14,186	3,670	17,856	13,788	4,071	17,859	398	(401)	(3)
1983	17,044	3,351	20,395	17,407	3,442	20,849	(363)	(91)	(454)
1984	19,240	3,274	22,514	19,583	3,782	23,365	(343)	(508)	(851)
1985	18,975	5,663	24,638	21,392	5,536	26,928	(2,417)	127	(2,290)
1986	14,002	8,813	22,815	18,146	7,706	25,852	(4,144)	1,107	(3,037)
1987	10,164	7,345	17,509	16,758	8,753	25,511	(6,594)	(1,408)	(8,002)
1988	13,833	11,376	25,209	18,590	11,456	30,046	(4,757)	(80)	(4,837)
1989	19,274	13,982	33,256	21,435	15,146	36,581	(2,161)	(1,164)	(3,325)
1990	23,879	7,332	31,211	22,688	6,511	29,199	1,191	821	2,012

126. For the first time in seven years, the programme is no longer based on overprogramming. By the end of 1990, programme commitments were below resources available by \$1,191,000 in CC and by \$821,000 in NCC.

127. The implementation rate of the programme based on the TACF, which had been decreasing steadily, showed remarkable improvement in 1990, jumping from 58% in 1989 to 71.3%. Intensified monitoring and follow-up of programme delivery made possible through the new organizational structure of the Department was instrumental in achieving this recovery. However, some additional elements contributed to the positive result. The same factors which depress the implementation rate somewhat in the first year of a biennial cycle, act in favour of higher implementation in the second year: preparations for full implementation are initiated in the first year and difficulties are overcome, leading to higher implementation in the second year. In addition, rephasings are carried out in the second year, lowering the adjusted programme against which implementation is measured. This adjusted programme was also below that of the previous year because it no longer included overprogramming. New obligation policies which now ensure that all training courses, as well as travel costs, are properly obligated towards year-end also had a positive influence on the implementation rate. Not all of these factors will prevail in 1991, so that it would not be realistic to anticipate increases in implementation rates of this magnitude in the following year. The following table gives a five-year summary of the implementation of the TACF part of the programme.

Year	Adjusted programme	New obligations	Implementation rate	Earmarkings
	\$	\$	%	\$
1986	37,020,799	28,015,778	75.7	9,005,021
1987	40,436,825	27,078,352	67.0	13,358,473
1988	43,652,306	28,383,470	65.0	15,268,836
1989	48,867,916	28,320,331	58.0	20,547,585
1990	46,880,397	33,422,585	71.3	13,457,812

128. Very full use was made of the Reserve Fund in 1990. Of the \$700,000 set aside, \$532,400 was allotted to new projects and \$153,000 for urgently needed supplementary assistance to on-going projects. Several of the projects financed from this resource dealt with safety aspects of nuclear power plants, including pre-OSART and OSART missions. They also included the provision of radiation monitoring equipment to countries particularly effected by the Chernobyl accident. Details of all approvals are provided in Annex VIII.

2. Extrabudgetary Resources (including Funds in Trust)

Resources	\$4.8 million (10.8% of total)
Adjusted programme	\$12.4 million (19.9% of total)
New obligations	\$6.2 million (14.5% of total)
Implementation rate	49.5%
Disbursements	\$7.2 million (14.5% of total)

129. The sharp decline in extrabudgetary resources, from \$7.4 million to \$4.8 million (a drop of 35%) is largely due to a \$1.7 million loss on exchange booked against the USSR roubles. In addition, \$0.9 million less than in 1989 was received from a number of traditionally large donors. As a result, extrabudgetary resources in 1990 only accounted for 10.8% of resources as compared with 14.7% in the previous year.

130. The execution of the extrabudgetary part of the programme is subject to a variety of constraints which do not exist in the TACF-financed part of the programme and which are likely to keep implementation of this part of the programme below that of the TACF. Notwithstanding these facts, the overall implementation rate for extrabudgetary funds increased from 46.5% to 49.5% in 1990. However, implementation rates vary significantly between the various donor funds which comprise this resource, and the Secretariat is conscious of the additional efforts required to bring implementation in all funds up to desirable levels.

131. Most of the new extrabudgetary resources were received for footnote-a/ projects for which financing was still being sought at the beginning of 1990. With these contributions, six projects were made operational for the first time. The low number of new projects made operational is a phenomenon connected with the character of the first biennial programme, in which relatively few projects were scheduled to begin in the second year. Total 1990 provisions of footnote-a/ projects amounted to only \$6 million — as against nearly \$10 million in the first year of the cycle. The share of footnote-a/ projects made operational with new resources therefore rose steeply, from 53.7% in 1989 to 72.5% in 1990, as illustrated in the following table.

Year	Approved footnote-a/ projects	Footnote-a/ projects & components made operational	Share of footnote-a/ projects made operational
	\$	\$	%
1986	8,361,205	3,455,500	41.3
1987	6,352,200	3,005,300	47.0
1988	8,182,800	3,782,102	46.2
1989	9,933,900	5,332,606	53.7
1990	6,013,000	4,359,800	72.5

132. In 1990, the Federal Republic of Germany became the largest single contributor of extrabudgetary funds, followed by the USA, the United Kingdom and Australia.

133. Extrabudgetary resource figures include the funds-in-trust category, which consist of funds donated for use in the country of the donor. A minor part of the Agency's technical co-operation activities are covered by these funds and they only accounted for 1.2% of the total adjusted programme in 1990. Although the amounts involved are modest, the services the Agency can provide from them are nevertheless considered highly valuable by the donor/recipient.

3. UNDP

Resources.....	\$2.9 million (6.4% of total)
Adjusted programme.....	\$3.2 million (5.2% of total)
New obligations.....	\$2.9 million (6.7% of total)
Implementation rate.....	88.6%
Disbursements.....	\$3.3 million (6.6% of total)

134. In the UNDP part of the programme, "resources" equal total delivery as UNDP makes available whatever the executing agency spends for a UNDP-financed project in a given year within the approved budget. The "adjusted programme" reflects the total value of approved UNDP projects at year-end. As indicated in the Explanatory to Table 7, the UNDP "Disbursements" figure for 1990 includes disbursements against prior year obligations.

135. The implementation rate in 1990 rose from 70.2% to 88.6%. It should be recalled, however, that implementation is measured at the end of the year against the then prevailing budgets. In accordance with UNDP procedures, budgets are rephased during the year to keep them in line as closely as possible with expected delivery. If the peak budgets for UNDP projects approved during the year are considered, an amount of \$4 million (as compared with \$5.9 million in 1989) was available to the Agency for implementing approved UNDP projects. Implementation measured against this figure would of course result in a lower rate.

136. Whereas disbursements rose by \$490,000 during 1990, other indicators were down in absolute terms: resources by \$250,000 and the adjusted programme by \$1.2 million.

Year	Adjusted programme	New obligations	Implementation rate	Earmarkings
	\$	\$	%	\$
1986	4,157,676	3,480,543	83.7	677,133
1987	3,307,300	2,568,677	77.7	738,623
1988	3,682,121	3,050,530	82.8	631,591
1989	4,427,249	3,105,808	70.2	1,321,440
1990	3,223,083	2,855,764	88.6	367,319

137. The 1990 adjusted programme for UNDP was not only the lowest since 1986 as shown above but also the lowest ever recorded. The fact that, by the end of 1990, the number of prospective new UNDP projects in the pipeline had dwindled to near zero leaves no hope whatsoever that this dismal picture will improve significantly as long as present conditions prevail. Changing the present conditions is beyond the means of the Department of Technical Co-operation and depends on the collective will and actions of Member States.

138. As has been repeatedly explained in the past, UNDP country funds are allocated in accordance with priorities established by national planning authorities of the countries themselves. To obtain a larger proportion of UNDP funds for activities in the Agency's sphere of competence, national atomic energy commissions have to be able to convince their national planning authorities, through the substantive ministries, of the relevance and importance of project proposals dealing with nuclear techniques in the context of sectoral and national development plans.

139. To assist national atomic energy agencies more consistently in this task would require investments in far more intensive on the spot contacts which are not possible under prevailing budgetary constraints. Proposals to utilize UNDP overhead funds fully and directly for this type of support have not found favour with donor Member States since this would entail a reduction in miscellaneous income to the Agency's Regular Budget and a concomitant increase in assessed contributions which, in view of the zero-growth budget principle, is considered unacceptable.

140. During 1990, three UNDP-financed projects were completed and two new ones approved so that 20 such projects were under implementation. These projects are listed in Annex VI. The IAEA also acted as an associated agency for two UNDP-financed projects executed by UNTCD and for one project executed by the Government of China.

4. Assistance in kind

Resources	\$2.2 million (5% of total)
Disbursements	\$2.2 million (4.5% of total)

141. Very few changes occurred compared to 1989. The volume of assistance in kind made available in 1990 is only slightly below that of the previous year (\$2.2 million against \$2.3 million). As in this resource category the resources made available equal disbursements, as recorded at year-end, the concepts of "adjusted programme", "new obligations" and "implementation rate" do not apply.

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

143. Whereas a variety of activities are made possible through assistance in kind, this resource category remains particularly important for the Agency's training programmes. About 14% of all fellowships, covering 528 months of training, were provided by 18 different countries amongst which were 8 developing Member States. In addition, 135 experts were provided either cost-free or part-free.

144. Six countries provided stipends and covered travel costs for 95 participants in regional training courses. The five developing countries involved financed 82 of these. Projects in Poland and Nigeria benefitted from equipment donations valued at \$125,000.

145. As shown in Annex X, the USA remained the largest donor, followed by Germany, India, Italy, Hungary, Belgium and Austria. The percentage of assistance in kind donated by Member States who are themselves recipients of technical co-operation increased to 30.8%.

III. A PROFILE OF TECHNICAL CO-OPERATION ACTIVITIES IN THE MIDDLE EAST AND EUROPE

INTRODUCTION

146. The feature introduced in 1987 — the presentation of a profile of technical co-operation activities in one of the four regions recognized in the Agency's Technical Co-operation Programme — is completed in this report with an overview of the activities in the past ten years in the Middle East and Europe Region.

147. This Region is in many respects best considered as comprised of two sub-regions, Middle East on the one hand and the Europe on the other. Many of the projects reflect this sub-regional sense of identity, primarily based on similarities in national needs and priorities.

148. However, even the countries within a sub-region differ widely — in size, population, gross national product and geophysical attributes. Hence there are substantial differences in the roles that nuclear energy and the application of nuclear techniques play in each of them.

149. Many European countries started exploiting the advantages of the peaceful uses of atomic energy as far back as the 1950s and have built up considerable know-how in their fields of interest. The Middle East countries have, only recently, started to allocate higher levels of priority to applications of nuclear techniques; the topics currently of greatest interest are reflected in the choice of the sub-regional collaborative projects. Nevertheless, the continuing exchange of scientific and technical information, collaboration in various areas of technology, as well as the provision of training to fellows from collaborating countries and the hosting of Agency training courses and workshops at appropriately equipped institutes are firmly established features in the Region as a whole.

150. Perhaps one aspect where Member States can be seen to differ markedly is in their use of and attitudes towards nuclear power as a way of meeting electricity demands. Considering only recipients of assistance through the Technical Co-operation Programme in the period 1980-90, the Member State with the largest investment in nuclear power is Spain, with 7057 MW(e) generating capacity connected to the grid in 1990. At the other end of the generating scale are countries such as Yugoslavia with a single unit producing some 600 MW(e). Finally, among the countries with no plans to use nuclear power, some — like Iceland — have no need of it, while there are others where public opinion has caused the governments to suspend the nuclear option.

151. Nevertheless, whatever the national programme, a common feature is the strong emphasis on radiological protection and public and environmental safety, with considerable interest in measuring any possible radioactive contamination that might originate outside a country's own territory, being "imported" via the atmosphere, water or even foods.

152. The following narratives describing the Agency's programme with the individual countries of the Region do not purport to be comprehensive; they merely present an overview that should enable the reader to form a picture of aspects of such programmes that the Agency considers will be of particular interest at the time of writing. The focus is primarily on activities undertaken during the past decade, with an indication in many cases of how the programmes are expected to develop.

153. All monetary figures given in the tables preceding the narratives are in thousands of United States dollars. As in the past, the financial data are given for a five-year period.

AFGHANISTAN

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

Year	TACF share	TACF pledged	Extrabudgetary funds	In-kind support	Experts from country	Persons trained in country
	\$	\$	\$	\$		
1986	3.0	0.0	0.0	0.0	0	0
1987	3.4	0.0	0.0	0.0	0	0
1988	3.8	0.0	0.0	0.0	0	0
1989	4.2	0.0	0.0	0.0	0	0
1990	4.6	0.0	0.0	0.0	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 \$	\$	\$	\$	\$
1986	0.0	0.0	0.0	0.0	16.9	0.0	0.0	0.0	0.0	16.9
1987	0.0	50.0	50.0	0.9	4.1	9.2	0.0	0.0	0.0	13.3
1988	14.4	20.0	34.4	0.6	4.2	0.0	0.0	0.0	0.0	4.2
1989	0.0	0.0	0.0	0.0	0.0	3.6	0.0	0.0	0.0	3.6
1990	0.0	0.0	0.0	0.0	1.3	1.0	0.0	0.0	0.0	2.3

154. Afghanistan entered into technical co-operation with the Agency in the mid-1970s. The main emphasis was placed on manpower development so that the country could in due course incorporate the use of nuclear techniques into its national development programme. For 1976, the Agency assisted the Faculty of Science of Kabul University to establish a Nuclear Science Department, with initial teaching focusing on applied nuclear physics. A substantial quantity of equipment was provided under projects in nuclear science and nuclear instrumentation, with Agency experts advising on programme and curriculum planning and instructing staff on the use and maintenance of equipment. One of the experts also advised the Government authorities on possible application of nuclear techniques in support of various sectors of the economy.

155. In 1977 a 4 kCi replacement cobalt-60 source was supplied for the teletherapy machine at the Ali Abad Hospital in Kabul. Experts provided on-the-job training over an extended period in treatment planning, medical physics and safe operation of the unit. In 1987, a second phase was planned, with the aim of replacing some of the now decayed source elements by 3 kCi of cobalt-60. However, owing to the civil unrest in the country, it was decided to postpone the transportation of the source until its safety could be guaranteed. A related project dealing with dosimetry in radiotherapy at the same hospital was approved in 1988 to strengthen the infrastructure for treatment planning, quality control and radiation safety in radiology and radiotherapy. Although a staff member of the hospital undertook a scientific visit to institutes in the Soviet Union and to the Agency's Dosimetry Unit in Seibersdorf, other elements of the project could not be implemented. The two projects are being held in abeyance by the Agency with the expectation that they will be revitalized when the situation in the country has stabilized.

ALBANIA

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

Year	TACF share	TACF pledged	Extrabudgetary funds	In-kind support	Experts from country	Persons trained in country
	\$	\$	\$	\$		
1986	3.0	3.0	0.0	0.0	0	0
1987	3.4	3.4	0.0	0.0	0	0
1988	3.8	3.8	0.0	0.0	0	0
1989	4.2	4.2	0.0	0.0	3	0
1990	4.6	4.6	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 \$	\$	\$	\$	\$
1986	143.4	0.0	143.4	3.0	87.1	38.0	0.0	0.0	8.6	133.7
1987	201.2	50.0	251.2	4.7	299.1	32.1	0.0	0.0	0.2	331.4
1988	134.3	0.0	134.3	2.5	113.4	32.5	0.0	0.0	0.0	145.9
1989	104.4	0.0	104.4	1.4	204.0	83.9	0.0	51.9	8.3	348.1
1990	222.0	50.0	272.0	3.6	97.4	4.2	0.0	62.0	12.4	178.0

156. Albania has been a recipient of assistance under the Agency's Technical Co-operation Programme since the mid-1970s. The greater part of the co-operation involved the Institute of Nuclear Physics (INP), Tirana, which is the main institute in the country that uses nuclear techniques in training, research and practical applications in the country. Its activities cover nuclear analytical techniques, isotope tracer studies and irradiation procedures on behalf of a diversity of sectors, including industry, agriculture, water resource planning, mining and radiopharmaceuticals. The other, recent counterpart is the Ministry of Agriculture, for applications in animal science.

157. A national interest has been to build up INP's capabilities in analytical services, a progressive activity initiated in 1976. X-ray fluorescence analysis and the Moessbauer technique were introduced and upgraded as services to industry, as was nitrogen-15 analysis in connection with fertilizer use efficiency studies.

158. A particular strength of the Institute is the practical application of tracer techniques in support of industry, including the mining sector and water resource management. The hydrogeological characteristics of the country, in particular as they relate to the karstic formations, required isotope studies to trace subterranean water flows, recharge and interchange between aquifers and to solve problems relating to the planning and construction of a dam. In industry, process control has been improved by application of tracers, for example in the exploitation of the country's mineral resources.

159. The Institute is receiving Agency assistance with the planning, design, ordering and commissioning of a low-power research reactor that will in due course be used to produce short-lived radioisotopes, in particular for use in radiopharmaceuticals, and for neutron activation analysis. A 250 kW Triga Mark-I reactor was selected in 1990, and the Government has commenced with the construction of the buildings for the reactor and associated laboratories. This major activity is being funded by UNDP (US \$2 million) with IAEA as executing agency; the Agency is providing additional inputs through two large, complementary projects. The tripartite negotiations between the supplier, recipient country and the Agency are at a final stage, and Board of Governors approval of terms and conditions is now awaited.

160. In connection with the research reactor activities, and as a reflection of the growing use of radiation sources, the Agency is assisting the INP to establish a Radiation Protection Laboratory, one of its functions being the operation of a personnel dosimetry service.

161. The Government is also seeking support to upgrade its nuclear medical diagnostic services to use the short-lived isotopes to be produced by the reactor. The aim is to be able to undertake static and dynamic studies with a gamma camera in support of clinical medicine at Hospital No. 1 in Tirana. Both training and provision of equipment are foreseen.

162. In animal husbandry, the Ministry of Agriculture is setting up a radioimmunoassay laboratory with Agency assistance to diagnose diseases of cattle and sheep, and to assess and control their effects on the reproductive efficiency of the livestock. The project, initiated in 1989, focuses particularly on the on-the-job training given by Agency experts.

163. In summary, since 1976, there has been a steady build up of manpower to support the various applications of nuclear techniques in the country. The training and the provision of equipment have been remarkably task-oriented, with rapid practical use being made of equipment and staff in support of the national economy.

BULGARIA

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

Year	TACF share	TACF pledged	Extrabudgetary funds	In-kind support	Experts from country	Persons trained in country
	\$	\$	\$	\$		
1986	54.0	54.0	0.0	9.4	15	0
1987	54.4	54.4	0.0	0.0	9	1
1988	60.8	60.8	0.0	14.0	17	8
1989	67.2	67.2	0.0	2.3	11	16
1990	68.3	68.3	0.0	1.3	21	2

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 \$	\$	\$	\$	\$
1986	64.5	505.0	569.5	12.0	384.0	4.0	0.0	0.0	25.6	413.6
1987	24.1	490.0	514.1	9.7	545.8	342.7	0.0	0.0	27.8	916.3
1988	58.8	370.0	428.8	8.0	426.3	769.3	161.0	0.0	5.0	1361.6
1989	113.0	225.0	338.0	4.6	80.7	23.2	151.6	0.0	28.9	284.4
1990	242.1	170.0	412.1	5.4	378.3	457.7	0.0	0.0	30.6	866.6

164. Bulgaria was one of the first countries to engage in technical co-operation with the Agency. Its nationals have received extensive training through Agency fellowships, and main centres for research and development have been assisted to modernize their equipment and facilities, among them, the Institute for Nuclear Research and Nuclear Energy (INRNE), the Institute of Genetics, the N. Poushkarov Institute of Soil Sciences and Agroecology, and about 14 other research institutes related to the Bulgarian Academy of Sciences. However, despite a large nuclear power programme, there was little assistance requested in this area, apart from fellowships, until the mid-1980s. Indeed, nationally, there has been a distinct separation between nuclear power production and the country's research institutes, with little collaboration. The Bulgarian Committee on the Use of Atomic Energy for Peaceful Purposes

has recognized that this situation is inefficient and is encouraging improved ties between INRNE and the nuclear power sector, a trend that is strongly supported by the Agency.

165. With the exception of hydrology, where studies were oriented towards gaining knowledge about water resources with a view to improving management thereof, the Agency had, over the years, been requested to assist with diverse, small to medium sized projects, most having little relevance to economically interesting applications. This pattern has steadily changed throughout the 1980s, with growing emphasis on projects relating to quality assurance and safety in respect of nuclear power, radiation protection, and studies linked to commercial uses of nuclear techniques.

166. The principal counterpart has been INRNE, which is a research complex centred around the 2 MW(th) research reactor (IRT-1000). In 1982, under a UNDP-funded project started in 1978, a centre for the application of isotopes was established; the project objectives focused on manpower development and, over five years, 21 fellowships for advanced training abroad were granted. Analytical techniques promoted by providing Agency experts to give on-the-job training included activation analysis, Moessbauer spectrometry and X-ray fluorescence analysis, as well as uses of stable isotopes in tracer studies. These "tools" are now being used to support industrial activities. A high-yield neutron generator has been ordered to further improve activation analysis.

167. Then, from 1982, a major project was funded to modernize the reactor for which, after 20 years of operation, fuel and spares were no longer available. This work was completed in 1991, and commissioning is awaiting the Government's decision on licensing.

168. Nuclear power activities were to a great extent organized based on bilateral co-operation between Bulgaria and the USSR, and Bulgaria embarked on a relatively large programme in the 1970s. It has four 440 MW(e) and one 1000 MW(e) units, with an additional four 1000 MW(e) units to be connected to the grid shortly at Kozloduy. There are also, under construction, four 1000 MW(e) WWERs at the Belene site. Nevertheless, until recently, the Agency's involvement in this programme was minimal.

169. From the mid-1980s, as the Agency became able to offer expertise on safety analyses connected with WWER-type reactors, Bulgarian personnel were trained through interrègional and regional training courses to make use of well-ried computer codes for calculating reactor parameters under various operating and fault conditions. At the same time, the Agency was requested to send site safety review missions and Operational Safety Review Team (OSART) missions to assist in bringing national operating safety standards in line with internationally accepted norms. Initial missions were carried out in 1990 to the Kozloduy Nuclear Power Plant and to the construction site of the future Belene plant (full missions have been approved for 1991).

170. At the review meeting attended by Bulgarian and Agency experts in August 1990, it was decided to implement a number of urgent recommendations as outlined in the final reports of the above missions. The short-term plan of action was aimed at clarifying the immediate problems related to seismic safety. Completion of the local meteorological station at Kozloduy was considered an important factor. A comprehensive plan of action will be implemented by the Bulgarian authorities when final reports are available. The Agency input will consist of a data acquisition and processing system, specialised software related to the tasks contained in the plan of action, and expert services in the form of review and advisory and follow-up missions. A number of fellowships to train the local engineers in various related fields are also foreseen.

171. A quality assurance programme for nuclear power plants was started in 1989 at the Economic Combine for Welding and Testing, Sofia, with the objective of establishing systematic in-service inspection and quality assurance procedures, and of enhancing capabilities through the provision of equipment and training. The inspection of the main plant components is one of the major tasks directly influencing operational safety of nuclear power plants in the country. This project is now well under way and, here too, prime emphasis is being placed on fellowship training.

172. The treatment of radioactive wastes is also receiving attention. As a result of the recommendations of an Agency WAMAP mission in 1987, a project was initiated in which various technologies were to be assessed, leading to a design for a pilot waste treatment plant for Kozloduy.

173. In agriculture, the Agency has supported studies in mutation breeding, with particular reference to barley and wheat, and some mutants with improved characteristics are being tested.

174. In support of radiotherapy, assistance was given to the Academy of Medicine to conduct studies to correlate planned treatment doses with absorbed doses measured in and around the tumour site.

175. As indicated, the Government has been showing increased interest in commercial applications of radiation technology. One area is the production of short-lived radioisotopes for use in radiopharmaceuticals. Another related area is the radiosterilization of medical and cosmetic products. During 1989-90, the Agency provided the commercial organization Pharmachim, Sofia, with a semi-industrial cobalt-60 gamma irradiator that was duly installed and commissioned. In the field of plastics, one industrially oriented research project, commenced in 1984, is devoted to radiation-induced polymerization to produce plastic films and electric cable sheathing. An electron accelerator was provided to the counterpart, the Higher Institute for Chemical Technology, Bourgas, to undertake development of these processes with a view to realizing commercial application of such more homogeneously cured films and coatings.

176. In summary, with a well qualified professional labour force, Bulgaria requires access to specialized training in specific aspects of nuclear technology, and assistance in obtaining certain specialist items of equipment or facilities. This is reflected by the fact that, for 1980-89, some 68% of the technical co-operation funding was disbursed on equipment purchases, and 29% for fellowship training abroad, with only 3% expended on the services of Agency experts.

177. Future collaborative activities between the Agency and Bulgaria will focus on strengthening the local infrastructure in support of the nuclear power programme, in particular as regards safety and quality assurance, and in establishing a long-term programme to promote the use of nuclear techniques for the benefit of national economic development.

CYPRUS

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

Year	TACF share	TACF pledged	Extrabudgetary funds	In-kind support	Experts from country	Persons trained in country
	\$	\$	\$	\$		
1986	3.0	2.6	0.0	0.0	0	0
1987	6.8	6.8	0.0	0.0	0	0
1988	7.6	7.6	0.0	0.0	0	1
1989	8.4	8.4	0.0	0.0	0	0
1990	9.1	9.1	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 \$	\$	\$	\$	\$
1986	20.0	0.0	20.0	0.4	32.2	0.0	0.0	0.0	9.2	41.4
1987	55.0	10.0	65.0	1.2	69.3	0.0	0.0	0.0	0.0	69.3
1988	87.5	0.0	87.5	1.8	22.4	0.0	0.0	0.0	0.0	22.4
1989	125.7	0.0	125.7	1.7	75.3	0.0	0.0	0.0	0.0	75.3
1990	103.8	0.0	103.8	1.4	91.8	0.0	40.1	0.0	0.0	131.9

178. In its programme of technical co-operation with the Agency, Cyprus has placed the greatest emphasis on support for agriculture. The Agricultural Research Institute of the Ministry of Agriculture received assistance with its studies of the nutritional value of various feed regimens for penned and free-grazing cattle, sheep and goats, seeking to improve the reproductive efficiency and meat and milk production. Equipment for nitrogen determination in feeds and radioimmunoassay for hormone level assessment was provided by the Agency, together with experts to give on-the-job training. After field trials, the modified husbandry practices were adopted by the farming community with satisfactory results. This project has been followed by one concerned with diagnosis and control of animal diseases, these also playing a major role in reducing animal productivity; the counterpart in this case was the Central Veterinary Laboratory in Nicosia. Interest was also shown in evaluating the impacts of pesticide residues in the environment and in developing safer chemical pest-control techniques, as well as non-chemical methods; these studies were supported under two projects over the years 1983-85. Improved productivity of crops is also the subject of study, being the main aim behind a project concerned with soil/plant interactions.

179. In hydrology, environmental isotope techniques were introduced to assess water resources in the country. Recharge rates of aquifers were studied, with the aim of improving water management practices. The isotopic analyses of water samples were performed at the Agency's Laboratory in Vienna. A related activity was the use of tracers to study the transport of pollutants from sewage outfalls on the coast, making it possible to determine a suitable, safe site for a sea outfall for discharging effluents from Nicosia without endangering tourism, a major source of income for the national economy. Agency expert assistance played a valuable role in site assessment.

180. The Radiation Dosimetry Laboratory of the Nicosia General Hospital was established with Agency assistance to enable the Hospital to discharge its responsibility for personnel dosimetry services in the country. A thermoluminescence dosimetry system is being introduced with Agency support. Furthermore, based on the lessons learned from the Chernobyl accident, the Cypriot authorities decided to establish an Early Warning Environmental Radiation Monitoring System (EWERMS) at strategic points in the country. The fully operational project will have EWERMS set up at three

stations of the Meteorological Service, with a central control at the Nicosia General Hospital. The Agency will be providing equipment and training under the project approved for the 1991-92 biennium.

181. Carefully chosen developmental topics and sound allocation of priorities by the Government has ensured that the support received from the Agency has effectively introduced appropriate nuclear techniques, with a continuing impact on the national economy and on radiation safety.

CZECH AND SLOVAK FEDERAL REPUBLIC

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

Year	TACF share	TACF pledged	Extrabudgetary funds	In-kind support	Experts from country	Persons trained in country
	\$	\$	\$	\$		
1986	225.0	225.0	0.0	89.5	7	37
1987	234.6	234.6	0.0	26.5	16	40
1988	262.2	262.2	0.0	16.0	19	6
1989	289.8	289.8	0.0	3.8	19	57
1990	295.8	295.8	0.0	22.5	19	13

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 \$	\$	\$	\$	\$
1986	0.0	0.0	0.0	0.0	31.6	1.3	0.0	0.0	0.0	32.9
1987	17.1	10.0	27.1	0.5	70.9	1.9	0.0	0.0	0.0	72.8
1988	40.0	0.0	40.0	0.8	48.5	0.0	0.0	0.0	0.0	48.5
1989	50.0	0.0	50.0	0.7	107.0	0.0	0.0	0.0	5.0	112.0
1990	0.0	0.0	0.0	0.0	108.1	0.0	0.0	0.0	30.0	138.1

182. Czechoslovakia was one of the eighteen Member States whose ratification of the Agency's status was instrumental to its entering into force in 1957. In the early years, it benefitted considerably from the Agency's Technical Co-operation Programme, in particular by introducing the teaching of nuclear techniques into university curricula and obtaining equipment to initiate research projects. However, due to the country's rather rapid economic development, the assistance requested decreased. Since the late-1980s, some limited scope but important projects have been approved, connected with the country's nuclear power programme.

183. Czechoslovakia has, in turn, assisted the Technical Co-operation Programme significantly by making experts available for missions to other recipient countries.

184. In 1987, the Czechoslovak Atomic Energy Commission sought Agency assistance with its plans to set up a national standardization laboratory within the Metrology Division of the Institute for Research, Production and Application of Radioisotopes. The Agency provided primarily expert services to advise on project planning, design and construction of a secondary standards dosimetry laboratory, which has since been established. The laboratory now participates as a member of the IAEA/WHO Network of Secondary Standards Dosimetry Laboratories. It also is responsible for certain facets of the dosimetry connected with safety at the operational nuclear power plants and at those that are under construction.

185. With regard to the nuclear power programme, the country has placed particular emphasis on matching the operational safety of its reactors at Bohunice and Dukovany to internationally accepted norms, and on obtaining outside experts to under-

take design reviews of power plants under construction (Temelin and Mochsile) or planned. A number of Agency Operational Safety Review Team (OSART) missions visited Czechoslovakia during 1989-90. Safety practices were reviewed at Dukovany in 1989, and a follow-up OSART in 1990 reviewed implementation of the recommendations and suggestions made at the earlier visit. Dukovany is a four-unit 440 MW(e) WWER-type plant of Soviet design. Unit 1 was put in commercial operation in 1985, Unit 2 in 1986, Unit 3 in 1987 and Unit 4 in 1988. The overall results of the OSART review indicate that Dukovany has a highly qualified and dedicated management, and a well-trained and experienced work force, aware of their responsibilities for ensuring the health and safety of plant personnel and the general public.

186. A safety mission was also sent to Bohunice to review and document special safety measures that had been put into force.

187. There were also pre-OSART and Site Safety Review missions to the Temelin site. It is expected that missions to Temelin will be supplemented by another pre-OSART review in 1992/93, i.e. a year before the start-up of unit 1, and an OSART review at the commencement of commercial operation and the first refuelling.

188. To further assist in the evaluation of the Temelin nuclear power plant project, several Design Review Missions (funded from the Regional projects concerned with safety of WWER-type reactors) were also organized at the Government's request. The topics under review were highly specialized and demanded a critical selection of nuclear experts. Several organizations of the Republic in addition to the staff of Temelin were involved in the technical discussions. Additionally, as the developers of the basic design of the WWER-1000 reactors, 38 Soviet specialists from several USSR organizations participated in the review. A good understanding of the Temelin design was achieved and, based on this, a report for the Government was prepared.

189. In the area of industrial applications of irradiation processing, the Agency provided the Food Research Institute in Bratislava with a semi-industrial cobalt-60 irradiation facility for pilot-scale studies on irradiation of animal feeds and other food materials to improve storage life and effect disinfestation. The aim is to introduce food and feed irradiation as a commercial activity in due course.

190. Projects approved for the 1991-92 biennium are all concerned with reactor operation, ranging from the testing of noise thermometry in WWER reactors to assessments of environmental status. It is expected that this double emphasis — on reactor operation and on radiation safety and protection — will remain predominant for some time in the future in requests for technical co-operation.

GREECE

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

Year	TACF share	TACF pledged	Extrabudgetary funds	In-kind support	Experts from country	Persons trained in country
	\$	\$	\$	\$		
1986	117.0	117.0	0.0	0.0	3	5
1987	146.2	146.2	0.0	0.0	5	5
1988	163.4	163.4	0.0	2.0	6	2
1989	180.6	180.6	0.0	0.0	2	2
1990	177.5	177.5	0.0	0.0	2	24

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 \$	\$	\$	\$	\$
1986	90.8	0.0	90.8	1.9	90.8	0.5	47.2	0.0	14.5	153.0
1987	168.2	22.0	190.2	3.6	154.4	0.0	0.0	0.0	30.8	185.2
1988	230.4	0.0	230.4	4.3	216.5	0.0	97.7	0.0	0.0	314.2
1989	208.9	220.0	428.9	5.8	300.1	8.3	30.5	0.0	0.0	338.9
1990	143.9	300.0	443.9	5.8	244.8	3.3	38.6	0.0	26.8	313.5

191. The Greek Atomic Energy Commission (GAEC) is the authority responsible for co-ordinating all activities concerned with the peaceful uses of atomic energy in the country. Its principal establishment for such activities is the Demokritos Nuclear Research Center. The Center incorporates several institutes, of which the Institute of Nuclear Technology and Radiation Protection (INTRP) operates a 5 MW(th) research reactor commissioned in 1961.

192. Since 1975, 51 projects have been approved for implementation, of which one was a UNDP uranium exploration project executed by the Agency, and sixteen were footnote^a projects. Twelve of the latter were partially or completely funded by the United States of America, and two by the Federal Republic of Germany; one awaits funding. The distribution by fields can be summarized as follows, the current projects of the total being shown in parentheses: nuclear physics and nuclear analytical techniques 6 (2); radiopharmacology, including diagnostic kit preparation 10 (1); exploration and test mining for uranium 3 (1); research reactor support 3 (2); agriculture, including animal husbandry 10 (0); medical treatment and diagnostics 3 (0); microbiology 2 (0); industrial (including pilot-scale) applications and studies 2 (1); hydrology and geothermal studies 4 (2); and radiation protection, including environmental aspects 8 (2).

193. Of the three research reactor projects, one concerned the more efficient utilization of the facility, and the two current ones an upgrading of performance and of safety. The latter is concerned with installation of a stack radiation monitor with an acoustic warning system, and the provision of instrumentation for the new meteorological tower at the Demokritos centre, since the situation of the reactor, in the Athens basin, a densely populated area, requires that emissions be kept continually under control and at an acceptable level. In 1988-89, the Institute responsible for reactor operation faced staffing problems owing to the retirement of the supervisor and several other experienced operating staff; owing to a "generation gap", the vacancies proved difficult to fill. This was reflected in a delay in implementing the current projects.

194. Nuclear medical diagnostics and related assays are well advanced in Greece. The Radiopharmaceuticals Laboratory produces 23 products on a regular basis (diagnostic and radioimmunoassay kits, labelled compounds and radioisotopes), these being distributed to some 200 centres in Greece, covering some 90% of the national demand. Many of the hospitals have gamma cameras or scintigraphy equipment and some can undertake dynamic diagnostic studies. The research reactor is used to produce the radioisotopes. As can be seen, radiopharmacology is the field that received the greatest support, in terms of projects, in the period since 1977, and the success with which the laboratory meets local demands highlights the appropriateness of the effort expended. Quality assurance was an aspect included from the start of this national activity, and this emphasis on control of quality has materially assisted the laboratory in acquiring a good reputation. In addition, the Agency gave the Government assistance in the preparation of national regulations on radiopharmaceuticals.

195. Uranium exploration has been of interest to the Government for many years, and it received Agency support at various times. In 1979, a major UNDP project was initiated to consolidate data acquisition and, in 1981, this was followed by help with pilot studies regarding the feasibility of mining uranium ore at selected prospects in Macedonia and Thrace. The current project is designed to assist the Greek Institute of Geology and Mineral Exploration in computerizing the data collected so far and in evaluating it using appropriate software, in part supplied by the Agency. In addition, the Institute will continue borehole logging to build up more detailed information in areas of interest. The development of the very advanced, computerized borehole logging device being used was supported through the project; a particular feature is the rapidity with which data are obtained.

196. Of the ten projects in agriculture in the period 1974-89, nine were concerned with crop improvement, ranging from optimizing water-use and fertilizer-use efficiency to treatments for saline soils. In addition to the Democritos Nuclear Research Center, the Institute of Land Reclamation, the Institute for Subtropical Plants and Olive Trees and the Institute for Cotton and Industrial Plants, benefitted from collaboration in crop and soil research with the Agency. The main purpose of these projects was to transfer knowledge of principles and techniques, for example nitrogen-15 labelled fertilizer studies, so that the staff could use the techniques to seek improved farming practices. Information on the necessary pattern of irrigation for citrus fruits and olives, and of nitrogen application for cotton, all important export crops, has been passed on to growers. In animal science, the Department of Helminthology of the Veterinary School of the Aristotelian University, Thessalonika, undertook studies of dicrocoelium infection in sheep, benefitting considerably from support given by Agency. However, delays in receiving funds from the Greek authorities hampered project execution, and work on the economic impact of this parasitic disease is still outstanding.

197. The Institute of Nuclear Physics of the Demokritos Nuclear Research Center provides nuclear analytical services to third parties as well as undertaking basic and applied research — thereby ensuring that the country is able to hold its own at the frontiers of nuclear science and technology. In addition, the Centre has undertaken studies in isotope hydrology with a view to improving the management of the country's water resources, and is exploring for geothermal fields that could be used to provide either process heat for industry or to generate electricity, thus reducing the country's consumption of fossil fuels — a national developmental objective.

198. In the summer of 1990, a fire in the Physical Chemistry and Biology Building of the Demokritos centre destroyed five laboratories of the Institute of Physical Chemistry, three of which were devoted to work in radiation chemistry, and damaged the Institute's Gammacell cobalt-60 irradiator beyond repair. This unit, provided by the Agency in 1965, was to have received a new charge under a project approved for the 1991-92 biennium to replace the exhausted loading; both it and the laboratory equipment will need to be replaced when premises are again available.

199. Environmental safety has also been receiving growing emphasis, both for land and marine environments. In the latter case, the Agency assisted the National Centre for Marine Research with studies to determine the level of contamination of sea water following the Chernobyl accident. Furthermore, the Environmental Radioactivity Laboratory at the Demokritos centre has been upgraded to enable it to undertake ecological studies involving definition of base-line radioactivity levels.

200. In the period 1980-89, 17% of the funds disbursed were for expert services, 65% for equipment and 18% for training through fellowships and scientific visits. It may be noted that, apart from radiopharmaceutical and radioisotope production, and provision of nuclear analytical services, little use has been made of the Agency's potential to introduce nuclear technology at the industrial level. However, collaboration in other fields of activity has been extensive.

HUNGARY

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

Year	TACF share	TACF pledged	Extrabudgetary funds	In-kind support	Experts from country	Persons trained in country
	\$	\$	\$	\$		
1986	69.0	79.6	0.0	21.4	42	68
1987	74.8	80.9	0.0	76.5	41	46
1988	83.6	92.3	0.0	59.0	38	57
1989	92.4	79.4	0.0	92.6	46	54
1990	95.6	106.5	0.0	121.0	39	69

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 \$	\$	\$	\$	\$
1986	156.9	365.0	521.9	11.0	383.3	151.6	115.5	11.4	7.2	669.0
1987	67.1	450.0	517.1	9.8	360.4	2944.8	143.7	3.7	0.0	3452.6
1988	103.2	72.0	175.2	3.3	102.1	19.9	492.0	0.5	5.5	620.0
1989	62.9	0.0	62.9	0.8	165.3	7.1	27.9	2.8	0.0	203.1
1990	158.4	0.0	158.4	2.1	64.5	109.4	129.4	21.5	31.5	356.3

201. Hungary became a member of the IAEA in 1957, and has participated in the Agency's programme of technical co-operation from its inception in 1958. By the end of the first twenty years of programme, it ranked as the 15th largest recipient of technical assistance.

202. In the period 1981-90, the Agency approved a total of 15 technical co-operation projects in Hungary, of which 10 have already been completed and five are still operational. Of these projects, two were UNDP projects for which IAEA was executing agency, two were funds-in-trust projects, and three were funded extrabudgetarily by USSR (US\$ 0.85 million). In the same period, over 200 Hungarians received training abroad through Agency fellowships and scientific visits, and some 120 Hungarian specialists participated in regional and interregional training courses held by the Agency. Hungary also supported the Agency's Technical Co-operation Programme by hosting interregional training courses, while Hungarian institutions hosted over 189 Agency fellowships and scientific visits, and 275 Hungarian specialists completed assignments as experts on Agency technical co-operation projects and as lecturers at Agency training courses.

203. Hungary has developed on a strong infrastructure to support nuclear research, development and applications. There are many highly qualified experts and reasonably equipped laboratories and installations.

204. The sizeable nuclear power programme in Hungary, with four WWER-440 units in operation in Paks and the planned construction of additional larger units make in-service inspection of the major plant components one of the main tasks directly related to safe operation. The Steel Research and Development Enterprise (VASKUT) is responsible for the establishment of systematic in-service inspection of the reactor vessel and the class 1 components of the primary circuit, including responsibility for developing adequate methodologies and equipment as well as for specifying the criteria to be followed. In 1988, the Agency was requested to assist by providing expert services, training and certain items of inspection equipment. This on-going project is a typical of projects directed toward technology transfer in nuclear power

engineering. It is co-ordinated with a regional project in the same field with the objective of updating domestic capability for ensuring the safe and reliable operation of the country's nuclear power units.

205. In 1988, an Operational Safety Review Team (OSART) mission visited Hungary. The mission's findings and recommendations resulted in the formulation of revised plans and activities at Paks. This mission, and the benefits derived from it, were highly appreciated by Hungarian authorities and technical counterparts. A follow-up OSART mission will be sent to Paks in 1991.

206. The Central Research Institute for Physics, Budapest, has been operating Hungary's only research reactor since 1959. Initially designed with a maximum power of 2.5 MW(th), the reactor was upgraded to 5 MW(th) in 1967 to meet the growing demand for short-lived radioisotopes. While this demand continued to increase, technical assessment of the reactor's condition in 1985 called for a shut-down of the facility in a few year's time if modernization were not undertaken. The Agency was requested in 1986 to assist with the upgrading of the system, reactor pumps, hot cells manipulators, seismic instrumentation and reactor monitoring equipment. The Agency also assisted the counterpart with the preparation and review of the Safety Analysis Report required for re-licensing of the reactor.

207. The Agency assisted the Institute of Nuclear Research, Debrecen, in obtaining and commissioning, in 1985, a cyclotron and auxiliary facilities. Expert services and 26 project-related fellowships and scientific visits contributed to the widening of expertise among local staff. Extensive use is being made of the cyclotron laboratory for fundamental research in atomic and nuclear physics and for applications in industrial, agricultural and medical fields, including isotope production. The Institute also organizes meetings, seminars, and group and individual training related to nuclear physics and radioisotope production.

208. Hungary started a programme of food irradiation in the early 1980s. The Agroster Joint Irradiation Development Company, Budapest, had carried out food irradiation experiments. The main objective was to pave the way for the introduction of food irradiation technology on an industrial scale. To further these studies, the Agency, with support from USSR, was able to provide a 200 kCi cobalt-60 source and grant a project-related scientific visit to the principal counterpart to visit Canada and the USA.

209. At a later stage, and in connection with its national nuclear power programme, Hungary decided to produce cobalt-60 sources locally. The Institute of Isotopes of the Hungarian Academy of Sciences, Budapest, in collaboration with the Atomic Power Plant Company, Paks, undertook a multi-year project to produce cobalt-60 by activation in nuclear power reactors. The Agency provided advisory services in reactor physics and radiation source technology, and supplied hot-cell manipulators and lead-glass windows. The project has been very successful, and Hungary can now also export sources in addition to meeting local demands.

210. A current UNDP-funded project is also concerned with radiation treatment of foodstuffs. The objective is to provide for basic and applied research into pulsed radiolysis to determine biological effects, the effects on food products and spices, and the polymerization behaviour of natural and other substances.

211. The Agency has also provided assistance in various areas pertaining to analytical techniques. Another UNDP-funded project provided for installation of an electron accelerator for on-line spectroscopy. The Institute of Isotopes of the Hungarian Academy of Sciences initiated a project for the introduction of multiple labelling with stable isotopes in the fields of chemical and biochemical research. With funding from USSR, the Agency provided a combined high-performance gas chromatograph and mass spectrometer to the Institute. Since the completion of the project, the staff have started investigations into oxygenated products in catalytic hydrocarbon reactions, as well as using the instrument to measure the isotopic content of oxygen-18 labelled

products. They are also collaborating with other departments in various research projects for which the instrument is a necessary tool. Further areas include neutron activation analysis for protein determination based on nitrogen isotopes. Analysis of the chemical composition of raw materials use in glass making, and of agrochemical residues in Lake Balaton and Lake Neusiedl were also supported.

212. Various projects have considered safety aspects. A project running from 1977 to 1982 was concerned with the simple, safe and economical storage of radioactive waste. There have been activities relating to the use of computer codes to analyse reactor transients, and fault and accident behaviour. A current project on management of accidents is being supported extrabudgetarily by France. The country projects in this area were backed up by regional and interregional projects concerned with specific aspects of WWER-type reactor performance.

213. Environmental monitoring has been and is being supported. In addition to providing equipment and advice for monitoring related to nuclear power plants, help was given to improve radioactivity assessment as part of a Chernobyl follow-up activity. A current project is concerned with setting up a nation-wide "early warning" environmental radiation telemetry system, building on existing localized systems operated by the Central Research Institute for Physics for its research reactor and by the Paks Nuclear Power Plant (with real-time computer programs), and using the stations of the Hungarian Meteorological Service to obtain wide coverage.

214. Another current project is designed to help modernize the national personnel dosimetry system that covers 15,000 radiation workers.

215. At the basic manpower development level, a project, to be funded extrabudgetarily by USA, is concerned with establishing a co-ordinated pattern of university courses and qualifications to satisfy the demands for nuclear engineers in the future.

216. Hungary's on-going projects are an indication of the well established infrastructure and a successful nuclear power programme. In recent years there has been growing emphasis on projects concerned with nuclear safety and radiation protection. It is, however, difficult to provide a forecast of the requirements for Agency assistance to Hungary. Nuclear activities, and the nuclear power programme in particular, are affected by the changes that are taking place in the region. One development that has already affected the nuclear programme is the Government decision to delay construction of the two Soviet-made 1000 MW(e) nuclear power units which were intended to complement the four 440 MW(e) units already in operation at Paks. For the present, the technical assistance requests are for small but critical inputs of equipment and training not locally available, with emphasis on the improvement and upgrading of the nuclear and radiation safety infrastructure and practices.

ICELAND

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

Year	TACF share	TACF pledged	Extrabudgetary funds	In-kind support	Experts from country	Persons trained in country
	\$	\$	\$	\$		
1986	9.0	9.0	0.0	3.9	1	0
1987	10.2	10.2	0.0	0.0	0	0
1988	11.4	11.4	0.0	0.0	0	0
1989	12.6	12.6	0.0	0.0	1	0
1990	13.7	13.7	0.0	0.0	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 \$	\$	\$	\$	\$
1986	76.9	0.0	76.9	1.6	66.0	0.0	0.0	0.0	0.0	66.0
1987	0.0	0.0	0.0	0.0	45.4	0.0	0.0	0.0	1.8	47.2
1988	57.2	0.0	57.2	1.1	35.2	0.0	0.0	0.0	0.0	35.2
1989	35.0	0.0	35.0	0.5	50.6	0.0	8.5	0.0	0.0	59.1
1990	0.0	0.0	0.0	0.0	11.8	0.0	0.0	0.0	0.0	11.8

217. Iceland, an island of 102,000 square kilometres in the North Atlantic, has a population of some 200,000. Much of the country is at a height of over 800 metres, with over 100 volcanoes. The lowlands (some 25,000 km²) are only partly habitable, and only about 14,000 km² of the land are productive.

218. The volcanic nature of the country and the sizeable number of geothermal springs, has made it possible to utilize geothermal energy for district heating and, to a lesser extent for electricity generation and process heating. As there is a national policy to reduce dependence in imported fossil fuels, Iceland sought Agency support to evaluate the geothermal reserves. In two projects on radioactive logging and a later major project on the use of isotopes in exploration for and evaluation of geothermal resources, the Agency assisted the National Energy Authority and the Science Institute of the University of Iceland by providing appropriate equipment and instrumentation for sampling and evaluation of data on hot springs; some studies on glaciers and groundwater were also undertaken. Agency experts then advised the counterpart staff on the interpretation of results. These and complementary estimates have shown that there are some 1000 TWh of harnessable geothermal energy in the upper three kilometres of Iceland's crust; a programme to use it to generate electricity for export to Europe is being studied at the present time.

219. In agricultural applications, the Agency assisted the Agricultural Research Institute and the Institute for Experimental Pathology in Keldur to evaluate the utilization of pasture forage by ewes and lambs; another endeavour was aimed at supporting Iceland's livestock production through improvement of animal health by utilizing radioimmunoassay techniques for disease diagnosis, as well as through improvement of winter feed by means of mutation breeding.

220. The Agency has also been assisting Iceland, through a project with the National Institute of Radiation Protection, to establish services for personnel dosimetry and environmental monitoring. A thermoluminescence dosimetry (TLD) system was provided to support the monitoring of all radiation workers in the country. A low-level counting system is to be provided for environmental radioactivity assessment. It is foreseen that effort in this area will be expanded by establishing an Early Warning Environmental Radiation Monitoring System (EWERMS), similar to that already established in the Nordic countries, to warn the authorities of radiological emergencies.

THE ISLAMIC REPUBLIC OF IRAN

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

Year	TACF share	TACF pledged	Extrabudgetary funds	In-kind support	Experts from country	Persons trained in country
	\$	\$	\$	\$		
1986	171.0	0.0	0.0	0.0	4	0
1987	210.8	0.0	0.0	0.0	2	0
1988	235.6	0.0	0.0	0.0	3	0
1989	260.4	0.0	0.0	0.0	5	0
1990	309.4	390.4	0.0	0.0	9	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 \$	\$	\$	\$	\$
1986	41.4	0.0	41.4	0.9	174.4	4.4	0.0	91.4	0.3	270.5
1987	241.7	40.0	281.7	5.3	283.3	8.8	245.0	263.7	19.4	820.2
1988	347.1	110.0	457.1	8.6	268.0	24.6	5.3	84.0	0.5	382.4
1989	429.7	120.0	549.7	7.4	502.7	60.2	0.0	47.5	14.3	624.7
1990	537.1	125.0	662.1	8.7	808.0	150.0	0.0	-2.0	58.4	1014.4

221. The Islamic Republic of Iran became a Member State of the Agency in 1958, but until the early 1980s, most requests for technical co-operation comprised primarily expert advice, particularly in respect of the planning of nuclear laboratories or facilities. Since that time the programme has developed on a broad front.

222. The Atomic Energy Organization of Iran (AEOI) is the body responsible for nuclear activities in the country. It operates three nuclear centres in the country, the Nuclear Research Centre in Tehran, where a research reactor is situated, the Nuclear Research Centre for Technology in Esfahan, and the Nuclear Research Centre for Agriculture and Medicine in Karadj, at present under construction. A high priority is being given to the nuclear power programme: the construction of the Bushehr Nuclear Power Plant had had to be suspended, but it is intended to redevelop the infrastructure and re-start construction. Priority is also being given to identifying economically favourable uranium resources to be used in support of the nuclear power programme.

223. In the present atmosphere of strong national socio-economic development, the Government has placed a particular emphasis on manpower development. A national project with this title was approved for the 1991-92 biennium, with planning to 1994. The TACF funds allocated will provide fellowships for training abroad in the various fields of the peaceful uses of atomic energy, the Iranian authorities covering the travel costs of their fellows and scientific visitors.

224. Planning for nuclear power commenced in the mid-1970s, and an Agency expert assisted in this activity during 1977. It was foreseen that two 1200 MW(e) PWRs would be erected at the Bushehr site. Construction was halted in 1980, and subsequently some damage was caused to the main and auxiliary buildings by military action. The growing need for electricity to support economic development led to a decision to revivify the programme, and the Agency was called on to provide experts to assess the safety of the concrete structures and to evaluate the damage. Criteria for rehabilitation of the plant and site have been drawn up and are being implemented.

225. The Government also foresees exploitation of national uranium resources; the country is among the few in the world with a relatively strong exploration programme. About 40% of its territory has been surveyed by airborne gamma-ray spectrometry since 1974. Follow-up work on favourability has led to the discovery of some interesting uranium deposits, several of which are associated with polymetallic sulphide mineralizations. The Agency has been providing technical assistance since 1985 under a long-term project on the processing of the airborne data, preparation of maps and interpretation of the geology. Support is expected to continue for a comprehensive exploration programme which should lead, after evaluation, to a feasibility study on the mining and processing of uranium ores. To prepare the infrastructure and introduce the technology, a supplementary project was approved from 1991 on ore dressing and leaching of uranium ores, with the objectives of setting up a properly equipped dressing laboratory and determining the feed and leaching parameters that permit optimum uranium recovery. In addition, in a project approved for 1992, advice will be provided on effluent treatment and on the design of the liquid waste treatment and tailing disposal systems for safe operation of the pilot uranium ore processing plant.

226. The 5 MW(th) pool-type research reactor at the Nuclear Research Centre was put into operation in 1967. The original high-enrichment fuel is still in use, and this now limits operation to a few hours per day at a power level below 2 MW(th). The Research Division at the Centre is currently engaged on core conversion to a low-enrichment uranium fuel, which has been purchased from Argentina. Work on modernizing the reactor instrumentation is under way, and the new safety analysis report is being prepared. The Agency has assisted by facilitating procurement of the fuel and it will be sending experts to advise on reactor safety and operation.

227. The Esfahan Centre was established in the mid-1970s with co-operation from France. Its original tasks were to support the national nuclear power programme, in particular providing technical and scientific support for the Bushehr plant. It was to be responsible for the training of operators, covering aspects such as waste management, in-service inspections, and non-destructive testing of the nuclear power plant components and systems. To aid the work of the Centre, the Agency will be sending an expert to assist in setting up and commissioning a radioactive waste incinerator, in line with the recommendations of a WAMAP mission, and will advise on a nuclear power plant training simulator for operators. It has also been assisting with the design and commissioning of a sub-critical assembly and a zero-power reactor, this last project being seen as providing practical experience of reactor physics and safety calculations, thereby helping to build up trained manpower.

228. The Government has placed considerable emphasis on the local production of radioisotopes and radiopharmaceuticals, and the Agency has been a major partner in this activity since 1982. The national programme aims to make the country to a large extent self-reliant in the production of the commonly used radiopharmaceuticals. At the Nuclear Research Centre in Tehran, a Radiopharmaceutical Laboratory has been established to produce, primarily, the two principal radioisotopes used in medical diagnostics, namely technetium-99m and iodine-131. The technetium isotope is being derived from technetium generators using the fission product molybdenum-99, which is being imported in bulk; the iodine-131 is to be locally produced in the research reactor.

229. Agency support has consisted of provision of the in-cell equipment for isotope handling: the cell frame, shielding and support structures were fabricated by the Centre. The Agency also provided items of essential equipment such as a large freeze-drying machine (for the preparation of in-vivo kits), and assay and quality control instruments. Agency experts advised on the various aspects of radioisotope and radiopharmaceutical production and on quality control. The generator production line was commissioned in December 1990, and trial production is under way. The iodine-131 production facility is expected to be commissioned in July 1991.

230. A related project foresees the installation of a variable-energy cyclotron, purchased with Government funds, at the National Research Centre for Agriculture and Medicine. It is to produce short-lived isotopes for positron-emission tomography studies on patients. The Agency will supply expertise, as well as some laboratory and interface equipment needed for the cyclotron, and will provide training for local specialists. Advice on the selection of the cyclotron and on project planning has already been provided.

231. In 1982, a US\$1.5 million UNDP project on radiation technology was instituted for which the IAEA was executing Agency. A Gamma Irradiation Centre was established under the auspices of the Nuclear Research Centre, Tehran, and a 200 kCi irradiation facility has been installed and commissioned. It is already being used to sterilize disposable medical supplies, while research and feasibility studies into different applications of radiation technology, such as food irradiation, are being undertaken. The irradiator and part of the source costs were covered by Iranian funds-in-trust. An Agency expert assisted with planning, the vendor undertook installation, commissioning and training of operators, and other Agency experts provided instruction in various aspects of radiation technology, including process control and microbiological safety. Several fellowships and scientific visits were provided.

232. The use of isotope tracer techniques and nucleonic control systems in industrial applications is being furthered by a group at the Tehran Centre. There is particular interest in developing thickness and density gauges using sealed radioisotope sources. The Agency is supporting the group by providing expertise and equipment. It is envisaged that the techniques will, inter alia, have application in the chemical, mineral, petroleum, steel and paper industries.

233. A further activity that supports various sectors of the national economy is elemental analysis, in particular that concerned with precise determination of trace quantities. The team at the Tehran Centre operating a 3 MV Van de Graaff accelerator is to receive Agency support from 1992 to upgrade their analytical services through the introduction of proton-induced X-ray emission and Rutherford backscattering as standard techniques.

234. There was, in the past, little interest shown by the Government in the application of nuclear techniques in agriculture, and the only topic supported by the Agency to date has been the improvement of wheat production through a project initiated in 1987. Isotopes are being used to improve management of fertilizer and irrigation water, and trials of induced mutants are showing promise after some three years of field experiments. It is believed that this type of activity will be extended to other crops in the future. Indeed, the greater interest shown in such activities is evinced by the fact of the establishment of the Nuclear Research Centre for Agriculture and Medicine itself.

235. A UNDP-funded project is concerned with strengthening the Water Resource Research Institute to enable the Government to plan the management and use of scarce water resources. Activities in this sector have included studies to determine the site of leakage from a reservoir dam in karstic terrain so that action could be taken to halt the water loss.

236. The range of nuclear activities in the country require concomitant activities in the field of radiation protection and environmental monitoring. The AEOI has established national regulations, procedures and the technical infrastructure needed for a nationwide radiation protection service. Its National Radiation Protection Department (NRPD), as competent authority, is responsible for all radiation protection matters. The various activities include the personnel monitoring service, internal dosimetry, environmental monitoring and meteorology, radiation surveillance at nuclear research centres, and *training and education on radiation protection*. The NRPD also carries out the functions relating to licensing and inspection. At the Government's request, a RAPAT mission visited the country in 1989; the recommendations included the

up-grading of NRPD facilities and equipment. Under a project approved from 1991, the Agency will be assisting the country by providing a range of radiation monitoring and related equipment and by assisting in the establishment of an early warning environmental monitoring system. There will also be support for environmental monitoring, in particular in connection with potable water, under a project initiated in 1985.

IRELAND

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

Year	TACF share	TACF pledged	Extrabudgetary funds	In-kind support	Experts from country	Persons trained in country
	\$	\$	\$	\$		
1986	54.0	30.0	0.0	0.0	0	0
1987	61.2	61.2	0.0	0.0	1	0
1988	68.4	0.0	0.0	0.0	0	21
1989	75.6	0.0	0.0	0.9	4	25
1990	81.9	0.0	0.0	1.2	6	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 \$	\$	\$	\$	\$
1986	0.0	0.0	0.0	0.0	5.2	0.0	0.0	0.0	0.0	5.2
1987	0.0	0.0	0.0	0.0	4.5	0.0	0.0	0.0	0.0	4.5
1988	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1989	33.1	0.0	33.1	0.4	0.0	0.0	0.0	0.0	0.0	0.0
1990	0.0	0.0	0.0	0.0	37.8	0.0	0.0	0.0	1.5	39.3

237. Ireland became a Member State of the Agency in 1970. There is only a limited use of radiation sources in the country, primarily for cancer therapy and medical diagnosis, and in industry where radioisotope sources are used for thickness gauging and similar nucleonic process control systems. Agency assistance through the Technical Co-operation Programme has only been sought in respect of internal contamination monitoring and to establish a standardization laboratory for low-levels of ionizing radiation. The Nuclear Energy Board set up a Secondary Standards Dosimetry Laboratory (SSDL), with Agency assistance in the form of a dosimetry system that comprised radiation detectors, calibration sources, and calibration stands with related equipment to make possible high precision measurement. About one quarter of the funds disbursed were provided as trust funds by Ireland. The SSDL supports, inter alia, the country-wide personnel dosimetry service for which the Board is responsible, as well as environmental radioactivity measurements.

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

Year	TACF share	TACF pledged	Extrabudgetary funds	In-kind support	Experts from country	Persons trained in country
	\$	\$	\$	\$		
1986	36.0	36.0	0.0	1.5	7	0
1987	40.8	20.4	0.0	0.0	2	0
1988	45.6	45.6	0.0	0.0	6	0
1989	50.4	50.4	0.0	0.0	3	5
1990	54.6	54.6	0.0	0.0	0	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 \$	\$	\$	\$	\$
1986	244.9	0.0	244.9	5.1	163.0	0.0	0.0	0.0	0.4	163.4
1987	206.9	30.0	236.9	4.5	249.0	3.7	0.0	0.0	2.6	255.3
1988	214.3	50.0	264.3	5.0	247.9	16.3	0.0	0.0	13.1	277.3
1989	163.4	0.0	163.4	2.2	91.5	17.2	0.0	0.0	0.0	108.7
1990	174.4	200.0	374.4	4.9	259.6	7.3	0.0	0.0	0.0	266.9

238. Iraq has benefitted from technical co-operation with the Agency since 1959, the year it became a Member State. At the present time, the Iraqi Atomic Energy Commission (IAEC) is the organization responsible for co-ordinating all nuclear activities in the country. There is a Nuclear Research Centre at Tuwaita where two research reactors and most of the nuclear laboratories and institutes are situated, and a Nuclear Power Project in Baghdad that has field stations undertaking siting studies.

239. During the 1970s, the Agency provided equipment to support the upgrading of the 5 MW(th) IRT-5000 reactor. The Agency also helped the country to establish licensing procedures for the research reactor operators, assisted with training, advised on format and content of the Safety Analysis Report and reviewed the final draft. In addition, the Agency advised on the re-start of the smaller 0.5 MW(th) reactor.

240. The Agency has also supported the Government's wish to introduce nuclear power by assisting the regulatory body with site evaluations for a possible nuclear power plant at four sites in the Sammara region, and by helping to build up the infrastructure for initiation of a nuclear power programme using WWER-type reactors, covering areas such as manpower development, project management and quality assurance aspects of design and construction. Advice was given on adaptation of the Preliminary Safety Analysis Report format for WWER reactors and on organization and tasks for the nuclear safety department. Training on probabilistic safety analysis was provided to introduce modern concepts of nuclear safety.

241. Complementary to the above are reactor safety studies using a loop to investigate two-phase flow and heat transfer, as well as loss-of-coolant accident scenarios, which form part of the manpower development programme; the Agency assisted by providing an expert to review the safety studies.

242. Collaboration with Iraq also included: help for spectrometric analysis of stable isotopes as a means of control in connection with production processes; aspects of quality control in the production of radiopharmaceuticals; radioimmunoassay (RIA) to strengthen the capability of the country to prepare RIA kits and analyse samples; and advice on the use of radioisotopes in agriculture — in particular regarding barley

mutation studies; and the establishment of a laboratory for introduction of the sterile-insect technique. There were also plans to acquire a low-energy cyclotron for research and medical applications.

243. Planning for the 1991-92 biennium included assistance with the development of specialized radiopharmaceuticals for studies of kidney function and pulmonary disease, with neutron-induced transmutation doping of silicon, and with several agricultural projects including further work on mutation techniques for crop improvement, development of controlled-release insecticides to control the Dubas bug, a serious insect pest in the date-palm/ citrus plantations, RIA for rinderpest diagnosis, and planning for a pilot-scale food irradiation facility.

244. The Government has also sought Agency assistance to strengthen the radiation protection services in the country, focusing on improving personnel dosimetry, environmental monitoring and the monitoring of industrial and medical facilities where radiation is used. An Agency RAPAT mission in 1984 made recommendations, and these are reflected in the programme of work. Routine radiation protection services and emergency preparedness programmes are being established. The Agency has provided a thermoluminescent dosimetry (TLD) system, calibration facilities and various types of radiation measuring and monitoring equipment. In particular, establishment of an early warning monitoring network is at a final stage. A regional workshop on radiation protection in industrial applications of ionizing radiation was organized in 1989 in Baghdad for the middle-east Arab countries.

245. For the time being, the programme of technical co-operation is in abeyance, awaiting redetermination of national priorities.

JORDAN

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

Year	TACF share	TACF pledged	Extrabudgetary funds	In-kind support	Experts from country	Persons trained in country
	\$	\$	\$	\$		
1986	3.0	3.0	0.0	7.1	4	0
1987	3.4	3.4	0.0	0.0	3	0
1988	3.8	3.8	0.0	1.0	5	9
1989	4.2	4.2	0.0	0.0	1	18
1990	4.6	4.6	0.0	0.0	1	9

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 \$	\$	\$	\$	\$
1986	233.5	0.0	233.5	4.9	133.2	0.0	0.0	0.0	0.0	133.2
1987	228.7	58.0	286.7	5.4	108.3	0.0	0.0	0.0	2.3	110.6
1988	361.6	20.0	381.6	7.2	258.5	13.2	0.0	0.0	0.0	271.7
1989	178.6	0.0	178.6	2.4	236.5	21.9	0.0	0.0	0.0	258.4
1990	252.2	0.0	252.2	3.3	257.7	0.0	0.0	0.0	0.0	257.7

246. Jordan has primarily made use of technical co-operation with the Agency to build up and sustain national infrastructures for the application of nuclear techniques in support of various sectors of the national economy.

247. In the early 1980s, the Government sought advice regarding energy planning, in which both the Agency and the World Bank assisted. At present there are no plans to use nuclear power. Towards the end of the 1980s interest grew in extracting

uranium from the phosphate minerals being mined by the Jordan Phosphate Mines Co. In line with the recommendations of a pre-project mission, a programme has been established to examine the feasibility of extraction and of setting up a pilot plant. At the same time, the Geological Survey and the Bureau of Mines are collaborating in a related project to seek uranium deposits of economic potential in the phosphatic rock deposits.

248. A Nuclear Science Laboratory was set up in 1978 at the University of Jordan to undertake various forms of elemental analyses; it was to serve other departments as well as national sectors such as agriculture, geology and industry. Fellowship training was provided to help establish appropriate staffing. X-ray fluorescence analysis and the proton-induced X-ray emission technique (using the Van de Graaff generator donated by the Federal Republic of Germany) were introduced. Services offered include precise determination of a range of trace elements.

249. The Royal Scientific Society has been charged with the responsibility of applying new techniques and technologies to the developmental needs of Jordan. It has set up a collaborative project with the Agency to extend the industrial applications of radiation and radioisotopes, areas of primary interest being tracer studies and nucleonic gauging, in particular for process control, for example in the water, petroleum and fertilizer industries. In support of these various activities, as well as its radiation protection activities, the Society has also been given help to establish a repair and maintenance facility for nuclear and related instruments.

250. Water is a scarce commodity in Jordan and a detailed knowledge concerning the characteristics of the four main underground basins was needed. Through a project commenced in 1977, using extrabudgetary funds from the USA to supplement TACF support, and a continuation project commenced in 1983, the Agency assisted the Water Research and Isotope Laboratory of the Water Authority in Amman to establish an Isotope Hydrology Laboratory; it is now running high quality routine analyses of water samples, not only for Jordan, but also for neighbouring countries in the region. The Agency provided a mass spectrometry system and a substantial amount of analytical equipment for, inter alia, carbon-14 and tritium analysis. Agency experts gave training in analytical techniques and advised on interpretation of results, for example concerning the sizes and recharge rates of aquifers and the interconnections between surface and groundwaters.

251. The Water Authority, from 1991, is also receiving assistance with measuring levels of radioactivity in drinking water and groundwater, in particular in respect of radon and radium, since most aquifers of importance, the major sources of potable water in Jordan, lie in formations that include phosphatic rocks associated with relatively high concentrations of uranium and its daughters. The project is being supported with extrabudgetary funds provided by the United Kingdom.

252. Large areas of Jordan are either arid or semi-arid. The only suitable areas for food production are in the Jordan Valley region and the highland areas. Through a project on Nuclear Techniques in Agriculture which began in 1987, the Agency is assisting the Faculty of Agriculture at the University of Jordan to conduct isotope-aided studies on fertilizer- and water-use efficiency with reference to the rain-fed highlands in Jordan. The initial results from field experiments indicate that improved techniques for conserving irrigation water and for applying fertilizer at optimum times in respect of soil water content would increase production of grains and legumes, while helping to reduce the need for imported fertilizers. To control post-harvest losses, the Government also sought expert advice on the feasibility of introducing food irradiation processing. In addition to improving storage times, it was expected that it would lead to a reduction in the use of insecticides and fumigants, have deleterious side effects. The Agency expert is to be funded extrabudgetarily by France. From 1991, a new

project in support of farming was approved, concerned with introducing the use of radioimmunoassay to study hormone levels in livestock with the aim of improving reproductive efficiency.

253. Help has been given to the Radiology Department of the Ashrafieh Hospital to undertake practical dosimetry of both radiological and radiotherapeutical applications of ionizing radiations, including the requisite calibrations. Both it and the Jordan Cancer Centre at the Al-Basher Hospital received expert missions to advise on and to train staff in treatment planning techniques and quality assurance. A new project, given extrabudgetary funding by the United Kingdom, will continue with upgrading facilities at the Al-Bashir Hospital, and providing on-the-job training and fellowships, and supporting the national emphasis on developing manpower in this field in Jordan. Furthermore, in support of nuclear medical diagnostics, the Agency is assisting the Faculty of Science of the University of Jordan to assess the possibility of introducing production and dispensing of radiopharmaceuticals.

254. The Royal Scientific Society has the responsibility for the practical application of radiation protection in Jordan, and it established with Agency support a Radiation Protection Laboratory charged with duties for personnel monitoring, environmental radiation surveillance and the control of medical and industrial applications of radiation and isotopes. The Laboratory covers calibration and radiation metrology as a basis for the above activities, and it is also to serve as a training centre. Appropriate alpha, beta and gamma spectrometry equipment and a thermoluminescence dosimetry system have already been provided by the Agency. Experts advised on analytical techniques and on a draft nuclear law for Jordan; the law has since been promulgated.

255. The Government has decided to set up a radiological emergency team and an Early Warning Environmental Radiation Monitoring System for which it has received equipment. Agency experts will be providing guidance in all aspects of emergency response, bearing in mind the uses of sources and radioisotopes in the various sectors in Jordan and the need to act in the event of an accident in one of the neighbouring countries with more ambitious nuclear programmes.

256. It is expected that the pattern of support established since 1985 will continue, it reflecting national planning priorities.

POLAND

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

Year	TACF share	TACF pledged	Extrabudgetary funds	In-kind support	Experts from country	Persons trained in country
	\$	\$	\$	\$		
1986	213.0	203.6	0.0	14.6	28	14
1987	214.2	183.1	0.0	32.9	28	52
1988	239.4	239.4	0.0	48.0	27	26
1989	264.6	264.6	0.0	16.0	33	32
1990	250.3	250.3	0.0	2.5	36	31

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 \$	\$	\$	\$	\$
1986	249.1	0.0	249.1	5.2	375.6	457.9	213.0	0.0	3.8	1050.3
1987	244.2	30.0	274.2	5.2	797.0	19.1	22.1	0.0	21.9	860.1
1988	254.4	15.0	269.4	5.1	550.7	57.3	3.8	0.0	8.8	620.6
1989	467.8	0.0	467.8	6.3	460.9	100.0	0.0	0.0	88.4	649.3
1990	133.6	300.0	433.6	5.7	361.5	1200.8	624.2	0.0	121.6	2308.1

257. Poland has participated in the programme of technical co-operation since the early days of the Agency and has been one of the largest recipients in the period between 1958-90, being allotted about 20% of all the assistance provided in the Europe and Middle-East Region in the past decade. Its co-operation with the Agency has included both technical co-operation projects and Research Contracts. The largest proportion of assistance has been for nuclear engineering and technology, which includes reactor technology, in particular of research reactors, followed by nuclear physics, with emphasis on mass spectrometry. Applications of isotopes and radiation in agriculture are followed by applications in industry and hydrology. Nuclear safety in its various forms has also received significant support. In the period between 1980-90, a total of 30 technical co-operation projects were approved, of which 24 have already been completed and the remainder are operational. For 1991-92, four new projects were approved (for TACF funding), and five approved with footnote/ status. During this period more than 300 fellowships and scientific visits were awarded and some 170 Polish scientists participated in Agency training courses. Expert services provided during the same period amounted to just over 2.5 person-years, which is a comparatively small amount.

258. At the same time, Poland has contributed to the Agency's technical co-operation programme by hosting regional and interregional training courses, providing experts and in-kind support. Between 1980-90, over 200 Agency fellows were trained in Polish institutes, and Polish experts completed nearly 200 expert assignments on Agency projects.

259. Poland embarked on a nuclear power programme at the beginning of the 1980s. The plan included in its first stage four units of 440 MW(e) WWER-type reactors to be built at Zarnowiec. The National Atomic Energy Agency and the Institute of Atomic Energy, Swierk, sought Agency assistance, through several projects associated with the Zarnowiec site, related to radiation protection, quality assurance programmes, environmental monitoring and reactor safety studies. The Central Laboratory for Radiological Protection was the counterpart responsible for two projects, one for improving radiation protection in Poland and the other concerned with atmospheric dispersion modelling for the Zarnowiec Nuclear Power Plant.

260. In connection with the power plant studies, the Agency also provided expert services in quality assurance, organized training courses and supplied quality control equipment and instruments. Construction work at Zarnowiec was stopped in 1989, during a period of economic difficulty, and there was also public concern about the safety of the plant. The IAEA, in response to the Government's request, organized a number of safety missions: a pre-operational safety review in September 1989; a site safety review in March 1990; and a safety review of the containment in April/May 1990. Nevertheless, for reasons of economy, the Government decided, in September 1990, to suspend the nuclear power programme for the time being.

261. Poland has a very complete range of research and development facilities. Several institutes at Zerzan, Swierk and Krakow are actively engaged in work related to the peaceful uses of atomic energy. In addition to these centres, there are academic institutions such as the Polish Academy of Sciences, the Academy of Mining in

Krakow, the University of Warsaw, the Warsaw Agricultural University, the University of Agriculture Poznan, and the Medical Academy of Lodz, which have, at various times, been recipients of Agency assistance. The National Atomic Energy Agency of Poland (NAEA) has direct or indirect links to all these institutions. Apart from other duties, the NAEA carries out, together with the Central Laboratory for Radiological Protection, all the regulatory and licensing activities.

262. The largest nuclear centre and associated facilities are located at Swierk, where two research reactors and one zero-power reactor have been operating for many years at the Institute of Atomic Energy, the Soltan Institute of Nuclear Studies and the Radioisotope Production and Reactor Centre. The Institute of Atomic Energy is working in the field of nuclear engineering and is involved in quality assurance and quality control relating to the nuclear installations. The Soltan Institute of Nuclear Studies carries out research in many fields of practical and theoretical nuclear physics, including nuclear spectrometry, nuclear electronics, radiation shielding physics, thermonuclear research, high-energy physics, cosmic radiation physics, and atomic and nuclear theory. The Institute produces semiconductor detectors and manufactures computerized systems for X-ray fluorescence analysis, linear electron accelerators for medical therapy, and associated microprocessor controlled dosimeters.

263. The centres of nuclear activity next in importance are located at Zeran, namely the Institute of Nuclear Chemistry and Technology and the Central Laboratory for Radiological Protection with its associated institutions nation-wide. The Institute comprises several departments covering all aspects of the use of nuclear techniques in radiation chemistry. Various applications of electron-beam technology, including flue-gas purification and food irradiation, are being studied using electron-beam accelerators supplied using Agency assistance. The Central Laboratory is responsible for dosimetry, radiobiology in the context of biological protection, the control and licensing of all purchases and use of radionuclides in the country (over 2000 users), and the monitoring of radiation levels in the environment.

264. The activities at Krakow, the third main centre, involve the Institute of Nuclear Physics and the Academy of Mining and Metallurgy. The Institute has laboratories dealing with applications of nuclear techniques ranging from nuclear borehole logging, to those used in medicine, biology and agriculture. A very impressive undertaking has been the construction of two automatic isochronous cyclotrons which can provide proton energies in the range of 15-60 MeV. The two cyclotrons operated in tandem produce heavy ions with energies of 10-12 MeV/nucleon.

265. The Institute of Physics and Nuclear Techniques of the Academy of Mining and Metallurgy is one of the few institutions in the country which is not under the auspices of the National Atomic Energy Agency, with which, however, it co-operates closely. This Institute has a history of pioneering work in physics, and it has had for many years close links to the IAEA. The Institute houses many laboratories, some of which (the nuclear geophysics, gas chromatography, radiation detector and nuclear electronic groups) have designed and manufactured a range of specialist nuclear instruments.

266. The Institute of Nuclear Chemistry and Technology is using nuclear techniques in a wide variety of applications including environmental studies, materials research in connection with electronic components, and materials analysis. In this connection a project was initiated in 1983 providing the Institute with Ge(Li) detectors, an atomic absorption spectrophotometer, and relevant expert services and training. Through another project, on electron-beam radiation processing, the Institute has acquired an electron accelerator and auxiliary equipment. The facility is being used for research on the use of radiation to modify the properties of materials and for pilot-scale sterilization of pharmaceuticals. In 1987, the Institute planned a demonstration plant to show that irradiation of flue gases could be used to tackle the severe environmental

pollution problems caused by the burning of coal for electricity generation and process and district heating. Radiation processing of stack gases is presently the only technology through which sulphur dioxide and nitrogen oxides can be removed in a single step with the nitrogen-containing by-products usable as fertilizers. Under this multi-year project, the Agency has provided, inter alia, an electron beam machine together with equipment for chemical analysis. The results obtained so far have been encouraging and the demonstration plant at Kaweczyn, near Warsaw, will be in operation from May 1991. Under a new phase of the project, it is hoped to introduce manufacturing capabilities for these specialized accelerators in the country.

267. In 1988, the Institute of Atomic Energy initiated a project to modernize the Maria high-flux research reactor. The reactor is based on the Soviet MR-type of reactor having beryllium as moderator and with pressurized fuel channels cooled by water. The reactor had been closed down in 1985 after 14 years of operation for reconstruction of the core and improvement of safety. Agency assistance included provision and installation of new beryllium blocks.

268. The Medical Academy of Lodz, in co-operation with other institutes, sought Agency assistance in 1984 for a project sponsored by the Polish Academy of Sciences that aimed at introducing parametric scintigraphic imaging. The existing gamma cameras were linked using special interfaces to desk-top computers for static and dynamic imaging, and the nuclear medicine centres were, in turn, connected to each other over a computer network. The Agency provided experts to assist with the endeavour, and the result is a unique concept in medical diagnostics achieved with low-cost, universally available add-on equipment.

269. In support of agricultural production, a project on plant breeding using induced mutations was started in 1985. It enabled the Polish Academy of Sciences and several associated institutions to obtain more productive, higher quality and more resistant cultivars. Another project was concerned with the radiation preservation of agricultural products; assistance was provided to the Institute of Nuclear Studies and the Nuclear Methods Laboratory of the University of Poznan. In addition, the Department of Animal Physiology of Warsaw Agricultural University, in co-operation with several national institutes involved in animal studies, has been collaborating with the Agency in a project to use local fodder, industrial by-products and non-protein nitrogen to up-grade ruminant feeds in an attempt to increase milk and meat production as well as animal fertility. This project has been successfully completed recently with most of its results having been published in more than twenty scientific papers. The project will help to improve animal feeding practices in large-scale animal husbandry in the country.

270. Poland's current projects are mainly related to environmental protection, radiation waste disposal and management, agricultural and medical applications, and radiation monitoring. Some of these were initiated as a result of special Agency missions. The country has highly qualified and competent scientists in all these fields, and hence the Agency's assistance will, on the whole, be limited to the provision of complementary equipment and some training in specialized areas.

PORTUGAL

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

Year	TACF share	TACF pledged	Extrabudgetary funds	In-kind support	Experts from country	Persons trained in country
	\$	\$	\$	\$		
1986	54.0	54.0	0.0	2.1	2	1
1987	61.2	0.0	0.0	0.0	4	18
1988	68.4	0.0	0.0	0.0	5	0
1989	75.6	75.6	0.0	0.0	4	0
1990	81.9	0.0	0.0	0.0	5	2

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 \$	\$	\$	\$	\$
1986	241.9	170.0	411.9	8.6	320.6	275.8	16.0	0.0	26.9	639.3
1987	364.1	10.0	374.1	7.1	346.0	0.7	99.5	0.0	0.0	446.2
1988	166.9	20.0	186.9	3.5	199.3	2.2	46.8	0.0	7.1	255.4
1989	139.7	500.0	639.7	8.6	143.1	626.5	205.4	0.0	0.0	975.0
1990	143.8	770.0	913.8	12.0	169.5	-17.1	69.3	0.0	2.6	244.3

271. Portugal has a satisfactory infrastructure for applications of nuclear technology and an adequate pool of manpower to support this type of programme. The main body undertaking these activities is the National Laboratory of Engineering and Industrial Technology (LNETI), and it has also been the principal counterpart for receipt of Agency assistance. Major activities have involved: the "rejuvenation" of the Van de Graaff accelerator in the mid-1980s and the plans to upgrade it for advanced forms of analytical work starting from 1991; the establishment of a gamma irradiation facility for sterilization of medical products and for pilot-scale industrial studies that include work on food irradiation, a project completed in 1991; and the modernization of the research reactor, which commenced in 1987.

272. The Government has been interested in the possibilities of nuclear based electricity generation since the 1970s, and sought Agency assistance to develop a draft plan for a programme, to develop the necessary administrative as well as the licensing and regulatory frameworks, and in general to consider various safety aspects. Definite plans for a programme have not materialized for various country-internal reasons, and activity in this area appears to be in abeyance at the present time.

273. The General Directorate for Geology and Mines in Lisbon, which is under the Ministry of Industry and Technology, has been receiving support for a range of projects concerned with various aspects of exploration for and extraction of uranium, as well as environmental safety considerations connected with mining and milling wastes. France, the Federal Republic of Germany and the United States of America have provided extrabudgetary support for some of the nine projects approved since 1977. Initial prospecting in sedimentary formations of eruptive rocks was followed by strengthening the analytical capability of the laboratory at Canas de Senhorim. Borehole logging included considerations of the feasibility of recovering residual uranium in old mines, while a pilot plant for extracting uranium from low-grade ores using ion exchange was constructed. There were also studies on the leaching of uranium ores in the Azere region with a view to commercial exploitation. Recent efforts have concentrated on establishing regulations for the mining and milling of ores that

correspond to currently accepted practice and a mapping of radiometric anomalies as well as natural background radiation levels over an 8000 square kilometre area known to contain deposits.

274. As indicated, a broad range of support has been given to the laboratories at LNETI to modernize its facilities. This was initiated by provision of a fast-pneumatic transfer system for production of short-lived radioisotopes. It was subsequently noticed that the research reactor suffered leaks in the primary circuit and the pool, and required repair. At the same time, power was to be raised from the nominal 2 to 5 MW(th) to improve the capability to produce radioisotopes to meet national demand, and to undertake advanced analytical work and studies in materials science. The Agency is providing, inter alia, the beryllium blocks needed as reflectors, as well as assistance with preparation of the new safety analysis report.

275. The Department of Physics established with Agency assistance a gamma irradiation facility with which pilot-scale sterilization of medical products, control of microflora in cork products and studies of radiation processing of various food products is being undertaken. The laboratory has also been studying radiation-induced processes that have industrial potential. As an extension of these studies, in particular in connection with the curing of surface coatings and the induction of cross linking in synthetic materials such as those used for cable sheathing, the Agency is providing an electron accelerator so that further development work can make use of the specific advantages of electron beam technology.

276. The Chemistry Department of LNETI has received support to expand its production of *technetium-99m* labelled radiopharmaceuticals, with advice on quality control; substantial assistance, with some extrabudgetary funding from the Federal Republic of Germany and USA, was also given to expand the work on actinide chemistry, which includes studies on organometallic compounds using nuclear magnetic resonance spectrometry. The Department also operates an isotope hydrology laboratory, and the provision of a range of equipment, including, recently, a mass spectrometer, to improve its analytical capability has helped to establish excellent facilities. Interests have included the measurement of carbon isotopes in water and other samples to assess the age of groundwater and related hydrological characteristics.

277. The monitoring of environmental radioactivity has featured as one of the major activities of LNETI. Agency support was given to a project in 1980 to assess radioactivity in the coastal waters of Portugal, in particular to assess whether there is evidence of contamination deriving from dumping of radioactive waste in the Atlantic. The Agency provided both expert assistance and monitoring equipment. Recent efforts have centred on the establishment of a country-wide scheme to assess individual and collective doses to the population. An early warning environmental radiation monitoring network to give warning of higher than usual levels of radioactivity, especially in the event of a nuclear accident, has also been established, equipment being provided through a bilateral arrangement. Other on-going activities include improving personnel dosimetry country-wide, and improving radiation protection in medical facilities for both staff and patients. To support the dosimetry services of LNETI, an Secondary Standards Dosimetry Laboratory was set up in the mid-1980s.

278. LNETI supports medicine and medical research in various ways. It produces solid radioimmunoassay kits for in vitro hormone diagnostics and it is starting a comprehensive programme to record dietary intake in Portugal in order to be able to assess the population's nutritional status. This latter is the subject of a large project approved from 1991.

279. In the field of radiation therapy, the Agency assisted the Francisco Gentil Institute of Oncology, Lisbon, to assess the needs of its Radiotherapy Service. Use of radium-226 needles has been suspended, following recommendations of the expert, in favour of safer treatment methods. The expert also advised on improved use of computerized treatment planning and a Research Contract was granted to support

preparation of an atlas suited for local mixed-beam therapies. The throughput of patients undergoing treatment has been markedly increased, and quality control procedures were instituted.

280. Agency support was also given for agricultural applications. A project on nitrogen fixation studies, aiming at improved soil/water management, was undertaken by the Departamento de Pedagogia of the Estacao Agronomica Nacional, Oeiras. Nitrogen-15 fertilizers were provided, as well as analytical equipment for determining the fertilizer uptake; Agency experts advised on experiments and interpretation of results. In another activity, the Estacao Nacional de Selecao e Reproducao, Lisbon, was assisted with its studies on the progesterone levels in milk to determine the reproductive efficiency of dairy cows. The Agency's laboratory in Seibersdorf supplied the radioimmunoassay kits for this undertaking.

281. An interesting proposal approved from 1991 for extrabudgetary funding is based on the Government's wish to ensure that radiation workers are properly trained in radiological protection, being fully aware of current internationally-accepted practices. There are some 1700 installations using radioactive materials, involving some 10,000 workers. The Agency has been asked to provide expert services to help the authorities to set up such a regular training programme, using modern training aids to ensure effective impact.

ROMANIA

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

Year	TACF share	TACF pledged	Extrabudgetary funds	In-kind support	Experts from country	Persons trained in country
	\$	\$	\$	\$		
1986	57.0	0.0	0.0	0.9	1	0
1987	64.6	0.0	0.0	0.0	0	1
1988	72.2	0.0	0.0	0.0	3	0
1989	79.8	0.0	0.0	0.0	2	0
1990	86.5	0.0	0.0	1.3	11	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 \$	\$	\$	\$	\$
1986	349.9	164.0	513.9	10.8	259.6	15.2	0.0	57.2	0.0	332.0
1987	281.1	140.0	421.1	8.0	231.5	10.0	0.0	57.1	16.4	315.0
1988	278.7	130.0	408.7	7.7	304.2	42.2	0.0	5.5	7.0	358.9
1989	277.3	65.0	342.3	4.6	452.4	154.3	0.0	38.5	2.7	647.9
1990	259.3	0.0	259.3	3.4	322.6	29.0	0.0	145.8	1.4	498.8

282. Romania became a Member State of the Agency in 1957. From the mid-1960s to the mid-1970s, its programme of technical co-operation with the Agency mainly concerned research in nuclear physics and some medical and other applications of radiation and isotopes. However, shortage of energy being one of the crucial problems in Romania, with at times a shortfall of 3000 MW(e), in 1976 a decision was taken to embark on a nuclear power programme using CANDU-type reactors. The construction of the first five units started in 1978 at Cernavoda, and the orientation of Romania's technical co-operation projects was shifted to satisfy the needs of the nuclear power programme, and nine Agency and three UNDP projects (for which IAEA was the executing agency) approved since the late 1970s have been directly concerned with it.

283. In the period 1980-89, the Agency approved a total of 19 Technical Co-operation projects for Romania of which 14 have already been completed. The largest share of project resources was allotted to projects in nuclear engineering and technology (42%), followed by nuclear physics (40%); the third largest share of funds (8%) was allotted to projects in nuclear safety. Romania ranks sixth (7.6% of total funds) in the overall Technical Assistance Programme provided to the Member States in the European and Middle East Region during the period 1980-89.

284. During this period, 63 Romanians received training abroad through Agency fellowships and scientific visits, one of the lowest figures for any country in the Region. Ninety Romanians participated in regional and interregional training courses. Twenty-six Agency fellows from other countries were trained in Romania, and 15 Romanian specialists carried out expert assignments or served as lecturers.

285. The nuclear industry in Romania is basically controlled through several ministries under whose auspices the four main organizations involved in nuclear research and development function. The National Commission for Nuclear Activities Control acts through separate divisions both as inspectorate for nuclear installations and as the licensing authority. The main organization responsible for the Cernavoda Nuclear Power Plant is the Department of Electrical Energy, together with its commercial arm, RENEL SA. During the past decade it has received substantial Agency assistance through nine projects carried out with its subsidiary institutes (Cernavoda Enterprises, Institute for Nuclear Power Reactors, Pitesti, and Institute for Power Studies and Design, Bucharest). The third organization involved in nuclear activities is the Institute of Atomic Physics which, together with its related institutions, has a staff of about 5000 active in nuclear research and development; it has been counterpart for five projects.

286. Agency assistance to the Cernavoda project has been and is of crucial importance to the country. Romania has one of the major nuclear power plant construction sites in the world, with five CANDU units of 660 MW(e) being built on the canal between the Danube and the Black Sea, two kilometres from the town of Cernavoda. The five containment buildings are standing, but the units are at very different stages of completion. The first two units have closed containments with calandrias and steam generators installed; some non-nuclear parts have also been installed. It is estimated that commissioning of the first systems will start in 1992, with the first unit possibly going on line in late-1993. Unit 5 is only expected to come on line only in 1999, owing to unavailability of critical components.

287. The Institute for Nuclear Power Reactors (IRNE), Pitesti, is one of the main institutes involved in the nuclear programme. Several of its projects received Agency assistance. IRNE has been involved in fuel fabrication for the Cernavoda Power Plant, in testing of Romanian made steels for nuclear power plant component manufacture, in the treatment of low- and medium-level radioactive wastes, and in design and testing of a fuelling machine. Over a three-year period, through a UNDP-funded project, the Agency provided various items of equipment, including a data acquisition system for the fuelling machine test facility. Expert services helped to elaborate the test programme and fuelling procedures. The current programme includes a UNDP funded project under which the refuelling machine head is being tested. In addition, the project supports testing control-rod drive mechanisms as well as checking fuel behaviour under severe accident conditions; furthermore it is the vehicle used to support the start of an in-service inspection programme. In 1983, IRNE received through the Agency 4.5 kilograms of 19.55%-enriched uranium dioxide. Mixed with indigenous natural uranium, this enabled IRNE to produce CANDU-type fuel elements for the Cernavoda reactors. Additional assistance was provided to IRNE for the conversion of IRNE's materials testing reactor to low-enriched uranium and for the development of ionization and fission chambers. In 1988, a project was approved to assist IRNE to strengthen further its capability in nuclear safety, radiological protection, facility commissioning and the qualification of personnel for nuclear power plant operation and maintenance. The Agency has provided and is continuing to provide

extensive training and expert services concerned with the various aspects of nuclear safety (e.g. probabilistic safety analysis, specifications for a training centre for Cernavoda personnel, and design of a full-scope simulator).

288. The Institute of Atomic Physics (IAP) and its associated institutions in Romania have been engaged in nuclear physics and applications of nuclear techniques for more than 25 years. It has established a very extensive research and development programme with hundreds of qualified personnel. The projects undertaken by IAP or its associated organizations involving Agency assistance fall into several categories. The Institute of Physics and Nuclear Engineering, the main institution belonging to IAP, had by 1984 designed new dosimetry instrumentation for use at the Cernavoda nuclear power plants, including devices for personnel and area dosimetry and for the continuous monitoring of radioactive effluents. Through the testing and calibration laboratory established at this Institute in 1977, it had already gained valuable experience with measuring devices and the use of standards. With the newly designed devices, different types of radiation sources and more precise reference instruments and measuring techniques were needed, and Agency assistance was used to establish a new performance testing and calibration unit.

289. From 1982, an Agency assisted project was initiated at IAP to continue advanced studies of the chemistry of actinides, with interest in glass matrices used to immobilize radioactive waste and application of earlier discoveries relating to thermoluminescence to dosimetry and solar batteries. Through another project, the Institute's heavy-ion research laboratory which uses a Van de Graaff tandem accelerator was assisted to upgrade the laboratory facilities. However, as a result of an earthquake in 1986, the tandem columns were damaged and the Agency extended its assistance to the repair of the accelerator.

290. The Department of Mining, which is responsible for uranium mining and processing in the country has, together with the Institute of Physics and Nuclear Engineering, collaborated with the Agency in one project, initiated in 1986. The emphasis was on the use of nuclear techniques in borehole logging, on-line coal analysis, in-situ determinations of lithological character, porosity, density, moisture content and mineral ore grade, and hydrogeological studies to control flooding in mines. The project also contributed to exploration for and discovery of additional oil resources and more efficient exploitation of mineral resources such as molybdenum, bauxite, uranium and thorium.

291. A few projects have been carried out in areas that are not related to the nuclear power programme. For instance, in 1984, the Department of Nuclear Medicine of the Institute of Endocrinology, Bucharest, was assisted in the introduction of radio-receptor assay techniques to supplement radioimmunoassay, which was already in use for the diagnosis and treatment of endocrine disorders. The Department of Plant Nutrition, Fertilizers and Isotopes, in collaboration with the network of agricultural research stations of the Research Institute for Cereals and Industrial Crops, Fundulea, sought Agency assistance to broaden an existing research programme aimed at developing methods for improving crop productivity by, for example, enhancing biological nitrogen fixation and increasing the solubility of rock phosphate.

292. The locally-imposed limitations on the opportunities for Romanians to take up training abroad over the past two decades has exacerbated the shortage of specialized manpower in certain areas related to nuclear power. To match a change in national policy, the 1991-92 Agency programme has been tailored to help alleviate the problem by allotting a higher proportion of funds for fellowship training to Romania. Several national workshops on specific nuclear power related themes will also be organized.

SAUDI ARABIA

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

Year	TACF share	TACF pledged	Extrabudgetary funds	In-kind support	Experts from country	Persons trained in country
	\$	\$	\$	\$		
1986	255.0	0.0	8.0	0.0	0	0
1987	326.4	0.0	0.0	0.0	0	0
1988	364.8	0.0	0.0	0.0	1	0
1989	403.2	0.0	0.0	0.0	0	1
1990	459.6	0.0	0.0	0.0	0	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 \$	\$	\$	\$	\$
1986	55.2	0.0	55.2	1.2	10.4	0.0	0.0	0.0	0.0	10.4
1987	63.5	0.0	63.5	1.2	0.0	0.0	0.0	0.0	0.0	0.0
1988	64.8	0.0	64.8	1.2	0.0	0.0	0.0	0.0	0.0	0.0
1989	0.0	0.0	0.0	0.0	19.5	0.0	0.0	0.0	0.0	19.5
1990	16.8	0.0	16.8	0.2	6.8	0.0	0.0	0.0	0.0	6.8

293. The Agency's assistance to Saudi Arabia is limited mainly to the provision of expert advice and fellowship training for its nationals, particularly in connection with training courses and workshops. The Saudi Arabian authorities generally seek only advice concerning appropriate equipment for their nuclear research activities; procurement is undertaken by them.

294. During the 1970s, Agency experts advised the Atomic and Nuclear Research Centre in Riyadh on which nuclear analytical techniques would be appropriate for the planned programme of work and what equipment would best match the needs, and the Atomic Energy Department of the Ministry of Petroleum and Mineral Resources on the type of training and research institutions needed to provide the manpower and know-how for an expanded nuclear programme, including the possibility of a future use of nuclear power.

295. The four current projects, all introduced in the mid-1980s, are with the Nuclear Engineering Department of the King Abdulaziz University at Jeddah. Experts advised the University, as a follow-up to the planning initiated in the 1970s, on possible applications of nuclear techniques in industry, hydrology and exploration for natural resources, including water, petroleum and minerals. Again planning for manpower training in these areas was a particular priority. To complement this project, two further projects were approved subsequently, one which has successfully introduced the neutron-capture technique to support exploration for minerals with initial data obtained on site, and one in which the Agency is to provide advice on the introduction of industrial radiography.

296. Following the Chernobyl nuclear accident in 1986, the King Abdulaziz University acquired a number of nuclear instruments, including whole-body counters, for measuring low-level radioactivity — particularly in humans and environmental and food samples, the last mentioned with a view to controlling imports. The Agency is providing expert assistance to provide training for staff of the Nuclear Engineering Department on measuring low levels of radioactivity.

SPAIN

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

Year	TACF share	TACF pledged	Extrabudgetary funds	In-kind support	Experts from country	Persons trained in country
	\$	\$	\$	\$		
1986	573.0	30.0	0.0	32.9	32	16
1987	683.4	30.0	0.0	47.9	25	62
1988	763.8	30.0	0.0	63.0	29	37
1989	844.2	30.0	0.0	27.6	45	50
1990	878.2	90.0	147.3	40.2	25	40

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 \$	\$	\$	\$	\$
1986	0.0	0.0	0.0	0.0	14.4	0.0	0.0	0.0	0.0	14.4
1987	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1988	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1989	93.1	0.0	93.1	1.3	10.6	0.0	0.0	0.0	0.0	10.6
1990	0.0	0.0	0.0	0.0	61.9	0.0	0.0	0.0	0.0	61.9

297. Spain has had an interest in peaceful applications of various nuclear technologies since the 1950s, becoming a Member State of the Agency in 1957. It has built up the necessary infrastructures for an ambitious nuclear power programme, with 9 units delivering 7067 MW(e) on stream in 1990, around one third of the total national electrical energy production. The first reactor commenced full power operation in February 1969.

298. In the 1970s and early 1980s, during the early phases of Spain's implementation of its nuclear power programme, the Spanish authorities, through the Junta de Energia Nuclear (the national atomic energy commission) in Madrid, requested and received substantial expert assistance through the Agency's Technical Co-operation Programme. Support covered areas such as reactor engineering, reactor safety and waste management. Specialist advice included topics such as the design and construction of an experimental liquid sodium loop facility, reactor safety review techniques, the construction of a plant for the treatment of intermediate- and low-level solid and liquid wastes, and commissioning of a nuclear power plant. Further expert assistance was provided to facilitate the setting up of a national radiological monitoring network, and for studies on the possible impact of nuclear facilities not only on the environment, but on the population at large. As a result of the studies undertaken in connection with this project, a better understanding was also obtained of the distribution of marine radioactivity, in particular that resulting from transuranic elements, in the coastal waters around south-east Spain.

299. The only current technical assistance activity, an agricultural project with the Estacion Experimental del Zaidin, Granada, is, since 1989, supporting efforts to optimize the production of pasture, forage, grains and legumes in the arid and semi-arid regions of Spain by studying the possibilities of improving biological nitrogen fixation.

SYRIAN ARAB REPUBLIC

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

Year	TACF share	TACF pledged	Extrabudgetary funds	In-kind support	Experts from country	Persons trained in country
	\$	\$	\$	\$		
1986	9.0	0.0	0.0	2.2	4	0
1987	13.6	0.0	0.0	0.0	8	5
1988	15.2	0.0	0.0	0.0	3	6
1989	16.8	0.0	0.0	0.0	1	0
1990	18.2	0.0	0.0	0.0	5	19

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 \$	\$	\$	\$	\$
1986	372.2	0.0	372.2	7.8	709.6	42.2	77.4	0.0	0.0	829.2
1987	332.6	60.0	392.6	7.4	230.3	12.8	143.1	173.6	0.0	559.8
1988	168.9	270.0	438.9	8.2	195.5	3.2	141.9	186.6	0.0	527.2
1989	189.8	350.0	539.8	7.3	174.3	23.1	110.2	85.4	7.9	400.9
1990	277.2	310.0	587.2	7.7	227.1	56.8	48.0	18.0	16.5	366.4

300. The Syrian Atomic Energy Commission (SAEC), the national body that co-ordinates and supervises the application of nuclear techniques in the country, is the main counterpart in technical co-operation with the Agency.

301. In a project approved from 1979, SAEC and the Ministry of Electricity, with Agency support, studied the possibilities of introducing nuclear power production towards the end of the 1980s. The Ministry entered into negotiations with Soviet suppliers for the construction of two WWER-type reactors in 1984, and the Agency assisted with site selection, nuclear safety and the waste management aspects, as well as with manpower training. Negotiations fell through, and the Syrian authorities are considering acquisition of a small research reactor with a view to making practical studies in nuclear activation analysis and of short-lived radioisotope production, and to training manpower.

302. Since 1985, and since 1987 with UNDP funding, the Agency has been assisting SAEC to assess the country's uranium resource potential. It has been undertaking systematic exploration for uranium by means of airborne and car-borne survey, screening large parts of the central and eastern Syrian Arab Republic for uranium deposits. The findings indicate poor prospects for discovering economically interesting uranium ores, and this prompted studies for a project for the recovery of uranium from phosphoric acid, which was established at SAEC in collaboration with a phosphoric acid plant at Homs. A follow-up pilot scale project, prior to setting up an industrial plant, has been prepared for consideration by UNDP.

303. From 1982 to 1990, the Agency assisted SAEC to establish a Nuclear Analytical Laboratory. Through this project, a sizeable quantity of analytical equipment was provided, in part with UK funding. Seven expert missions were organized to install and calibrate equipment and to instruct counterparts on various analytical techniques; fellowship training was also provided to the counterpart staff. The laboratory, which initially concentrated on uranium analysis in geological samples, is now running routine analyses atomic absorption spectrophotometry, X-ray fluorescence spectrometry, gamma spectroscopy, and gas and liquid chromatography for the benefit of various institutions in the country.

304. Several projects in agriculture have been implemented. With approval from 1974 and UNDP funding, a project on the use of radioisotopes in animal science initiated studies on radiation attenuation of animal vaccines, as well as nutrition and productivity research, carried out by the Department of Animal Production at the University of Aleppo. The Faculty of Agriculture at Damascus University studied root activity in fruit trees, using labelled fertilizers to determine the fertilizer-use efficiency. A national training course on soil/plant relationships introduced a long-term project in 1985 (completed in 1991) on plant/soil/water/fertilizer relationships in which the use of soil and fertilizer nitrogen was studied. A follow-up project to consider the effect of phosphate fertilizers on nitrogen uptake is awaiting extrabudgetary funding from 1991.

305. In the medical field, the Faculty of Medicine of Damascus University received assistance with training to introduce in-vitro radioimmunoassay as a diagnostic aid in the mid-1970s. No collaboration was then sought until the late 1980s, when support for preliminary work on radiopharmaceutical production and radiation sterilization of medical products received approval under two projects. There is planning for a future project to upgrade radiotherapy and related treatment planning.

306. In the field of water supply management, some interest was shown by the Ministry of Public Works and Water Resources in the 1970s in the application of nuclear tracing techniques; however, a wish to continue such work was only reflected recently through a project, awaiting extrabudgetary funding, through which replenishment and flow dynamics in two major aquifers are to be studied. The project is a follow-up of activities supported by a regional project that focuses on isotope hydrology in Middle-East countries.

307. There is national emphasis on manpower development, and many projects referred to above have included fellowship training abroad and national training courses for local staff. As part of this process, SAEC set up a Nuclear Training Laboratory in the period 1984-87 for training graduates of various faculties to apply nuclear techniques in their fields of interest.

308. These various activities have resulted in a large national inventory of nuclear electronic and related instruments. In a project approved from 1986, the Agency assisted in developing a trained body of staff to maintain and repair such devices and to design and construct one-off units. Items of test equipment and an assortment of components and spare-parts were provided to the nuclear electronics laboratory. Among locally designed and constructed items was an automatic sample changer for remote counting of radioactivity.

309. In view of the rapidly increasing applications of radiation and nuclear techniques at SAEC and other centres in the country, the Agency assisted SAEC to set up personnel dosimetry, environmental radioactivity monitoring and food contamination control services. An appropriate calibration system for radiation protection and medical physics instrumentation has been established, with substantial Agency assistance in the form of equipment and expertise. In related activities, radon and thoron levels in the environment are being determined to safeguard the population against possible health risks. An automatic early warning environmental radiation monitoring system (EWERMS) has also been established, to warn of higher than normal levels of radiation, especially in the event of a nuclear accident. The computerized networks that were established operate via telephone and other lines, assuring continuous remote sensing.

310. In June 1984, SAEC approached the Agency with a request for assistance in the purchase of equipment to be financed under a funds-in-trust arrangement. Funds deposited by the Syrian Arab Republic by 1990 had reached some US\$300,000, boosted by a further US\$350,000 contribution from Kuwait. Substantial quantities of equipment and supplies for use in technical co-operation projects or related activities

have been provided, SAEC benefiting from technical advice available from the Agency and good purchase and delivery services available through the Technical Co-operation Programme.

TURKEY

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

Year	TACF share	TACF pledged	Extrabudgetary funds	In-kind support	Experts from country	Persons trained in country
	\$	\$	\$	\$		
1986	96.0	96.0	0.0	2.8	5	0
1987	115.6	115.6	0.0	3.0	13	1
1988	129.2	129.2	0.0	10.0	10	10
1989	142.8	142.8	0.0	0.0	10	2
1990	145.6	145.6	0.0	0.0	6	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 \$	\$	\$	\$	\$
1986	415.1	10.0	425.1	8.9	628.1	9.9	2.0	0.0	69.0	709.0
1987	404.6	10.0	414.6	7.8	451.3	2.5	5.3	6.8	143.7	609.6
1988	333.4	75.0	408.4	7.7	270.3	1.5	0.0	72.4	94.6	438.8
1989	335.3	90.0	425.3	5.7	365.2	42.2	0.0	81.5	105.8	594.7
1990	379.7	50.0	429.7	5.6	442.2	11.4	0.0	85.0	4.2	542.8

311. Turkey has been involved in nuclear activities since 1956, when the Turkish Atomic Energy Commission was established and the first nuclear centre at Cekmece was founded. It became the 20th Member State of the IAEA in July 1957. The Commission co-ordinates all nuclear activities in the country, including nuclear power projects and nuclear safety. It operates four nuclear centres.

312. The Cekmece Nuclear Research and Training Centre (Cekmece NRTC) is the main centre, having two research reactors (a 1 MW(th) TR-1 reactor at present under reconstruction, and a 5 MW(th) TR-2 reactor used for radioisotope production). It has a comprehensive programme, including activities related to nuclear electronics, radiopharmaceuticals, health physics, radioisotopes, industrial applications of non-destructive testing, nuclear physics and chemistry, radiobiology, nuclear engineering and nuclear fuel.

313. The Ankara Agriculture Research Centre (ANTAM) is involved in soil/plant nutrition, plant breeding, soil fertility, biology and food irradiation, the Ankara Nuclear Research and Training Centre (ANAEM) is concerned with nuclear physics and chemistry, health physics and nuclear electronics, as well as running training courses, and the Lalahan Nuclear Research Institute in Veterinary and Animal Sciences (LHS-NAE) covers all nuclear applications in the animal sciences.

314. In 1990, both Ankara centres moved to Saraykoy where a new nuclear research centre is being established. A gamma irradiation facility is under construction at the Centre, and there are plans to construct a cyclotron facility.

315. There are also other institutions in Turkey involved in nuclear activities: The General Directorate of the State Hydraulic Works uses isotopes in hydrology, the National Institute for Geological Exploration (MTA) and ETI Bank (National Enterprise for Mining Exploration) conduct exploration for uranium, the Nuclear Energy Institute

of Istanbul Technical University has a Triga Mark I reactor for the teaching of nuclear engineers, and Ministry of Health establishments use radiopharmaceuticals and radiation for cancer therapy.

316. Since 1980, the Agency has approved 30 technical assistance projects; four of these were UNDP funded, with the IAEA as executing Agency. Fourteen are operational, including five projects approved for the 1991 programme. In the period 1980-89, technical assistance provided comprised 20% for expertise, 37% for equipment and 43% for training.

317. Since the early 1970s, the Government has considered nuclear power to be a necessary supplementary source of energy, and TAEA and the Turkish Electricity Company were studying the possibilities of starting a nuclear power programme. The original concept that the reactor vendors raise the money through a "build-operate-transfer" scheme did not succeed. To help establish an infrastructure in the country suitable for operating nuclear power plants, the Agency assisted Turkey in training staff both for the regulatory body and for the utility. The Agency also assisted Turkey with site studies, which were performed for a site in Akkuyu on the Mediterranean coast opposite Cyprus and a second site in Sinop on the Black Sea. The programme was plagued by a loss of trained personnel and the efforts in setting up an infrastructure and developing manpower did not yield the expected results. In 1989, the Turkish government decided to defer construction of major nuclear power plants.

318. In the same year, the Turkish authorities initiated a programme to construct a small power reactor of 25 MW(e). The reactor was to be used not only for electricity generation but also for district heating and possibly for water desalination. Infrastructure development for this project is now an important activity that is receiving Agency support.

319. The Agency has also been assisting the country to improve its laboratory capability at Cekmece NRTC for nuclear-fuel fabrication, including training of staff. The original plans to concentrate on CANDU-type fuel have been modified, and fuel fabrication for the research reactor is the present objective.

320. Assessment of Turkish uranium resources is considered an important contribution to the future of a nuclear power programme, and the Agency is assisting the country to collect the necessary data. In 1973, a UNDP-funded project initiated prospecting for uranium resources in south-west Anatolia and activities were continued with TACF funding for three projects covering aerial spectrometry, more detailed exploration for uranium resources, and studies on uranium recovery. Under the uranium recovery project, various techniques and methods were tested. A proven technology was introduced to study uranium recovery from phosphoric acid originating from different ore bodies. A laboratory-scale unit was installed to study the recovery process, and a feasibility study has still to be completed. The uncertainties in the nuclear power programme also slowed down the uranium exploration programme.

321. Proper management of groundwaters and surface waters is of great importance for Turkey, and nuclear techniques are extensively applied by the General Directorate of the State Hydraulic Works to assist with a variety of hydrological problems relating to the country's water resources. The list of priorities includes: use of environmental isotopes for studying the hydrology of karst regions; study of major aquifer systems of selected plains; sediment transport studies and problems related to silting up of reservoirs; river flow gauging by tracer methods; and a survey of isotopes in precipitation. These activities were initiated through a UNDP-funded project, and now the Agency is assisting the country in strengthening the isotope hydrology laboratory of the Directorate by helping to expand the analytical services both in terms of equipment and staff training. The Government has been interested in improving the industrial quality control standards in Turkey, in part to provide assurance of quality in components to be provided in respect of nuclear installations. In 1983, a project was

approved to enable the Cekmece NRTC to build up its non-destructive testing (NDT) capability on the one hand and a national certification scheme for personnel on the other. A committee for NDT and a national certification body were established, as were national standards for certification at levels 1 to 3. In 1987, a UNDP-funded project was initiated to help to set up a national centre for NDT training with a comprehensive programme that included radiography, as well as magnetic particle, eddy-current and ultrasonic testing techniques. A group of national specialists has been trained to act as trainers, while a good NDT laboratory, furnished with equipment for all the techniques and with suitable test pieces has been established at the Cekmece Centre. As a result, capability is being built up that will contribute to the Turkish nuclear programme and to sectors such as the petrochemical and metal working industries, civil engineering and construction, and transportation, by providing the basis for a uniform standard of quality assurance and quality control.

322. Introduction of radiation sterilization for medical products in Turkey is a goal of TAEA for which the Agency and UNDP were asked to provide technical assistance. Two projects started in 1989 support this objective and will provide a gamma irradiator and the necessary facilities and technical infrastructure. Construction of the laboratory buildings has commenced under the UNDP-funded project and the buildings will be finished in 1991 at the new Saraykoy Centre in time to receive the 100 kCi cobalt-60 irradiator, being purchased with TACF funding. Training of national specialists started in 1990. The TAEA will then be able to provide irradiation services to local industry at a level of about 35 million syringes or an equivalent amount of different products per year, which should be sufficient to cover domestic demand for some time to come.

323. Production of radioisotopes and radiopharmaceuticals has been a most important task of the Centre at Cekmece, and the Agency has provided various forms of assistance. Advice on the legal framework resulted in national regulations for radiopharmaceuticals, which were elaborated by TAEA in collaboration with the Ministry of Health. The establishment of a laboratory for the production of radioisotopes and radiopharmaceuticals has reached its final stage. The isotopes of greatest interest are iodine-131, iridium-192 and technetium-99m. The facilities for sterile kit production have been installed and staff have been trained in good manufacturing practice and quality control procedures.

324. In the field of animal science, the Lalahan Institute has been using nuclear techniques to improve the nutritional status and reproductive efficiency of livestock, and to control disease. Assistance has been given to equip the laboratory, including a gamma spectrometer being used to undertake trace-element studies, since certain areas of Turkey show deficiencies of essential trace elements in animal feeds. The institute has gathered experience in solving practical problems such as early non-pregnancy diagnosis and fertility control. At present the work is concentrating on developing a supplementary feeding strategy based possibly on urea molasses blocks.

325. There is also interest in human nutritional problems and Agency assistance has also been provided to the Institute in Lalahan and the Middle East Technical University of Ankara to study the role of trace elements in foodstuffs in the Turkish diet and their influence on human health.

326. There has been support for radiation protection activities for many years but, with the increasing use of radiation sources, the Government sought Agency advice. A RAPAT mission visited Turkey in 1985 and, as a result of this mission, a new radiation protection programme was established.

327. In 1986, the Chernobyl accident and its effects on the fishing and agricultural industry in Turkey caused public concern, in particular, the radioactivity levels found in fish caught in the Black Sea and in hazelnuts, both of which are important export commodities. Agency support provided equipment for monitoring and arranged for

training and expert advice. An environmental monitoring programme has been established, and a network of environmental monitoring stations has been installed. The counterpart institute received instructions on linking and operating the network.

328. Also in the context of nuclear safety, a national programme for the management of low- and intermediate-level radioactive wastes was established with Agency support to handle solid and liquid wastes deriving from the applications referred to above. The Agency also provided a radioactive waste treatment facility which was successfully installed and, after commissioning, put into operation at Cekmece NRTC. The safety analysis report was prepared, based on international regulations adapted to the Turkish situation, and the facility is appropriate and adequate for the present needs of the country.

UNITED ARAB EMIRATES

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

Year	TACF share	TACF pledged	Extrabudgetary funds	In-kind support	Experts from country	Persons trained in country
	\$	\$	\$	\$		
1986	48.0	0.0	0.0	0.0	0	0
1987	61.2	0.0	0.0	0.0	0	0
1988	68.4	0.0	0.0	0.0	3	0
1989	75.6	0.0	0.0	0.0	0	0
1990	86.5	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 \$	\$	\$	\$	\$
1986	38.8	0.0	38.8	0.8	7.2	0.0	0.0	0.0	0.0	7.2
1987	17.1	0.0	17.1	0.3	37.0	0.0	0.0	0.0	0.0	37.0
1988	71.6	0.0	71.6	1.3	31.6	0.0	0.0	0.0	0.0	31.6
1989	106.7	0.0	106.7	1.4	74.8	0.0	0.8	0.0	0.0	75.6
1990	100.4	0.0	100.4	1.3	62.1	0.0	335.9	0.0	0.0	398.0

329. Initially, the United Arab Emirates primarily made use of expert advice provided through the Agency in support of their limited nuclear programme. For example, in 1983, the Ministry of Health sought guidance on possible applications of nuclear techniques in the medical field. At present, the current projects are on a broader footing with emphasis not only on advice, but also on practical, on-the-job training by visiting experts.

330. The Ministry of Electricity and Water, Dubai, sought Agency support in 1977 with the establishment of an appropriate nuclear energy administration in the Emirates. Later, in 1984, Agency experts also assisted in evaluating proposals for uranium exploration.

331. Since 1985, the Agency has been assisting this Ministry to assess the groundwater resources in the Emirates through environmental isotope studies. The sizes and recharge rates of freshwater aquifers are being mapped with assistance from Agency experts, while the isotopic analyses of water samples are being performed at the Agency's Isotope Hydrology Laboratory in Vienna. The counterpart staff have been trained in well-water sampling techniques and on data interpretation, both on-the-job and through workshops in a related regional project on isotope hydrology in the

Middle East. The definition of the characteristics of the groundwater systems, in particular age and recharge parameters, will enable the Government to plan utilization and conservation measures.

332. The Government has also sought Agency support in its efforts to establish radiation protection measures, and assistance was given in formulating a nuclear law and radiation protection regulations. A thermoluminescence dosimetry system and a gamma spectrometer were provided to the radiation protection service's laboratory.

333. As a further radiation protection activity, the Central Food Control Laboratory of the Municipality of Abu Dhabi, under a project using funds-in-trust provided by the Emirates, is receiving Agency assistance to establish a mobile laboratory service for the measurement of radioactive contamination in food and environmental samples. Related spectroscopy instruments have already been provided, and Agency experts have been training counterpart staff on methodologies and on data interpretation techniques. A particular object is to control radioactivity in food imports. The laboratory has also been benefiting from Agency training workshops and intercomparison programmes organized through a related regional project on radiation protection in the Middle East.

YUGOSLAVIA

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

Year	TACF share	TACF pledged	Extrabudgetary funds	In-kind support	Experts from country	Persons trained in country
	\$	\$	\$	\$		
1986	135.0	135.0	0.0	4.3	30	35
1987	153.0	153.0	0.0	6.5	24	57
1988	171.0	171.0	0.0	14.0	25	8
1989	189.0	189.0	0.0	18.1	37	26
1990	204.8	204.8	0.0	0.0	32	45

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 \$	\$	\$	\$	\$
1986	542.9	0.0	542.9	11.4	527.3	2.8	195.7	16.7	85.6	828.1
1987	293.5	100.0	393.5	7.4	535.0	252.4	331.2	14.1	90.5	1223.2
1988	124.8	350.0	474.8	8.9	189.5	0.0	61.5	0.0	77.6	328.6
1989	96.5	870.0	966.5	13.1	165.7	107.9	23.5	0.0	17.7	314.8
1990	101.9	390.0	491.9	6.4	134.4	799.0	228.3	0.0	60.8	1222.5

334. The Yugoslav nuclear programme started in 1950, with construction of the first research reactor in 1955. Yugoslavia became a Member State of the Agency in 1957, the year of its establishment.

335. Since the 1950s, there has been a steady growth in the use of atomic energy both in research and in industry. Initially, the emphasis was on manpower development, and assistance was given to establish university courses in nuclear physics and related subjects. A number of nuclear institutes were established, with major ones in the three republics Croatia, Serbia and Slovenia, namely the Rudjer Boskovic Institute, Zagreb, the Boris Kidric Institute of Nuclear Science, Vinca near Belgrade, and the Josef Stefan Institute, Ljubljana, respectively. The 632 MW(e) Krsko Nuclear Power Plant is jointly operated by the Croatian and Slovenian authorities.

336. All nuclear activities in the country are co-ordinated by the Federal Secretariat for Energy and Industry in Belgrade. A Federal Nuclear Regulatory Commission is responsible for legislative aspects at the national level, while there are also bodies involved in regulatory and licensing aspects at the republic level.

337. There has been technical co-operation between Yugoslavia and the Agency since 1958. In terms of number of projects, it has had one of the largest co-operation programmes of any Member State. Forty projects were approved and implemented in the 1980s, while a further seven new projects were introduced in the 1991-92 programme — not including four footnote^a/ projects awaiting upgrading. Four UNDP-funded, Agency executed projects were operational at various times during the period 1979-88. Distribution of funds between expert missions, training and equipment during the 1980s was 13%, 25% and 62%, respectively.

338. The Krsko Nuclear Power Plant, situated between Ljubljana and Zagreb on the Sava River started test operation at 75% power in October 1981. In addition, planning for the Prevlaka Power Plant has reached an advanced stage. The Agency has supported the Yugoslav nuclear power programme from its inception, and it is worthy of note that 16 of the projects approved in the period 1980-89 were connected with power plant operation. Considerable emphasis was placed on training reactor operators, and a training centre for them was established in Ljubljana. In-service inspection has also received attention with projects relating to surveillance of pressure vessel embrittlement, heat exchanger corrosion; computer-controlled techniques for inspection of pressurized components are now in routine use at the Krsko plant, with particular attention being paid to welds and the steam generator. At the same time, a qualification programme for components and systems was developed. Nuclear safety studies were strongly furthered, not only by provision of hard- and software, but by a planned series of training courses in the different aspects of safety analysis and operational surveillance. For example, new techniques were developed and introduced to analyse isotopes in the fission gases in order to check for fuel defects in the core. At the same time, three complementary projects analysed different radioecological aspects of discharging cooling waters into the Adriatic aquatic ecosystem.

339. The Agency was involved in reviewing the final safety analysis report, and a current project supports the preparation of the probabilistic safety analysis (PSA), level 1, for the Krsko plant. There has also been a training course on the management of severe accidents, with particular weight placed on preventive aspects. At the request of the Government, an Operational Safety Review Team (OSART) mission visited the Krsko plant in 1984, with a follow-up mission in 1990.

340. These projects involved at different times the three main institutes, as well as the Institute za Elektroprivredu (the Institute for Electricity Generation Development and Research), Zagreb, the utility operator and others. Funding was in part provided by UNDP, the Federal Republic of Germany, the United States of America, and by Yugoslavia itself through a funds-in-trust arrangement — in addition to the allocations from TACF.

341. The original plans for an extension in the use of nuclear power generation were cancelled when, in 1989, the Federal Parliament approved a moratorium on the construction of any further plants. In the early 1980s, with UNDP funding, a uranium analytical laboratory was set up at Zirovski Vrh to support the national uranium exploration programme, and to strengthen process control in the mine and the mill. Projects with several geological institutes were also concerned with upgrading analytical capability and with carrying out airborne gamma-spectrometric and magnetometric surveys.

342. The Boris Kidric Institute at Vinca is the oldest nuclear centre in Yugoslavia and has as its main facility a 6.5 MW(th) heavy water moderated research reactor that was commissioned in 1959. A series of nuclear research and development laboratories covering a wide range of topics was established around the reactor, most of which have, at different times, been recipients of technical co-operation.

343. Under a current TACF/USSR funded project, the Agency assisted with the preparation of the design documentation for the modernization of the research reactor. Reactor control and instrumentation systems are being replaced, and research and radioisotope production facilities are to be upgraded. The Institute is also building a cyclotron facility for fundamental research and medical applications, and the Agency is providing expert services and some components.

344. The third irradiation facility is a cobalt-60 gamma irradiator that is used for pilot-scale studies on sterilization of medical products, food irradiation and radiation curing of polymer materials, in particular for the cable industry. This demonstration facility was set up in the period 1979-87 with UNDP-funding, following initial studies supported by a regular Agency project. Research is undertaken on the effects of radiation on chemicals such as monomers undergoing radiation polymerization, on foods and foodstuffs, and on pharmaceuticals and cosmetics; there is development of products and techniques, as well as of quality control procedures.

345. The Agency has assisted the Radioisotope Laboratory in its work on radiopharmaceuticals, for example in studies of the efficiency of labelling of hormones and proteins. Emphasis is now on upgrading production capability and quality control. The Institute is also engaged in environmental research; as one example, an Agency project in 1983 helped to initiate a continuing study of the radioecology of the Danube.

346. The Rudjer Boskovic Institute also started its nuclear activities in the 1950s. It is engaged in pure and applied research in the physical, chemical, biochemical, biomedical, marine and environmental sciences. A tandem accelerator was commissioned under a United States funded project and it is being used to support analytical techniques that, inter alia, provide data for a geological map of Croatia, determine trace elements in coal, and help to assess the environmental impact of coal-burning power stations. In further support of environmental studies, the Agency also assisted the Radiocarbon and Tritium Laboratory to improve its ability to determine carbon-14 and tritium in environmental samples. In addition, the Agency has been instrumental in providing replenishment cobalt-60 sources for the studies that are being undertaken on the radiation sterilization of medical products and the extension of these studies to food products, pharmaceuticals and polymer technology.

347. The Josef Stefan Institute has a 250 kW(th) Triga research reactor which is fully used for isotope production, experiments in nuclear physics and neutron activation analysis. There is also a 30 MeV linear electron accelerator that provides a high flux of gammas and also serves as a neutron source. In 1982, a Nuclear Training Centre was established at the Institute and there now regular courses on nuclear power technology and health physics. The various groups working at the Institute are very active, and have at various times received Agency technical assistance, for example in the fields of nuclear safety, radiation protection and environmental monitoring. There is also a current project with extrabudgetary funding from Germany to upgrade the Institute's capability in neutron activation analysis.

348. In connection with agriculture, the Agency has supported the Institute for the Application of Nuclear Energy in Agriculture, Veterinary Medicine and Forestry to study the photosynthetic process with a view to improving crop yields, and the Institute of Biology of Novi Sad University to undertake a mutation breeding programme to improve the quality of wheat and other crop plants, and to undertake hormone studies in cattle to improve fertility.

349. In medicine, the Faculty of Medicine of Novi Sad University received assistance for work on the early detection of thrombosis using isotope-labelled fibrinogen and for non-invasive diagnosis of cardiovascular diseases.

350. There is considerable emphasis on radiation protection and environmental monitoring in Yugoslavia and, in addition to the three major nuclear research institutes, the Institute for Medical Research and Occupational Health and the Institute for Electricity Generation Development and Research in Zagreb, and the Centre for Application of Radioisotopes in Science and Industry in Skopje have been counterparts for Agency collaboration.

351. The Agency executed a UNDP-funded project to establish an ecological laboratory having a mobile unit equipped to detect both radioactive contamination as well as contamination by certain chemical and biological substances. Under other projects, laboratories were upgraded and support was given for specific studies, some of which have already been mentioned.

352. Radioactive wastes have been collected at the Boris Kidric Institute for nearly 30 years, amounting to some 1000 cubic metres of solid and 300 cubic metres of liquid wastes, at present in interim storage. Agency experts, in a project approved from 1991, will be advising the Institute on appropriate methods of concentrating, immobilizing and disposing of these wastes in line with internationally accepted guidelines. Based on their recommendations, equipment will be provided, and it is expected that this activity will overcome the present storage problems.

353. Yugoslavia has an excellent manpower base for its nuclear activities, and has made good use of further training available through the Agency's Technical Co-operation Programme to keep its staffs fully aware of current practices in the various fields of application of nuclear energy. It is likely that the general pattern of project support that has evolved in the 1980s will continue, with the exception that the plans for expanding the use of nuclear power are in abeyance.

REGIONAL ACTIVITIES

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

Year	TACF share	TACF pledged	Extrabudgetary funds	In-kind support	Experts from country	Persons trained in country
	\$	\$	\$	\$		
1986	0.0	0.0	0.0	0.0	0	0
1987	0.0	0.0	0.0	0.0	0	0
1988	0.0	0.0	0.0	0.0	0	0
1989	0.0	0.0	0.0	0.0	0	0
1990	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 \$	\$	\$	\$	\$
1986	199.0	0.0	199.0	4.2	344.1	0.0	0.0	2.6	0.0	346.7
1987	456.3	55.0	511.3	9.7	198.2	10.6	0.0	0.0	0.2	209.0
1988	566.4	150.0	716.4	13.4	404.6	138.6	10.0	0.0	24.5	577.7
1989	1486.8	268.0	1754.8	23.7	763.5	88.7	0.0	0.0	31.8	884.0
1990	1412.3	321.3	1733.6	22.7	573.6	73.4	147.3	0.0	26.1	820.4

354. The Middle East and Europe Region, one of the four "regions" recognized in the Agency's Technical Co-operation Programme, can for many purposes best be considered, as its name suggests, in terms of two sub-regions. They comprise two groups of countries, the Middle Eastern and the European, having often dissimilar group priorities and interests concerning the peaceful applications of atomic energy, and this is reflected by having sub-regional programmes specifically tailored to meet the needs of the countries of a sub-region.

355. The value of regional collaboration among countries with similar levels of industrial and scientific activity, with consequent pooling of knowledge and resources, gave rise to the Agency's regional projects, designed to complement the national ones. As regional arrangements provide the advantages of close communication and collaboration between the scientists and specialists, the regional programme has led to a faster development of nuclear science and technology within a region.

356. In recent years, the Agency and Member States have considered setting up a "sub-regional" co-operative agreement among the Middle East countries, similar to those already established between the Asia and Pacific countries (RCA), the Latin American countries (ARCAL) and recently the African countries (AFRA), to accelerate application of nuclear techniques to solve problems common to Middle East countries. The Agency has signed co-operation agreements with the Arab Centre for Studies of Arid Zones and Dry Lands and the Arab Atomic Energy Agency; these agreements support the efforts of countries trying to pool their resources.

357. Many institutions in the Region are usefully applying nuclear techniques in such diverse fields as medicine, hydrology, agriculture and industry; radioisotopes and radiation techniques are being used to improve crops, to determine groundwater resources, to sterilize medical supplies, to analyse hormones, to check for weak spots in pipelines, to control the quality of industrial products, and to study environmental pollution. Also there is a wide range of regional activities related to nuclear power plant planning, construction, operation and safety. The Agency has focused particular attention on improving nuclear safety, in-service inspection, and maintenance of reactors in the region, as well as on radioactive waste management.

358. In support of advanced training, a regional project entitled Manpower Development in the Middle East and Europe Region was initiated in 1989 to make funding available for fellowship training and scientific visits, matching similar projects in the other three regions. The new system caters better for regional training needs than the previous global scheme, making it possible to provide training abroad that is valid and of high priority within a Member State's nuclear development programme but for which no allocation has been made in a current national technical co-operation project.

359. It is well recognized by the scientific community that food irradiation has the potential to reduce the incidence of food-borne diseases through the reduction of pathogen contamination in foods, especially in solid foods, and that it can also reduce post-harvest food losses, and extend the shelf-life of selected foods, thus making available a larger quantity and a wider variety of foodstuffs for consumers. It can also

serve as an effective quarantine treatment for certain foods, thereby contributing to international trade. Sources used are either cobalt-60 gamma irradiators or electron accelerators, depending on the processing and product.

360. Several countries in the Middle East and Europe Region have food irradiation programmes, at various stages of development; others are contemplating the introduction of this technology. At the request of Member States, the Agency initiated in 1987 a regional project on food irradiation with the objectives of providing assistance with programme planning, of promoting the harmonization of regulations governing food irradiation, in particular to encourage trade in irradiated foodstuffs, and of assessing technological and economic feasibility. Other aims include co-ordination of local pilot-scale food irradiation projects and assistance in assuring appropriate control of the food irradiation process.

361. The Soil Fertility, Irrigation and Crop Production Section of the Joint FAO/IAEA Division and the Soil Unit of the Agency's Seibersdorf Laboratory have been instrumental in developing over the years recognized methods of measuring nitrogen fixation by pasture and grain legumes based on the use of the stable isotope nitrogen-15 as tracer. Thus studies can be undertaken to improve nitrogen uptake under field conditions. Under a multi-year regional project on nitrogen fixation approved as of 1991, the Agency is assisting countries in the Region to co-ordinate experiments and to exchange information about national efforts. Group training and co-ordination meetings to discuss programmes and results are to be organized. The project is expected to promote regional co-operation in food production and also to strengthen existing national projects in biological nitrogen fixation in grains and legumes. Food production can be effectively enhanced by improving such fixation, at the same time reducing the need for fertilizer imports.

362. In medicine, the objective of the Agency's project on Radiopharmaceuticals in the Middle East, which began in 1988, was primarily to provide experts to lecture at regional workshops, where participants receive training geared to improving the quality control of radiopharmaceutical preparations. In the five workshops thus far organized, participants have been trained in techniques including radioimmunoassay, production of radioisotopes and radiation protection.

363. The Agency has been promoting environmental isotope studies to estimate the recharge rates of aquifers from rain and surface waters, the age of groundwater, and the interconnections between surface and groundwaters. Such studies have made enormous contributions to hydrological knowledge in the countries in the region. The Agency's project on Isotope Hydrology in the Middle East addresses the special needs of countries for water in their arid and semi-arid areas. The project began in 1989 with the objectives of familiarizing staff in the various countries working in hydrology or related disciplines with the advantages of applying environmental isotope techniques in hydrology, developing their capabilities for undertaking isotopic analysis of water and interpreting the experimental data. Three regional workshops have so far been organized, during which results of on-going well-water sampling programmes in the participating countries were discussed. In each workshop, participants were required to present case studies and the results were linked to the general hydrogeological problems in the region. This methodology has made it possible to evaluate the sizes, recharge rates and ages of major aquifers, which form the major part of the water resources in the participating countries.

364. The Agency has assisted countries in the Region to establish as well as to improve the measurement of radiation doses, for example in research institutes, in hospitals, in industry and in the environment; many institutions have benefited from dosimetric intercomparisons organized by the Agency. Under a multi-year project on Environmental Monitoring in the Middle East, which began in 1987, efforts were made to co-ordinate environmental monitoring efforts in the participating Member States. The project focused on determination of radiation levels in the local environment; this

issue became a central one after the Chernobyl accident. In response to Member States' requests, the Agency, in conjunction with Polish suppliers of appropriate monitoring equipment, developed for installation in the countries an automatic Early Warning Environmental Monitoring System (EWERMS) comprising a network of monitoring stations connected by telephone or land lines to a central facility to give appropriate warning of unusually high radiation levels. Monitoring of foodstuffs, including imports, was also a major objective after the Chernobyl accident; the Agency assisted institutes to set up gamma spectroscopy laboratories for measuring radioactive contamination in food and water. Six workshops have so far been organized under the project, and the topics of discussion have included derived intervention levels, intercomparison studies of milk powder samples, and EWERMS.

365. Among its many safety-related activities, the Agency makes available advisory services and information that reinforce national nuclear safety programmes. Following a number of Radiation Protection Advisory Team (RAPAT) missions to countries in the Region, a project on Strengthening Radiation Protection in the Middle East was initiated in 1989 to reinforce the national regulatory bodies. Practical aspects of radiation protection with regard to regulatory guides, and specific codes of practice for safe use of radioactive and ionizing sources in nuclear medicine, in radiotherapy and in industry, have been emphasized. Three workshops have so far been organized, focusing on radiation protection regulations and their implementation, radiation protection in industrial applications of ionizing radiations, and radiation protection in connection with medical applications of ionizing radiations; the last mentioned was organized jointly by the IAEA and WHO. Such group training of radiation workers on the safe use of isotopes, including the handling of X-ray equipment in hospitals, as well as on the practical aspects of regulation, licensing and inspection, have contributed to radiation health and safety in the participating countries.

366. Safety of nuclear power plants is a matter of particular concern. In-service inspection of the main components of a nuclear power plant is one of the most important tasks influencing nuclear safety. Technical assistance in support of efforts undertaken by Member States operating WWER-type reactors to develop adequate national infrastructures and systems for such inspections meets the increasing demand in Member States during the 1980s for assuring their safe operation. The Agency has provided assistance through on-the-job training, workshops and expert services. Emphasis has been on: establishment of inspection requirements, basic equipment criteria and general manpower requirements; evaluation of local capabilities; definition of the implementation approach; building up of basic in-service inspection capability; establishment of quality assurance programmes; and establishment of the in-service inspection programme. Also, through an extrabudgetary contribution from Spain, the technical specifications and basic design of appropriate in-service inspection equipment is being provided to the countries participating in this programme.

367. Countries of the Region operating or constructing WWER-type nuclear power plants sought Agency assistance for a regional project to exchange information and experience on safety in the plants and on the results of safety evaluations, and to upgrade operational safety systems; the project was initiated in 1984. The Agency, in training provided in Vienna, familiarized participants with the RELAP advanced nuclear safety computer codes, and advised them on the application of these codes to WWER-type reactors. An experimental loop has been constructed in Hungary with Agency assistance, and the results of experiments were used to define a standard exercise involving simulation of a loss-of-coolant accident. Participants from Bulgaria, Czechoslovakia, Hungary, Poland, Turkey and Yugoslavia have already profited. Furthermore, Design Basis Accident analyses have been performed for a reference plant (a WWER-440 of the 213 version). Country-specific analyses were performed and discussed at workshops.

368. After the Chernobyl accident, a working group was organized to deal with the problem of severe accident analyses. The group adapted an existing set of PWR computer codes for these (Source Term Code Package — STCP). The joint effort was organized in co-operation with the Kurchatov Institute, Moscow, which provided information on the reactor as well as expertise. The group was provided by the Agency with PC-based parallel processing systems which can run both RELAP5/Mod 2 and STCP codes. Valuable progress on comprehensive nuclear safety analysis has been achieved, with useful results for up-grading of plant safety. Mutual co-operation and exchange of information was strengthened both in respect of the reactor supplier and between the countries operating WWER-type reactors. A joint effort to elaborate the possibility of simulating a severe accident using the PC-based system has been initiated. In parallel with these analyses, there is continuing co-operation on probabilistic safety analysis (PSA), level 1, for WWER-type reactors, involving the same countries.

369. The regional projects (including the sub-regional activities) are initiated in response to requests from Member States, and reflect a common interest of several countries. That the Agency is well able to respond quickly to such demands has been seen in the case of environmental studies and reactor safety assessments resulting from concerns following in the wake of the Chernobyl accident.

IV. PROJECTS CONCLUDED DURING 1990: ACHIEVEMENTS

370. In the following pages, brief accomplishment summaries are given for projects — excluding training courses — which were “operationally” completed during 1990. For the projects cancelled during this period, the reasons leading to cancellation are given.

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

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

■ ALG/2/002

NUCLEAR ANALYTICAL LABORATORY

COMPLETED: 90-08-20

TOTAL COST: \$250,064

OBJECTIVES:

TO ESTABLISH A NUCLEAR ANALYTICAL LABORATORY FOR SAMPLE ANALYSIS IN MINING, AGRICULTURE AND OTHER FIELDS; TO WIDEN THE FIELDS OF APPLICATION AND IMPROVE THE QUALITY OF ANALYSES.

ACHIEVEMENTS:

The High Commissariat for Research sought Agency assistance to set up a Nuclear Analytical Laboratory that could offer sensitive analytical services country- wide. During the life of the project, 1985-90, Agency experts trained local personnel in the use and maintenance of equipment provided, which included an X-ray fluorescence spectrometer (later with a tube excitation facility), as well as a Moessbauer spectrometer and a positron-annihilation system to serve as analytical probes for studies in the materials sciences. Some dosimetric equipment, an Si(Li) detector, a calibration source and ancillary equipment were also provided. Training abroad for selected staff was provided through two project-funded and seven project-related Agency fellowships; of the latter group, three were supported by extrabudgetary funds made available by Belgium, one with funds from Hungary. The techniques introduced are now being used on a routine basis for the analysis of agricultural, medical and industrial samples. The Laboratory collaborates with other laboratories internationally in intercomparison studies.

■ ALG/9/006

RADIATION PROTECTION

COMPLETED: 90-05-28

TOTAL COST: \$117,368

OBJECTIVES:

TO ESTABLISH A MONITORING SYSTEM FOR PERSONNEL EXPOSED TO IONIZING RADIATION.

ACHIEVEMENTS:

Under this project, first approved in 1986, the Agency assisted the Centre for Development of Radiation Protection and Safety Techniques of the High Commissariat for Research to reorganize and improve its radiation protection services. Following the advice of an Agency expert, the external dosimetry and internal contamination (whole-body counting) laboratories were amalgamated, an automatic thermoluminescence dosimetry system was introduced for personnel dosimetry, and the radiation protection programme has been broadened. Among the items of equipment provided by the Agency were a fluorimeter, a counter, and calibration sources. Other experts advised on topics ranging from dosimetry by bioassay to medical care after irradiation or contamination. The project has helped to strengthen the existing infrastructure and the national expertise; it was supported by fellowship training abroad for two of the local staff. The counterpart organization has now a well founded programme to carry out external and internal radiation monitoring, and environmental studies. Advice given by an Agency expert on nuclear regulation has led to the enactment of legislation on radiation protection.

■ **ARG/4/077**

NUCLEAR ENGINEERING

COMPLETED: **90-02-12**

TOTAL COST: **\$3,291,082**

OBJECTIVES:

TO DEVELOP NUCLEAR TECHNOLOGY, IMPROVE THE SCIENTIFIC AND TECHNOLOGICAL INFRASTRUCTURE, AND TRAIN NUCLEAR ENGINEERS.

ACHIEVEMENTS:

The project, funded by UNDP, with cost-sharing by Argentina, was initiated in January 1979 with IAEA as executing Agency. The aim was to establish an academic programme to provide well qualified nuclear engineers in support of the technical infrastructure needed for Argentina's nuclear power and research programmes. To comply with the objectives of the project, a programme at the graduate level in nuclear engineering was created at the Instituto Balseiro and approved by the Cuyo National University in 1986. To develop the programme, Agency experts provided advice and specialist training to local professors and lecturers, and supervised the development of the curriculum and university infrastructure as well as lectures on several subjects. In order to consolidate the programme, several laboratories were set-up and equipped for teaching and research at the Bariloche Atomic Centre. Several research groups were created or developed around existing groups in areas such as instrumentation and control, thermal aspects of reactors, nuclear and neutron physics, and radiological protection. Training abroad using project-funded or related fellowships and scientific visits was granted to around 50 Argentine nationals. As a result of the project, 118 students have received degrees in nuclear engineering since 1981, among them six Peruvians and four Uruguayans. About 90% of the graduates are filling positions that are associated with nuclear engineering, and they have been a valuable manpower source for Argentinian industry. Moreover, a permanent faculty of high-standard comprising 63 persons was formed; it includes 23 graduates of the nuclear engineering school. A UNDP in-depth evaluation of the project was conducted with the participation of outside experts; it was concluded that the project had been well conceived and planned, and that its principal objectives had been fully met. To complete the staff training programme and to bring certain aspects of the university activities up to state-of-the-art standard, UNDP has approved a two-year continuation project under which the fellowship programme will be completed and some Agency experts will provide specialist training and support.

■ BGD/4/008

RESEARCH REACTOR COMMISSIONING

COMPLETED: 90-12-19

TOTAL COST: \$78,233

OBJECTIVES:

TO ENSURE THE RELIABLE AND SAFE OPERATION OF THE TRIGA MARK II RESEARCH REACTOR.

ACHIEVEMENTS:

Construction of the Bangladesh Atomic Energy Commission's 3 MW Triga Mark-II research reactor started in 1981, and it achieved criticality in October 1986. The project was first approved in 1983, the emphasis being placed on training, and expert support for operator training and qualification, and commissioning. Five of the operations and maintenance personnel were trained under the Agency's fellowship scheme, one of these fellowships being funded by USA. Operations staff were also given on-the-job training in making measurements of reactor core parameters. As a result, the reactor centre has a sufficient number of trained operators and support personnel for multi-shift operation of the reactor. Monitoring equipment, accessories and various types of supplies were provided to assure safe operation, maintenance and utilization of the reactor. The Commission has, as a result of the project, a research reactor capable of providing irradiation, radioisotope-production and analytical services to other research establishments and to the different sectors of the economy. This project has also assisted in implementing two other projects on utilization of the research reactor (BGD/4/006, Isotope production, and BGD/4/009, Research reactor utilization); steps are being taken to complete the installation of triple-axis neutron spectrometer by early 1991.

■ BGD/4/012

RESEARCH REACTOR DATABASE AND COMPUTER CODE DEVELOPMENT

COMPLETED: 90-12-19

TOTAL COST: \$44,974

OBJECTIVES:

TO DEVELOP COMPUTER CODES AND A DATABASE FOR STUDIES ON REACTOR PHYSICS AND THERMOHYDRAULICS.

ACHIEVEMENTS:

With the commissioning and operation of the Bangladesh Atomic Energy Commission's Triga Mark-II research reactor, it became necessary to establish a computing capability for safe, reliable and economical operation of the reactor. Through Agency support provided in the form of expert services and a desk-top computer with interface to the local computer system, a library of computer codes, utility modules and basic nuclear data have been developed to support nuclear engineering studies, in particular in the fields of reactor neutronics and analysis, reactor fuel management, neutron activation analysis and spectrum unfolding, radiation protection and shielding, and nuclear data preparation, management, processing and evaluation. The Centre regularly uses the TRIGAP code for the analysis of reactor performance. One project-related fellowship was funded by the Federal Republic of Germany. A continuation project, approved for the 1991-92 programme (BGD/4/015), awaits extrabudgetary funding.

■ BGD/5/012

NITROGEN FIXATION IN GRAIN LEGUMES

COMPLETED: 90-07-24

TOTAL COST: \$115,542

OBJECTIVES:

TO DEVELOP A PROGRAMME TO IMPROVE BIOLOGICAL NITROGEN FIXATION FOR IMPROVEMENT OF LENTIL AND PEANUT CROPS.

ACHIEVEMENTS: The project improved the capability of the Institute of Agriculture, Mymensingh, to develop a research programme to produce high yielding varieties of lentils and peanuts (important sources of vegetable protein and oil) with a high capacity for fixing atmospheric nitrogen. An expert in soil microbiology and plant physiology advised on nitrogen fixation studies. Laboratory equipment for nitrogen-15 analysis was provided for a direct quantitative measurement of biological nitrogen fixation. Other nuclear techniques, such as radiation-induced mutation breeding, and fertilizer-use efficiency studies undertaken with labelled fertilizer to assess different strains of Rhizobium, were introduced with the longer-term aim of improving agricultural practices. Six promising peanut mutants were developed, and these were evaluated in both heavy and light soils for different agronomic characteristics including high nitrogen fixation capacity. Five local strains of lentil rhizobium and five of peanut rhizobium were isolated, purified and evaluated for nodulation, dry matter production, nitrogen fixation and yield. The nitrogen fixation potential of a chickpea rhizobium combination was also determined. The success of these on-going studies has brought particular Government recognition.

■ **BRA/0/011**

NATIONAL SAFEGUARDS ANALYTICAL LABORATORY

COMPLETED: 90-06-13 TOTAL COST: \$102,948

OBJECTIVES: TO ESTABLISH A NATIONAL SYSTEM TO SAFEGUARD THE URANIUM FUEL CYCLE IN BRAZIL APPLYING DESTRUCTIVE AND NON-DESTRUCTIVE ASSAYS FOR THE ANALYSIS OF URANIUM MATERIALS.

ACHIEVEMENTS: The safeguards analytical laboratory of the implementing institution, the National Nuclear Energy Commission (CNEN) was designed and constructed under IAEA guidance. The Agency provided experts to advise on and train staff in the analysis of uranium using both chemical and gamma spectrometric methods, as well as equipment for the laboratory. A fellowship for training at the Agency Laboratory at Seibersdorf was granted to the project counterpart. The project provided the Commission with the capability to carry out independent verifications of destructive and non-destructive assays of uranium nuclear materials. Adequate procedures were developed for analysis, data collection and statistical treatment, and step-by-step instructions were incorporated into the national verification system. Very good results were obtained for uranium concentration determinations in pure, non-irradiated nuclear materials using potentiometric titration and ignition gravimetry, as well as using spectrophotometry for solutions of very low uranium concentration. Computer programmes for data acquisition and analysis were established.

■ **BRA/4/029**

RADIATION DEFECTS IN FERRO-ELECTRIC MATERIALS

COMPLETED: 90-06-13 TOTAL COST: \$73,745

OBJECTIVES: TO STUDY IN FERRO-ELECTRIC SUBSTANCES LOCALIZED DEFECTS CREATED BY IONIZING RADIATION.

ACHIEVEMENTS: The project was implemented by the Department of Physics of the University of Minas Gerais, and was a continuation of activities started under a previous project completed in 1980. The present project was fully funded by the Federal Republic of Germany. As the work on ferro-electric materials was being completed, the emphasis of the project was redirected towards the study of point defects in semiconductors. As a result of expert advice, upgrading and

automatization of the ESR-ENDOR spectrometer was initiated to support the work on semiconductors, and with an eye to the eventual establishment of optical detection of magnetic resonance. The project has contributed significantly to the training of students at master's and Ph.D. degree levels, and has resulted in the publication of several papers. The upgrading of the electron spin resonance spectrometer is being continued under the project "Study of multi-layer semiconductor structures" (BRA/1/029), also being funded by the Federal Republic of Germany.

■ **BRA/5/015**

ANIMAL SCIENCE

COMPLETED: **90-06-25**

TOTAL COST: **\$106,806**

OBJECTIVES:

TO APPLY RADIOISOTOPE TECHNIQUES IN ANIMAL SCIENCE WITH A VIEW TO STUDYING NUTRITION AND PROTECTION; TO DEVELOP IRRADIATED VACCINES AGAINST LUNGWORM; TO CONDUCT REPRODUCTION STUDIES.

ACHIEVEMENTS:

The project, which was implemented by the Centre for Nuclear Energy in Agriculture (CENA), was an extension of activities under earlier projects and a project funded by UNDP. It was mainly concerned with aspects of animal nutrition and reproduction, and involved nine visits by seven experts, to advise on related topics including radioimmunoassay and parasitology, and to help develop research programmes. Some equipment was financed to complete the inventory of the laboratory, including a multi-well gamma counter, a soil moisture meter and some computer accessories. In addition to the on-the-job training provided by the experts, one project-related and two project-funded fellowships were granted for specialist training in Australia, the IAEA Laboratory at Seibersdorf and USA, respectively. There were also three IAEA Research Contracts connected with the project that were successfully concluded. The progress achieved included identification of mineral deficiencies associated with low productivity and a treatment of sugar cane bagasse to provide low-cost nutrient for cattle and sheep in the dry season.

■ **BRA/9/019**

REACTOR SAFETY RESEARCH PROGRAMME

COMPLETED: **90-11-21**

TOTAL COST: **\$125,486**

OBJECTIVES:

TO FORMULATE AN INTEGRATED PWR SAFETY RESEARCH PROGRAMME INCLUDING INVESTIGATIONS OF THE INTERACTION BETWEEN REACTOR VESSEL AND CORE AFTER A LOSS- OF-COOLANT ACCIDENT.

ACHIEVEMENTS:

Agency assistance contributed to fostering research into two-phase flow effects after a PWR loss-of-coolant accident (LOCA). Initially, experts assisted the counterpart staff to develop a research programme on PWR dynamic behaviour, accident analysis and safety. Subsequently, tests were undertaken in a thermal loop constructed at Nuclebras' Centre for the Development of Nuclear Technology (CDTN) at Belo Horizonte. The studies enabled the counterpart staff to get sound knowledge about safety aspects related to the end-of-blowdown, refill, and reflood phases of a LOCA. The equipment component comprised mainly mechanical parts for the test section, a centrifugal pump, a containment tank, a steam supply vessel, and storage tanks. The project complemented bilateral activities with the Kernforschungsanlage

Juelich within a broad programme to promote research reactor studies in Brazil, and was financed jointly by the Agency (experts) and the Federal Republic of Germany (equipment).

■ **BRA/9/023**

RADIATION PROTECTION

COMPLETED: **90-11-30**

TOTAL COST: **\$325,794**

OBJECTIVES:

TO ESTABLISH A RADIOLOGICAL ACCIDENT DIAGNOSTIC CENTRE AND A TRAINING SITE FOR STUDIES ON HUMAN RADIATION EXPOSURE.

ACHIEVEMENTS:

The project assisted the Institute for Radiation and Dosimetry (IRD) in acquiring facilities and training staff to provide routine and emergency personal radiation monitoring and to estimate occupational exposure. Moreover, it contributed to improving personal monitoring techniques and to setting up guidelines and standard quality control procedures. The Agency provided equipment mainly for radiation monitoring and some for medical diagnosis. Experts advised on chromosomal aberration and bioassay techniques, internal monitoring and whole-body counting. Twelve members of the counterpart staff were trained, both at IRD and by means of project-related fellowships, as well as by project-related and project-funded scientific visits. The six fellowships involved training in France, Netherlands and USA, and visits were undertaken to Canada, Federal Republic of Germany, Italy, UK and USA. There was also a related Agency Research Contract concerned with the micronucleus as a measure of radiation exposure. The project was realized in two phases. Phase I of the project proved to be extremely beneficial, as the installations and training received were utilized in connection with the handling of the Goiania accident and subsequent activities. The second phase of the project, funded by the Federal Republic of Germany (providing approximately half of the total project funds), continued some of the activities connected with the accident by providing experts to evaluate the cases and to assist with the emergency counting facilities at Goiania. In addition, the second phase provided expert assistance and a thermoluminescence dosimetry system which laid the foundations for the establishment of a higher standard of medical practice in nuclear medicine, X-ray diagnosis and radiotherapy in Brazil. A systematic and efficient quality control and quality assurance programme was planned, including the development of a national inventory of radiation sources, and the improvement of information dissemination for and training of staff throughout Brazil. Activities, are being continued under project BRA/9/029 and BRA/9/035, the latter also being funded by Germany.

■ **BRA/9/026**

RADIATION PROTECTION

COMPLETED: **90-06-13**

TOTAL COST: **\$70,274**

OBJECTIVES:

TO PROVIDE TECHNICAL SUPPORT FOR OCCUPATIONAL RADIATION PROTECTION AND INTERNAL AND EXTERNAL DOSIMETRY.

ACHIEVEMENTS:

The project provided the Radiation Protection Division of the Centre for the Development of Nuclear Technology (CDTN/CNEN) with considerable support to improve the quality of the radiation protection services. The Agency arranged for expert services on area radiation monitoring, on monitoring of personnel for external dose assessment and on internal dosimetry (bioassay techniques). Recent concepts on external dose assessment were introduced and suggestions were made, in particular with respect to meaningful evalu-

ation of measurement data, calibration procedures and work-place analysis. A basic document matched to local needs was prepared containing all essential information, including references to IAEA Basic Safety Standards, and ICRP and ICRU recommendations, and handed over to the counterparts. There will be a significant improvement in the monitoring and control of external exposure when the expert's recommendations are acted upon by the authorities, in particular regarding closer collaboration between institutes. With regard to internal dosimetry, a second expert assisted the counterparts to establish a programme for analytical procedures in bioassay and evaluation of results. In support of these activities, equipment was furnished that included a nuclear spectrometer, a fluorimeter, an alpha counter, and some radiation monitoring equipment. A member of the counterpart staff was granted a fellowship for training in India on several aspects of internal radiation monitoring. Based on the knowledge gained, a comprehensive internal radiation programme has been set up.

■ **BRA/9/027**

NUCLEAR FUEL CYCLE INSTALLATION SAFETY

COMPLETED: 90-06-13

TOTAL COST: \$38,552

OBJECTIVES:

TO CREATE EXPERTISE IN SAFETY, ACCIDENT ANALYSIS AND ACCIDENT PREVENTION PROCEDURES FOR NUCLEAR FUEL CYCLE FACILITIES, IN PARTICULAR FOR MINING AND MILLING, TRANSPORT OF RADIOACTIVE MATERIAL, FUEL FABRICATION AND THE TREATMENT OF RADIOACTIVE WASTE.

ACHIEVEMENTS:

The project was approved to further activities that were established at the National Nuclear Energy Commission (CNEN) under two national projects completed in 1978 and 1984. Five experts, in seven visits, advised on the general methodology for licensing, on mining and milling safety, and on transport package design, testing and certification, in connection with which a national course on the safe transport of radioactive materials was held for fifteen persons involved in all aspects of the subject matter. In addition, two staff members of the counterpart staff were granted Agency scientific visits to Canada, France, UK and IAEA. The activities have enhanced the areas of licensing, inspection and safety assessment of plants, and of operations relating to the nuclear fuel-cycle.

■ **BRA/9/036**

RADIATION PROTECTION INFRASTRUCTURE

COMPLETED: 90-06-13

TOTAL COST: \$37,920

OBJECTIVES:

TO ASSESS THE NATIONAL INFRASTRUCTURE RELATING TO RADIATION PROTECTION IN MEDICAL PRACTICE AND TO ADVISE THE AUTHORITIES REGARDING IMPROVEMENTS.

ACHIEVEMENTS:

The project provided the basis for a national plan to assist the Ministry of Public Health and the National Nuclear Energy Commission (CNEN) in establishing effective surveillance of radiation protection practices in medical installations as well as an inventory and control system for radiation sources used in these installations. An expert was financed to assist in developing the plan, which includes physical surveillance methods related to personnel and area monitoring, and quality assurance of the performance of diagnostic and therapy installations. Assistance was also provided to formulate the continu-

ation of activities initiated here under the project BRA/9/035, "Radiation protection in medical practice" which is being funded by Germany with extrabudgetary contributions.

■ BUL/9/009

SEISMIC SAFETY REVIEW MISSION

COMPLETED: 90-12-22

TOTAL COST: \$52,238

OBJECTIVES:

TO REVIEW THE SEISMIC INTENSITY AND OTHER CHARACTERISTICS OF THE KOZLODUY AND BELENE NUCLEAR POWER PLANT SITES.

ACHIEVEMENTS:

At the request of the Bulgarian Authorities, under this Reserve Fund Project, eleven Agency experts reviewed the site characteristics from 11 to 23 June 1990. The final report of the Site Safety Review Mission was submitted to the Bulgarian Authorities in July 1990. A detailed programme for the implementation of experts' recommendations was also presented. The report of the advisory mission covered all important aspects such as seismic safety, safety foundation, meteorology, hydrology, demography, man-induced events and emergency planning. As a result of this project, a new technical co-operation project for the implementation of the main recommendations of the advisory team was established for 1991-92 (BUL/9/012).

■ BUL/9/010

PRE-OSART AND OSART MISSIONS

COMPLETED: 90-01-09

TOTAL COST: \$23,727

OBJECTIVES:

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

ACHIEVEMENTS:

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

■ CHI/1/013

NEUTRON DOSIMETRY

COMPLETED: 90-12-22

TOTAL COST: \$40,391

OBJECTIVES:

TO IMPROVE PERSONNEL NEUTRON DOSIMETRY.

ACHIEVEMENTS: The Chilean Nuclear Energy Commission requested assistance from the Agency to solve problems which were being experienced in slow and fast neutron personnel dosimetry. In 1983, funds were assigned, and since then the project has provided for the necessary training, including two project-related fellowships funded by the Federal Republic of Germany, and expert support, as well as for minor items of equipment to develop chemical and electrochemical etching techniques. An albedo dosimeter for experimental application was designed. Two publications were presented by the project counterpart at the First National Symposium on Experimental and Applied Physics which was organized in Chile in 1986. The project also established a technical link with Kernforschungszentrum Karlsruhe, Germany, and ENEA for the carrying out of intercomparisons.

■ **CHI/2/008**

DEVELOPMENT OF RADIOPHARMACEUTICALS

COMPLETED: 90-12-22

TOTAL COST: \$113,345

OBJECTIVES: TO DEVELOP AND PREPARE NEW RADIOPHARMACEUTICALS TO BE USED IN NUCLEAR MEDICINE DIAGNOSTIC STUDIES.

ACHIEVEMENTS: In 1985, the Agency approved this project to assist the Chilean Nuclear Energy Commission (CCHEN) in research into and development of radiopharmaceuticals, including bi-functional chelating agents. Expert advice and training of staff were instrumental in accomplishing development of lyophilization of stannous glucoheptonate to label platelets, and in labelling proteins and red blood cells. The support received under this project has had direct application, since most radiopharmaceuticals and radioisotopes for medical use in Chile are produced at the La Reina Research Reactor operated by CCHEN. Training support abroad was given through two fellowships and a scientific visit to the USA. A cryomicrotome and autoradiographic equipment for bio-distribution studies undertaken in experimental animals were among the items of equipment provided by the Agency. A particular focus was labelling of imaging agents with technetium-99m, with production of kits for kidney, liver, lung, and organ blood pool; novel cerebral and myocardial kits were introduced. The use of stannous glucoheptonate as chelating ligand ("pre-tinning") was developed. Another new kit labels polymorphonuclear leukocytes with great efficiency (80%) using small blood samples (2-10 ml), as opposed to conventional methods that need up to 500 ml labelled at 10-40% efficiency. Platelet labelling kits were also proved effective; these are used to study wound healing. Additional imaging compounds developed were ^{99m}Tc-DFO and ^{99m}Tc-sucralfate. The advances achieved have been reported in publications written by the project team for "The Current Applications in Radiopharmacology" (Pergamon Press, 1986), for the proceedings of the ALASBIMN X Congress, 1987, and the 33rd Congress of the American Nuclear Medicine Society, 1986.

■ **CHI/4/013**

RESEARCH REACTOR CORE CONVERSION (RECH-1)

COMPLETED: 90-12-22

TOTAL COST: \$54,909

OBJECTIVES: TO DETERMINE THE OPERATIONAL PARAMETERS OF THE RECH-1 REACTOR WITH FUEL ENRICHED TO 45% INSTEAD OF 80% WITH A VIEW TO ACQUIRING THE INFORMATION AND TECHNIQUES REQUIRED TO PERFORM CORE CONVERSION.

ACHIEVEMENTS: Since the Chilean Nuclear Energy Commission (CCHEN) had been having difficulties to obtain replacement fuel with 80% enrichment for its 5 MW La Reina Research Reactor, assistance was sought from the Agency to prepare to convert the core for operation with a new commercially available fuel at 45% enrichment. The funds for the necessary equipment were provided by CCHEN, while the Agency covered the expenses for training and expert advice which were fundamental to preparing for the core conversion process, including reactor- physics analyses, thermohydraulic calculations and determination of computer codes to ensure proper safety margins. Core conversion has been completed. In addition, the experience gained by the project team is proving useful for a core conversion which is to be carried out for the other CCHEN research reactor at Lo Aguirre.

■ **CHI/5/012**

REPRODUCTIVE BEHAVIOUR OF RUMINANTS

COMPLETED: **90-12-22** TOTAL COST: **\$119,577**

OBJECTIVES: TO INCREASE THE REPRODUCTIVE EFFICIENCY OF RUMINANTS THROUGH THE APPLICATION OF RADIOIMMUNOASSAY TECHNIQUES AND TO STUDY REPRODUCTIVE HORMONE LEVELS.

ACHIEVEMENTS: This technical co-operation project with the Southern University of Chile at Valdivia was approved in 1985. The work was undertaken with the additional support of a Research Contract awarded to the project counterpart and from the Regional Programme ARCAL. The assistance provided has made it possible to set up facilities for radioimmunoassay (RIA) and to train project personnel to use RIA methods to determine causes of reproductive failure in dairy cattle, and in embryo transfer. Five thousand samples of cattle milk and blood are being analysed every year for progesterone by solid-phase RIA, and the facilities are being used for training veterinary undergraduate and post-graduate students. Agency assistance has contributed significantly towards the establishment of a centre of excellence in Latin America; it is being used for training courses on animal reproduction attended by Latin American veterinarians and holders of Agency fellowships.

■ **COL/2/010**

RADIOPHARMACEUTICAL KIT PRODUCTION AND QUALITY CONTROL

COMPLETED: **90-11-19** TOTAL COST: **\$82,073**

OBJECTIVES: TO INCREASE THE PRODUCTION OF RADIOLABELLED COMPOUNDS AND THEIR QUALITY CONTROL; TO EXPAND TRAINING PROGRAMMES IN RADIOIMMUNOASSAY.

ACHIEVEMENTS: Initially, the Institute for Nuclear Affairs and the Central Military Hospital in Bogota requested Agency assistance to improve production and quality control of radiopharmaceuticals labelled with short-lived radioisotopes. Under this part of the project, approved in 1986, an expert provided the necessary guidance during 1986-87, and a chromatographic scanner and osmometer were, inter alia, provided. Subsequently, the project was extended to cover production of thyroid diagnostic reagent kits for radioimmunoassay (RIA) starting with bulk supplies. Since 1987, an "in house" RIA capability has been established using locally produced reagents or kits as far as possible. This improved a situation in which poor RIA practice and unreliable service was found to be due, above all, to the high cost and irregular availability of imported commercial RIA kits. The problem was approached by supplying

the laboratory with bulk reagents for the assay of thyroxine, tri-iodothyramine and thyrotrophine. The necessary materials for the local production of primary reagents for both RIA kits and radiopharmaceuticals were also supplied, activities in this direction being initiated at an early stage. Further items of equipment provided included a beta counter, a water purification system, an analytical balance, an isotope calibrator and a data processing package for RIA. Expert missions in connection with local reagent production for both RIA and radiopharmaceuticals were undertaken. One fellowship for training in Argentina was awarded. An expert also advised on establishing computer networking for medical data processing. Good progress was made towards realization of project objectives. In RIA, tracers for all three thyroid analytes were locally produced, and this was followed by the satisfactory production of first and second antibodies. "In house" assays have been established, validated and introduced into routine usage. In the field of radiopharmaceuticals, products of commonest importance, such as MDP and sulphur colloid, have been prepared locally for labelling with technetium-99m. Good quality control procedures have been established. As a result, the laboratory is much less dependent on imported materials and local hospitals are better serviced for both "in vitro" and "in vivo" nuclear medical diagnostic procedures. A 1991-92 follow-up project (COL/2/012) will be dealing with the production, use and quality control of technetium-99m labelled radiopharmaceuticals.

■ COL/8/011

ESTABLISHMENT OF A GAMMA FACILITY

COMPLETED: 90-08-08

TOTAL COST: \$18,151

OBJECTIVES:

TO MAKE AN EVALUATION OF THE EXISTING FACILITY AND TO ANALYSE THE POSSIBILITY OF INCREASING THE COBALT-60 SOURCE LOADING TO 100 KCI.

ACHIEVEMENTS:

The Institute for Nuclear Affairs in Bogota had requested assistance to design a materials handling conveyor and to upgrade the safety systems at the existing panoramic gamma irradiator of low capacity in order to make it ready for loading up to 100 kCi of cobalt-60. An Agency expert paid three visits to advise on technical and safety matters. The agreed modifications to the concrete and water shielding, safety systems and product and source transport mechanisms were, to a large extent, undertaken although there were delays resulting from the lack of components on the local market. In addition, an industrial thermoluminescent dosimetry system was provided and detailed dose mapping of the irradiator was carried out at the existing loading. The main objectives have been achieved. The follow-up project, COL/8/013, that is supporting the increase in source loading was approved for 1990-91. The present project has successfully prepared the way for source enhancement, which will make possible more realistic studies of industrial-scale food irradiation processing and radiation sterilization of medical products. With this, the Institute will have modest but significant capacity to provide radiation sterilization services to local manufacturers.

COMPLETED: 90-12-22

TOTAL COST: \$178,898

OBJECTIVES:

TO PROVIDE TECHNICAL AND SCIENTIFIC SUPPORT FOR ESTABLISHING A FACILITY FOR THE PRODUCTION OF DISPOSABLE SYRINGES AND OTHER MEDICAL PRODUCTS STERILIZED THROUGH GAMMA IRRADIATION.

ACHIEVEMENTS:

The Beijing Radiation Centre in co-operation with the Department of Chemistry of the Beijing Normal University planned to establish a pilot plant for the radiation sterilization of medical products, including disposable syringes. A 300 kilocurie cobalt-60 irradiation plant was put under construction, to be associated with a factory that would manufacture some 50-100 million syringes a year, also under construction. The Government and the Municipality of Beijing invested in the establishment of the gamma irradiation facility, and the Agency was requested to provide assistance with process and quality control and, in particular, with developing plastics suitable for manufacture of medical products that would be radiation sterilized. Under this multi-year project, first approved in 1986, four Agency experts undertook five missions to advise counterpart staff on radiation engineering, radiation chemistry and microbiological quality control, as well as on the commissioning of the irradiation facility. Two other experts lectured at a training course on quality control and sterility assurance. Equipment such as a differential scanning calorimeter and a high temperature liquid chromatography system were provided. In addition, two counterpart staff were trained abroad under project-related fellowships. The counterparts have developed expertise in related research and development. As a result, a new plastic product, a polypropylene resin (type PP1635), has been developed and approved for manufacturing syringes to be sterilized by radiation; industrial production by the Beijing Yan-shan Petrochemical Corporation has commenced.

COMPLETED: 90-12-20

TOTAL COST: \$248,394

OBJECTIVES:

TO MODERNIZE RADIATION PROTECTION PROCEDURES IN NUCLEAR-POWER AND FUEL-CYCLE ACTIVITIES.

ACHIEVEMENTS:

China has a broad spectrum of activities relating to the peaceful uses of atomic energy, including nuclear power, at institutions throughout the country. The Institute of Radiation Protection, Taiyuan, is a multi-disciplinary institution whose main responsibility is for radiation protection in respect of nuclear-power and fuel-cycle facilities. The Government is modernizing procedures related to licensing and radiation protection, particularly as regards the protection of workers and the general public. On the basis of recommendations made by a RAPAT mission in 1984, the project, approved from 1986, was tailored to assist in improving radiation protection in the nuclear industry and related institutes. The Agency provided a complete thermoluminescence dosimetry system for personnel monitoring, a low-level alpha-beta counter, and a hand, foot and clothing monitor. One expert advised on operational radiation protection and another on environmental radiation assessment. Four counterpart staff were trained abroad on long-term fellowships and five were granted scientific visits. The Government also contributed considerably. A laboratory was rebuilt to install the equipment supplied by the Agency, a low-background laboratory was constructed, and a Personnel

Dose Monitoring and Management Centre was established. A centralized computer system manages and processes personal dose data, and records and analyses the data in accordance with a unified standard. In order to ensure reliability and comparability of monitoring results of individual dose assessments coming from the Centre and elsewhere, an independent quality assurance group has been established. The Institute has now well developed expertise in personal dosimetry, has established regulations on the transport of radioactive materials and on emergency planning and preparedness. Atmospheric diffusion tests both at the site of the Qinshan Nuclear Power Station and in a wind tunnel have been undertaken as a pre-operational assessment of local conditions. The project has also furthered research into and development of various aspects of radiation protection; 23 scientific publications have resulted.

■ CUB/2/005

PREPARATION AND QUALITY CONTROL OF RADIOPHARMACEUTICALS

COMPLETED: 90-06-12

TOTAL COST: \$75,505

OBJECTIVES:

TO PREPARE LYOPHILIZED KITS AND TO ASSESS THEIR RADIOCHEMICAL PURITY AND STABILITY.

ACHIEVEMENTS:

The project was a follow up of a project implemented in 1974-75 and provided the National Institute of Oncology and Radiobiology with the capability for the preparation and quality control of lyophilized radioisotope-labelled diagnostic kits. Kits are now available for gammagraphic studies of the brain, liver, spleen, lungs, bones, heart and kidneys, and they are being distributed to nuclear medicine centres throughout Cuba. The Agency supplied the necessary equipment which included an automatic gamma counter and a freeze drying unit, and financed an expert who provided advice mainly on the preparation of kits labelled with technetium-99m and with radioiodine, as well as on the various aspects of quality control. To contribute to greater utilization of nuclear diagnostic techniques, an expert was provided to lecture at a national course on the subject. Participants included nationals from Dominican Republic and Guatemala, whose Agency fellowships were partially funded by Cuba.

■ CUB/7/002

RADIOISOTOPES IN BIOLOGY

COMPLETED: 90-06-13

TOTAL COST: \$169,671

OBJECTIVES:

TO IMPROVE RADIOISOTOPE METHODS IN THE FACULTY OF BIOLOGY, AGRICULTURAL AND MEDICAL RESEARCH.

ACHIEVEMENTS:

A laboratory was established at the Faculty of Biology of the University of Havana for teaching and training on the utilization of radioisotopes in biochemical, agricultural and medical research. A post-graduate course was designed and this has been taught for over three years, while laboratory work using radioisotopes has been incorporated in the curricula of the biochemistry, biology and microbiology programmes. Several research studies have been carried out, including some as part of theses to comply with requirements for undergraduate and graduate degrees. To achieve these objectives, the Agency furnished equipment for the laboratory, as well as an expert to provide advice on installation and calibration of equipment for applications in biological sciences. Furthermore, three experts were financed to lecture at a post-graduate course that included theoretical aspects of tracer techniques

and applications in biochemical analysis, as well as several experiments. Three project funded fellowships (Austria, Mexico and UK) and two project-related ones (Venezuela and Italy) were granted, the last-mentioned being funded by the host country for training at the National Nutrition Institute, Rome.

■ CZE/1/002

STANDARDIZATION LABORATORY FOR IONIZING RADIATION

COMPLETED: 90-12-22

TOTAL COST: \$49,151

OBJECTIVES:

TO INCREASE THE ACCURACY OF RADIATION MEASUREMENTS AND TO IMPROVE SAFETY AS RELATED TO THE APPLICATION OF IONIZING RADIATION THROUGH THE ESTABLISHMENT OF A NATIONAL STANDARDIZATION LABORATORY

ACHIEVEMENTS:

The Institute for Research, Production and Application of Radioisotopes of the Czechoslovak Atomic Energy Commission, Prague, sought Agency Support to establish a national standardization laboratory for ionizing radiation metrology and calibration of radiation instruments. Under this project, approved from 1987, the Agency assisted in the upgrading of existing facilities by providing expert services to advise on project planning, and design and construction of a secondary standards dosimetry laboratory, as well as by purchasing a 320 kV constant potential X-ray machine for calibration purposes. Two scientific visits were approved for local staff. This project has significantly improved the accuracy of radiation dosimetry, including personnel dosimetry, thereby promoting safe application of ionizing radiation in Czechoslovakia.

■ CZE/9/002

OSART MISSION TO DUKOVANY NUCLEAR POWER PLANT

COMPLETED: 90-12-22

TOTAL COST: \$16,134

OBJECTIVES:

TO REVIEW THE OPERATIONAL SAFETY OF THE NUCLEAR POWER PLANT AT DUKOVANY, AS WELL AS THAT AT BOHUNICE.

ACHIEVEMENTS:

Under this Reserve Fund project, two OSART missions were sent to the Dukovany Nuclear Power Plant. The first mission, comprising 13 Agency experts visited the plant and reviewed operational safety practices during the period 3-22 September 1989. The second mission, an OSART follow-up, visited the plant from 12-15 November 1990 and reviewed the implementation of the recommendations and suggestions made by the earlier OSART. Under the same project, a separate safety mission comprising six Agency experts was sent to Bohunice-VI Nuclear Power Plant (units 1 and 2) from 3-7 September 1990. This mission documented the special safety measures already taken at the plant to improve the safe operation of these units. The safety measures concerned the conduct of operations, equipment upgrading, personnel qualification, and plant surveillance.

■ CZE/9/003

PRE-OSART AND OSART MISSION TO TEMELIN NUCLEAR POWER PLANT

COMPLETED: 90-12-22

TOTAL COST: \$9,477

OBJECTIVES:

TO PERFORM PRE-OSART, OSART AND FOLLOW-UP VISITS TO TEMELIN NUCLEAR POWER PLANT, UNITS 1 AND 2.

ACHIEVEMENTS: Under this project, funded by the Reserve Fund, thirteen Agency experts reviewed, over the period 23 April to 12 May 1990, activities and preparations for future plant operation at the construction site of Temelin Nuclear Power Plant (two units of 1000 MW(e)). The review covered project management, quality assurance, civil engineering, mechanical and electrical equipment, preparations for start-up and operation, and training and qualification of personnel, and included advice on the planning for radiation protection, radioactive waste management and emergency response. The Agency recommendations are being currently implemented. A follow-up visit may be requested for the end of 1991 by the authorities responsible.

■ **CZE/9/004**

SITE SAFETY REVIEW MISSION TO TEMELIN NUCLEAR POWER PLANT

COMPLETED: 90-12-22

TOTAL COST: \$16,916

OBJECTIVES: REVIEW THE SAFETY ASPECTS OF THE SITE OF TEMELIN NUCLEAR POWER PLANT, UNITS 1 AND 2.

ACHIEVEMENTS: At the request of the Czechoslovak Atomic Energy Commission, a Site Safety Review mission, comprising seven Agency experts, was sent under this Reserve Fund project to the site of Temelin Nuclear Power Plant for the period of 18-24 April 1990. The team reviewed the site from the geological, seismological, atmospheric dispersion, hydrological dispersion and man-induced events points of view. Specific recommendations were made and submitted to the Government for consideration.

■ **EGY/0/007**

MICROPROCESSOR APPLICATIONS IN NUCLEAR SCIENCE

COMPLETED: 90-03-02

TOTAL COST: \$58,388

OBJECTIVES: TO TRANSFER SKILL AND KNOWLEDGE IN THE USE OF MICROPROCESSOR TECHNOLOGY AS APPLIED TO NUCLEAR MEASUREMENTS AND CONTROL.

ACHIEVEMENTS: Under this project, a training programme for eight staff members of the Engineering and Scientific Instruments Department of the Nuclear Research Centre, Inshas, was conducted by internationally recruited experts on hardware and software interfacing. Transfer of skill and knowledge of interfacing needed for nuclear experiments was achieved. The group which received training acquired sufficient knowledge to tackle interfacing projects for other departments of the Nuclear Research Centre and even for industry. The group is also in a position to provide training to other staff members to bring them to the same level of knowledge, and at the same time to further improve their own experience in this field of applications.

■ **EGY/4/028**

UPGRADING OF RESEARCH REACTOR INSTRUMENTATION

COMPLETED: 90-01-08

TOTAL COST: \$145,300

OBJECTIVES: TO MODERNIZE VARIOUS SYSTEMS, INCLUDING MEASURING INSTRUMENTATION, OF THE INSHAS NUCLEAR RESEARCH REACTOR WITH A VIEW TO IMPROVING SAFETY.

ACHIEVEMENTS: This project was established in accordance with the recommendations of a RAPAT mission of 1985 and provided measuring instrumentation for the over 20 year old Inshas research reactor with a view to improving the safety of its operation. Three of the counterpart staff were provided with short fellowships for training by the supplier of the instrumentation. This project, together with a related project (EGY/9/015, which provided a new radiation monitoring system), has enabled the Nuclear Research Centre to continue to operate the reactor under improved and appropriate safety conditions.

■ **EGY/5/013**

ERADICATION OF MEDITERRANEAN FRUIT FLY (MISR-MED)

COMPLETED: 90-11-19 **TOTAL COST: \$4,740,496**

OBJECTIVES: TO ERADICATE THE MEDITERRANEAN FRUIT FLY FROM EGYPT USING THE STERILE INSECT TECHNIQUE IN AN INTEGRATED PROGRAMME WITH OTHER MEDFLY CONTROL TECHNOLOGIES.

ACHIEVEMENTS: Substantial extra-budgetary funding was provided by Austria, Italy and USSR for the start up of this project. However, owing to unforeseen circumstances, the project could not be implemented beyond its initial phase and it was cancelled at the Egyptian Government's request.

■ **EGY/9/015**

RADIATION MONITORING SYSTEM

COMPLETED: 90-01-08 **TOTAL COST: \$362,003**

OBJECTIVES: TO IMPROVE RADIATION SAFETY AT THE (INSHAS) REACTOR THROUGH A NEW RADIATION MONITORING SYSTEM.

ACHIEVEMENTS: This project was established in accordance with the recommendations of a RAPAT mission of 1985 and provided a new radiation monitoring system for the over 20 year old Inshas research reactor. The head of the reactor department of the Nuclear Research Centre was awarded a scientific visit to the supplier of the equipment to become acquainted with the new system. This project together with a related project (EGY/4/028, which provided a new instrumentation system for the reactor), has enabled the Centre to operate the reactor under improved and appropriate safety conditions.

■ **EGY/9/017**

ENVIRONMENTAL RADIOACTIVITY SURVEY

COMPLETED: 90-09-18 **TOTAL COST: \$161,618**

OBJECTIVES: TO IMPROVE ENVIRONMENTAL MONITORING AROUND THE RESEARCH REACTOR IN INSHAS BY SETTING UP NEW FACILITIES FOR MONITORING AND DEVELOPING LOCAL TECHNICAL SKILLS.

ACHIEVEMENTS: The Atomic Energy Research Establishment sought Agency assistance with the environmental radioactivity monitoring programme related to research reactor operation at the Nuclear Research Centre, Inshas. Equipment comprising, inter alia, low-level beta counting, gamma spectrometry and continuous air monitoring systems, were provided, while the Centre set up a meteorological tower for measurements. Three experts in four missions advised on aerosol monitoring, gamma spectrometry and analysis of environmental samples. Some US\$41,000 were made available for expert services as an extra-

budgetary contribution of the Federal Republic of Germany. The combination of on-the-job training and equipment resulted in the start-up of an environmental radioactivity monitoring programme during the course of the project. The knowledge gained is being applied to undertaking an environmental survey in relation to a site being considered for a possible nuclear power plant (supported under project EGY/9/023).

■ **ETH/9/004**

RADIATION PROTECTION

COMPLETED: 90-03-20

TOTAL COST: \$122,483

OBJECTIVES:

TO CREATE A NATIONAL CENTRE FOR RADIATION PROTECTION IN ETHIOPIA.

ACHIEVEMENTS:

Following the recommendations of an Agency expert in 1983, the Institute of Pathobiology of the University of Addis Ababa was assisted in upgrading the monitoring and personnel dosimetry services offered by its Radiation Protection Service and Radiation Control Department, the only source of such services available in Ethiopia. In 1984, a thermoluminescence dosimetry (TLD) system for personnel dosimetry was provided to supplement local use of film badges. By 1989, some 500 radiation workers were being monitored on a regular but voluntary basis, as there is, as yet, no radiation protection legislation in force in the country. In 1987, a gamma spectrometer with a germanium detector was provided for measuring environmental and food samples for radioactive contamination. Agency experts provided training in TLD techniques, in calibration and operation of the equipment and in inspection of X-ray facilities. In addition to a scientific visit, one project-funded and six project-related fellowships were granted for training abroad, one for attending the Agency's radiation protection training course in Vienna in 1986. Prepared with Agency assistance, a draft proclamation concerned with radiation protection is now awaiting enactment by the Council of Ministers. A second phase of this project, to develop environmental monitoring and a calibration laboratory is being supported under project ETH/9/005.

■ **GHA/5/008**

NUCLEAR AGRICULTURE CENTRE

COMPLETED: 90-05-29

TOTAL COST: \$451,544

OBJECTIVES:

TO APPLY NUCLEAR TECHNIQUES IN AGRICULTURAL RESEARCH RELATED TO FOOD PRESERVATION, PLANT BREEDING, IRRIGATION PRACTICES AND EFFICIENT FERTILIZER USE.

ACHIEVEMENTS:

Under this project, the Agency assisted the National Nuclear Research Institute in Ghana in creating a Nuclear Agricultural Centre for carrying out multidisciplinary research in agriculture using nuclear techniques in the field of soils science, fertilizer use, mutation breeding and food irradiation. Ten experts undertook 15 assignments to advise on establishing the programmes; 17 fellowships for training abroad, some funded extrabudgetarily by Canada, Denmark, India, Italy, Sweden and USA, as well as 5 scientific visits were awarded to train local staff to carry out the programmes. Equipment to study soil/water/fertilizer/plant relationships, to undertake mutation breeding using in-vitro tissue-culture techniques, and to investigate pilot-scale disinfestation using a cobalt-60 irradiator was provided. As a result of this assistance, the Centre, in collaboration with the University of Ghana, made studies of soil moisture characteristics of different major soil types. Nitrogen fixation of field-

grown cowpeas, groundnut and beans is being assessed. Mutants of cassava and yam have been obtained and are being tested. Studies on food contamination and packaging materials are under way in preparation for pilot-scale studies with a gamma irradiator, expected to be installed in 1991. The project hosted an Agency regional training course on biological nitrogen fixation in 1988.

■ GUA/2/002

NUCLEAR ANALYTICAL LABORATORY

COMPLETED: 90-06-22

TOTAL COST: \$73,318

OBJECTIVES:

TO STRENGTHEN THE CAPABILITY OF THE EXISTING NUCLEAR ANALYTICAL LABORATORY FOR THE DETERMINATION OF RADIOACTIVE CONTAMINATION IN FOODSTUFFS.

ACHIEVEMENTS:

The General Directorate of Nuclear Energy (DGEN) received assistance to upgrade the analytical services it provides to the public and private sectors. They include qualitative chemical analyses of a variety of samples (using, among other methods, X-ray fluorescence analysis introduced in an earlier project), and quality certifications of imported and exported foodstuffs from the radiosanitary viewpoint. The Agency provided a low-level alpha/beta counter and ancillary equipment. Expert advice was provided on low-level alpha/beta counting to introduce the technique, which, included collection and preparation of samples, and evaluation of results. Lectures were given on calibration procedures and processing of radioactive calibration solutions. To complete the establishment of the laboratory, a continuation project GUA/2/003 was approved.

■ GUA/5/005

RADIOISOTOPES IN AGRICULTURE

COMPLETED: 90-06-20

TOTAL COST: \$232,076

OBJECTIVES:

TO INCREASE CROP YIELDS THROUGH RADIATION MUTATION BREEDING, IMPROVED FERTILIZER MANAGEMENT AND PRESERVATION OF AGRICULTURAL PRODUCTS.

ACHIEVEMENTS:

The project contributed to the establishment of the section of radiation and radioisotopes in agriculture at the General Directorate of Nuclear Energy. The Agency provided various items of analytical equipment including an automatic liquid scintillation counter, an amino-acid analyser, a UV/visible light spectrophotometer and a nitrogen-15 analytical system, as well as ancillary equipment and nitrogen-15 labelled fertilizer for field experiments. The seven expert visits covered support for mutation plant breeding, nitrogen-15 uptake analysis, soil/water/plant relationships, and irradiation preservation of food, and included on-the-job training, while further training was given through one project-funded and two project-related fellowships. A study of nitrogen fertilizer uptake by ten varieties of common bean was supported by an Agency Research Contract. Experiments were set up to establish the bases that will allow determination of the availability of nitrogen, phosphorus and sulphur from different fertilizers. Experiments were also conducted on the symbiotic fixation of nitrogen in five varieties of leaves. Furthermore, the methodology to obtain genetic improvements in cereals and legumes was developed, while optimal irradiation doses were determined to inhibit potato sprouting and to delay ripening of fruit. This work was undertaken in collaboration with the School of Agronomy of the National University of Guatemala and the Nutri-

tional Institute for Central America and Panama (INIAP). The studies are being continued and extended, the Agency providing expert support under project GUA/5/009 in 1991-92.

■ GUA/6/006

PREPARATION AND CONTROL OF RADIOPHARMACEUTICALS

COMPLETED: 90-06-25

TOTAL COST: \$137,030

OBJECTIVES:

TO ESTABLISH FACILITIES FOR THE PREPARATION AND CONTROL OF RADIOPHARMACEUTICALS TO BE USED IN THE COUNTRY'S MAJOR STATE HOSPITALS WITH A VIEW TO REDUCING PRODUCTION AND CONTROL COSTS.

ACHIEVEMENTS:

As a result of the project, a radiopharmacy laboratory was established at the San Juan de Dios General Hospital, the largest in Guatemala. The Agency supplied the equipment to establish the laboratory and experts advised on laboratory design and gave training on preparation and quality control of radiopharmaceuticals and kits. In addition, fellowships were granted for training at specialized centres in Brazil and Chile. By 1990, the laboratory was already producing ten different kits of lyophilized radiopharmaceuticals labelled with technetium-99m, which has resulted in a considerable reduction in the costs of such diagnostic kits, as only the basic ingredients are now being imported. Furthermore, lyophilized kits have been distributed free of charge to the main nuclear medicine centres in Central America, and several papers have been published.

■ GUA/6/007

NUCLEAR MEDICINE LABORATORY

COMPLETED: 90-06-13

TOTAL COST: \$58,796

OBJECTIVES:

TO ESTABLISH A PILOT NUCLEAR MEDICINE CENTRE FOR DIAGNOSTIC PROCEDURES.

ACHIEVEMENTS:

The project has contributed significantly to nuclear medicine diagnostics in Guatemala by assisting in the establishment of a centre for diagnostic procedures at the San Juan de Dios Hospital. In the in-vivo laboratory, production of some of the reagents necessary for radioimmunoassay (RIA) of thyroid hormones was started, an internal quality control programme for RIA was implemented, and an interlaboratory RIA quality control programme was organized. In the area of in-vivo nuclear medicine, the staff undertook clinical studies using an upgraded gamma camera, and the laboratory is now working in the difficult fields of human pathology such as pulmonary thromboembolism, brain lesions, and liver and thyroid diseases. Local production of freeze-dried pharmaceuticals (cold compounds) financed by the Agency under other projects has contributed to these studies. The Agency provided two experts on RIA, one who furnished advice on all aspects of the subject and included a course for the counterpart staff, and a second who dealt with advanced aspects, including the production of labelled material and first anti-T3 and anti-T4 antibodies, as well as with the introduction of solid-phase RIA using coated-tube technology. Furthermore, the latter expert assisted in the organization and implementation of a practical course in RIA for the San Juan de Dios and Roosevelt hospitals. Equipment was supplied for the in-vitro laboratory, including a gamma counter, and for the in-vivo laboratory

whereby the gamma camera was adapted to undertake clinical studies. A one-year fellowship was granted to train a physician in the field of dynamic organ studies.

■ HUN/4/006

REACTOR MODERNIZATION

COMPLETED: 90-12-22

TOTAL COST: \$3,336,721

OBJECTIVES:

TO ASSIST IN MODERNIZATION AND UPGRADING TO 20 MW OF A RESEARCH REACTOR.

ACHIEVEMENTS:

Agency assistance was sought under this multi-year project by the Central Research Institute for Physics, Budapest, to up-grade Hungary's only research reactor. Operating since 1959 at 2.5 MW, it was upgraded to 5 MW in 1967 to meet demands for short-lived isotopes. Modernization and upgrading was again needed from 1985 to extend its life for a further 20-25 years, while meeting current operational and safety standards. Power was, at the same time, to be increased to 20 MW. The equipment supplied by the Agency included a complete research reactor auxiliary system, as well as reactor pumps, hot cell manipulators, seismic instrumentation and reactor monitoring equipment. Three scientific visits and one fellowship were also granted. The Agency also assisted the Institute in the preparation and review of the Safety Analysis Report required for re-licensing of the reactor. The up-graded reactor has increased the local capacity for isotope production and physics research. In addition to the counterpart institute, scientists from some twenty different institutes have benefited from the reactor modernization.

■ HUN/8/006

FOOD IRRADIATION TECHNOLOGY

COMPLETED: 90-12-22

TOTAL COST: \$436,724

OBJECTIVES:

TO EXTEND A PILOT FOOD IRRADIATION FACILITY SO THAT LARGE-SCALE EXPERIMENTS CAN BE PERFORMED WHOSE RESULTS WILL BE APPLICABLE TO COMMERCIAL OPERATIONS.

ACHIEVEMENTS:

The AGROSTER Joint Irradiation Development Company, Budapest, sought Agency assistance in 1985 to upgrade its pilot-scale cobalt-60 irradiation facilities in order that it could enlarge the scope of its experiments in food irradiation technology. A 200 kCi cobalt-60 source was provided. Furthermore, a project-related scientific visit was granted enabling a staff member to attend scientific meetings in Canada and the USA on radiation processing and food technology to obtain state-of-the-art information. All objectives of the project were achieved, and AGROSTER can now demonstrate various aspects of food irradiation technology on an industrial scale.

■ INS/0/004

NUCLEAR MATERIALS ACCOUNTING

COMPLETED: 90-12-20

TOTAL COST: \$87,664

OBJECTIVES:

TO DEVELOP AN EFFECTIVE NUCLEAR MATERIALS CONTROL AND VERIFICATION PROGRAMME.

ACHIEVEMENTS: In view of the expanded nuclear programme in Indonesia under which a 30 MW(th) multi-purpose research reactor and a fuel fabrication facility were established at a new research complex at Serpong, there was an urgent need to establish a nuclear materials control and verification programme in the country. Under this project, supported by extra-budgetary funds from USA, the Agency provided some basic equipment such as a radiation detector, a shielded gamma assay monitor, two portable multi-channel analysers, a personal computer, certified reference materials, and standards. Two Agency experts advised on a state system of accounting and control relevant to the research reactor and the fuel fabrication facility, and trained the counterpart staff on the utilization of the equipment for non-destructive assay that will be used to establish a quality measurement system. Two counterpart staff were also trained abroad under project-related fellowships. The project is considered to have contributed significantly to the establishment of the State System of Accounting for and Control of Nuclear Materials, an important feature of the national nuclear safeguards system.

■ **INS/1/017**

NUCLEAR ANALYTICAL TECHNIQUES

COMPLETED: 90-12-20 **TOTAL COST: \$6,116**

OBJECTIVES: TO PROVIDE TRAINING IN GAMMA-RAY SPECTROMETRY FOR RESEARCH USING REACTOR NEUTRONS.

ACHIEVEMENTS: The National Atomic Energy Agency (BATAN) sought Agency assistance to provide training and to initiate some research activities in the field of prompt-gamma neutron activation analysis using the research reactor at Bandung, so that the trained manpower could in due course establish a comprehensive neutron activation analysis programme at Serpong after the 30 MW(th) multi-purpose research reactor had become operational. An Agency expert provided guidance and training to the counterparts at the Research Centre for Nuclear Techniques, Bandung, which is being utilized for developing a comprehensive programme of work for Serpong.

■ **INS/3/008**

URANIUM EXPLORATION

COMPLETED: 90-12-22 **TOTAL COST: \$310,762**

OBJECTIVES: TO STRENGTHEN THE GEOPHYSICAL EXPLORATION CAPABILITY IN URANIUM PROSPECTION

ACHIEVEMENTS: As part of Indonesia's expanding nuclear programme, the National Atomic Energy Agency (BATAN) had prospected with the aim of assessing the suitability of domestic uranium deposits for exploitation. Under this multi-year project initiated in 1982, Agency assistance covered a wide range of activities in uranium exploration and development. A total of eleven different experts provided guidance and training to the staff at the Nuclear Minerals Development Centre, Jakarta, covering the following activities: exploration strategy and planning; geological, structural and mineralogical evaluation of the Kalan area of Western Kalimantan; exploration tunnelling in the Kalan project; assessment of the sandstone-type of uranium deposit in Northern Sumatra; borehole logging; ore reserve estimation; automatic data processing; assessment of the uranium potential in volcanic rocks; and mass spectrometry. Five counterpart staff were sent abroad for specialized training under project-funded or project-related fellowships; two scientific visits were granted. A

range of equipment, including a gamma logging unit, a fluorimeter, an induced polarization system, a proton magnetometer, an isodynamic magnetic separator, and a microcomputer system, were supplied in order to upgrade the existing analytical, ore processing and mineralogical laboratories. The studies were also supported through an Agency Research Contract. Through the project, the expertise of the technical staff has been effectively upgraded, and it has prepared them to go beyond the introductory stage initiated by the project. Some favourable uranium ore deposits have been identified at the Edo-Remaja prospect in Western Kalimantan, and it is estimated that the reserve is sufficient to supply the domestic needs for yellow cake (uranium concentrate) for the nuclear power reactors planned for early in the twenty-first century. There are still a number of stages that remain to be dealt with, such as experimental mining and feasibility studies. These activities are being pursued under another project (INS/3/009) funded extrabudgetarily by France.

■ **INS/4/018**

REACTOR PHYSICS

COMPLETED: **90-12-20**

TOTAL COST: **\$256,731**

OBJECTIVES:

TO TRAIN LOCAL STAFF IN THE ANALYSIS OF RESEARCH REACTOR PERFORMANCE AND ITS ENGINEERING SAFETY SYSTEM.

ACHIEVEMENTS:

In view of the expanded nuclear programme in Indonesia under which a new research complex was being set up at Serpong, comprising inter alia a 30 MW(th) multi-purpose research reactor and a fuel fabrication facility, the Research Centre for Nuclear Techniques in Bandung initiated a comprehensive programme for manpower development in reactor physics investigations centring on the analysis of research reactor performance. Under this multi-year project first initiated in 1982, the Agency had been supporting the above activities under the regular Technical Co-operation Programme. The topics to be covered included reactor kinetics, modelling and design of fuel assemblies, thermohydraulic aspects of reactor safety, and operation of a thermohydraulic test loop. The project component relating to numerical reactor calculations was approved in 1986 with footnote-a status and was subsequently made operational through an extrabudgetary contribution from the Federal Republic of Germany. (some 50% of the funds disbursed). Eight Agency experts made 13 missions and provided advice and practical training to counterpart staff. Some equipment, including a computer system with calculational software and reactor physics data, fission chambers and a flowmeter were supplied. Three counterpart staff were also trained abroad under Agency fellowships funded by the USA. The counterparts have developed expertise in reactor kinetics, reactor noise and burn-up calculations, fabrication of fuel elements on a laboratory scale, and operation of the thermohydraulic test loop. The project has contributed significantly to manpower development in support of commissioning and initial operation of the research reactor at Serpong. Further development is being continued under project INS/4/023, approved from 1989.

■ **INS/4/021**

RESEARCH REACTOR COMMISSIONING

COMPLETED: **90-12-20**

TOTAL COST: **\$75,664**

OBJECTIVES:

TO EVALUATE PLANS FOR COMMISSIONING THE REACTOR AND ITS INTEGRATED FACILITIES, AND TO PLAN AND EXECUTE CORE PHYSICS MEASUREMENTS DURING AND AFTER COMMISSIONING.

ACHIEVEMENTS: The National Atomic Energy Agency (BATAN) built a 30 MW(th) multi-purpose research reactor at the new research centre at Serpong. In addition to capabilities normally found in multi-purpose research reactors, this reactor has the capability to test reactor fuels and materials. The reactor attained initial criticality in July 1987. The reactor commissioning, core physics measurements and commissioning of the integrated facilities were the responsibility of BATAN. In order to assist BATAN, four Agency experts undertook seven missions during 1987-89 and worked with the local staff and the reactor supplier on a programme of power ascension and core physics measurements for a total period of 8.5 months. As a result, BATAN has now a documented record of these studies and a written evaluation of the results, enabling an assessment to be made of whether the reactor has attained the specified performance levels, and permitting detailed plans to be made for the future operation of the reactor. The reactor is now in the final stage of power ascension. The Agency support initiated under this project is being continued under project INS/4/023.

■ **INS/8/014**

INDUSTRIAL BIOMASS CONVERSION

COMPLETED: 90-12-22 **TOTAL COST: \$112,713**

OBJECTIVES: TO ESTABLISH TECHNIQUES OF ENZYME AND MICROBIAL CELL IMMOBILIZATION BY MEANS OF IRRADIATION FOR BIOCHEMICAL AND BIOENGINEERING APPLICATIONS.

ACHIEVEMENTS: The Centre for the Application of Isotopes and Radiation, Jakarta, is investigating the use of radiation technology for biomass conversion of raw cellulose materials. It is considered that radiation-induced immobilization techniques would enable production costs associated with the fermentation of biomass to be reduced. The Centre had established technical co-operation with the Takasaki Radiation Chemistry Research Establishment of Japan in this respect. Under this multi-year project originally approved in 1986, the Agency was requested to provide equipment and expert services in developing techniques for the application of radiation technology for biomedical applications. Six Agency experts advised on radiation technology, biomass conversion and radiation immobilization. Some equipment including a glucose analyser, a laboratory fermentor, an incubator and a UV/visible light spectrophotometer were also supplied. Two of the counterpart staff were granted project-related fellowships. Considerable progress has been made on the immobilization of enzymes and in converting cellulosic and protein wastes into economically interesting chemicals (e.g. glucose and amino acids), and on a pharmaceutical production system. Radiation grafting of polymers to produce artificial hydrogel dressings and slow release drugs has already been realized and the new technology has been transferred to industry for the production of wound and burn dressings using radiation technology. The work pursued under the project has resulted in seven scientific publications to date, and is being continued under project INS/8/017 approved for the 1991-92 programme.

■ **INS/9/006**

RADIOACTIVE WASTE MANAGEMENT

COMPLETED: 90-12-27 **TOTAL COST: \$211,010**

OBJECTIVES: TO IMPROVE RADIOACTIVE WASTE DISPOSAL SYSTEMS AT BATAN RESEARCH CENTRES IN YOGYAKARTA AND BANDUNG.

ACHIEVEMENTS:

The Yogyakarta Nuclear Research Centre and the Centre for Nuclear Techniques, Bandung, each operate a research reactor and use radioisotopes. It was believed timely to invite Agency experts to review the radioactive waste disposal systems at both facilities and to augment the existing systems after receiving the experts' recommendations. Under this multi-year project initiated in 1984, a number of items of equipment, including a high pressure/high temperature liquid chromatography system, a differential thermal analysis system and a low-level alpha/beta counter, were supplied to support testing and monitoring, as well as operating the radioactive waste handling, treatment, conditioning and storage facilities. Six Agency experts provided advice on five major activities, which included waste management planning, review of waste management operations, waste handling and treatment technologies, and waste treatment and storage requirements for various types of radioactive waste. Two project-related fellowships were granted that provided selected staff with a chance to obtain practical experience of current practice abroad in the management of these wastes. The project met the objectives, and provided assistance to the Indonesian Government to improve the safety and determine the environmental impacts of radioactive waste management facilities in the country.

■ **INT/0/049**

INIS GROUP TRAINING

OBJECTIVES:

COMPLETED: **90-08-01**

TOTAL COST: **\$13,975**

TO TRAIN PROFESSIONALS IN THE FIELD OF NUCLEAR INFORMATION BY DEVELOPING THEIR SKILLS FOR INIS INPUT PROCEDURES AND THE USE OF INIS OUTPUTS.

ACHIEVEMENTS:

Seven experts provided training for 16 participants from 16 developing countries in the period 18 September to 3 November 1989. Attendance of trainees was funded from the Agency's fellowship programme, while lectures were charged through this project to the Reserve Fund. Based on both the reports of the trainers and trainees, the group training achieved its objectives, and it is expected that there will be improved use made of nuclear information provided through INIS and a better standard of data input for INIS received from the participating countries. Consideration will be given to continuing such training for the benefit of other developing Member States of the IAEA.

■ **INT/1/043**

INTERNATIONAL CONFERENCE ON NEUTRON PHYSICS

OBJECTIVES:

COMPLETED: **90-07-24**

TOTAL COST: **\$55,868**

TO FINANCE PARTICIPATION OF SCIENTISTS FROM DEVELOPING COUNTRIES IN THE "INTERNATIONAL CONFERENCE ON NEUTRON PHYSICS" (KIEV, USSR, 21-25 SEPTEMBER 1987) AND THEIR VISITS TO LOCAL INSTITUTES.

ACHIEVEMENTS:

Thirteen scientists from 10 developing countries were enabled to attend the International Conference on Neutron Physics and to undertake a subsequent study tour to several nuclear research institutes in the USSR (28 September to 2 October 1987).

■ INT/9/066**SEISMIC DATA FOR NUCLEAR POWER PLANT SITING**

COMPLETED: 90-11-30

TOTAL COST: \$224,767

OBJECTIVES:

TO COLLECT AND REVIEW "PRE-INSTRUMENTAL" INFORMATION ON EARTHQUAKES AND TECTONIC INSTABILITIES TO BE USED IN POWER PLANT SITING AND DESIGN.

ACHIEVEMENTS:

Instrumental data on seismic activity and tectonic instability may go back 40 years, but this time scale is not adequate when seeking design safety for nuclear power plants. This project, undertaken in co-operation with UNESCO, sought to collect, review and collate "pre-instrumental" data for the Mediterranean Basin. The project provided a forum for the participating Member States to exchange information. The interest of the States was such that the project has been transformed into an Agency Co-ordinated Research Programme (CRP) from 1990 (Seismic data for the siting and site revalidation of nuclear facilities). The participating Member States were France, Italy, Morocco, Portugal, Spain, Syria, Tunisia and Turkey. Each Member State developed an internally financed project to initiate or extend a catalogue of historical earthquakes for regions where the siting of a nuclear installation is planned. By the end of the project each Member State had compiled a catalogue of information gathered. Exchange of information and know-how was provided through annual coordination meetings and workshops. Italy, Portugal and Spain have already hosted workshops and printed the proceedings. Turkey is hosting the next meeting and workshop, which will be held under the new CRP. An Agency report (TECDOC-434) was published to guide the Member States in the procedures and methodology for the compilation of historical earthquake data.

■ IVC/5/012**OPTIMIZATION OF CULTIVATION METHODS FOR UPLAND RICE**

COMPLETED: 90-11-19

TOTAL COST: \$129,595

OBJECTIVES:

TO INITIATE SOIL-WATER STUDIES WITH A VIEW TO IMPROVING THE PRODUCTIVITY OF RICE.

ACHIEVEMENTS:

The Savannah Institute (IDESSA) at Bouaké requested Agency assistance for its studies to improve rice yields. Since 1983, equipment provided included a neutron-moisture meter, tensiometers, a Kjeldahl apparatus for nitrogen-15 fertilizer studies, and various agricultural and meteorological accessories. Agency experts assisted the local team with soil-water studies, work on efficiency of water use, and mineral nutrition of tropical cereals. The results of these studies, which have also yielded data on new varieties of rice and drought tolerance, have been used to define improved cultivation techniques and water management practices that are now being applied in the Bouake region. One of the IDESSA staff was given six months of training abroad.

■ IVC/5/019**NITROGEN AND CARBON UPTAKE OF PINEAPPLES**

COMPLETED: 90-05-29

TOTAL COST: \$6,826

OBJECTIVES:

TO DEVELOP METHODS FOR INCREASING PINEAPPLE PRODUCTION THROUGH INVESTIGATIONS ON THE EFFECT OF NEMATODES ON NITROGEN AND CARBON UPTAKE.

ACHIEVEMENTS: The Institute for Research on Citrus and Other Fruits, Abidjan, has been engaged in research to improve the yield and quality of pineapple, an important export crop. The Agency was asked to support an isotope-aided study concerned with the effect of nematode parasitosis with the aim of reducing nematocide and fertilizer use. An Agency expert helped to plan the experiments. Results obtained have helped to elucidate the physiological effects on pineapple of nematode attack and, hence, to define cultivation parameters that optimize production.

■ **KEN/5/011**

ANIMAL REPRODUCTIVE BEHAVIOUR STUDIES

COMPLETED: 90-09-10

TOTAL COST: \$195,307

OBJECTIVES: TO IMPROVE THE FERTILITY OF DAIRY CATTLE, SHEEP AND GOATS.

ACHIEVEMENTS: The project was initiated by the Government of Kenya in answer to the need to find a solution to the problem of low productivity in Kenyan livestock, especially dairy cattle, sheep and goats. The longer-term aim was for Kenya, a net importer of dairy products to become self-sufficient. The work plan detailed by Agency experts and staff enabled scientists of the Animal Physiology Department, the Reproductive Biology Unit and the Veterinary Research Department of the University of Nairobi to work out a protocol for the examination of hormones and metabolites in animals infected with trypanosomiasis and other diseases, and to define appropriate management strategies. A total of ten Agency experts visited the project since its inception in 1985 to advise on radioimmunoassay (RIA) and enzyme-linked immunosorbent assay (ELISA) techniques, disease diagnosis, assessment of reproductive efficiency and interaction between reproduction, nutrition and disease. Equipment provided included gamma spectrometer, an ELISA plate reader, a refrigerated centrifuge, and RIA and ELISA kits, chemicals and laboratory supplies. The work of the laboratory was also supported by the granting of four related Agency Research Contracts undertaken in the period 1986-90. The various studies referred to above are continuing in this well equipped laboratory.

■ **MAG/3/006**

ESTABLISHMENT OF RADIOACTIVE MINERAL RESOURCE INVENTORY

COMPLETED: 90-02-12

TOTAL COST: \$68,371

OBJECTIVES: TO DEVELOP A MINING DATA BANK FOR RADIOACTIVE MINERALS.

ACHIEVEMENTS: The National Military Office for Strategic Industries (OMNIS) sought assistance from the Agency to set up a computerized data bank for data obtained from years of exploratory surveys. A computer system was provided for establishing a mineral source inventory, and an Agency expert gave instruction on establishing a geological data bank. One of the two counterparts trained by the expert was awarded a fellowship in France for two months to complete the training in data base management. As a result of the project, the counterpart institute now has a fully automated data processing system which can be used for storage and retrieval of all information on radioactive minerals in Madagascar.

■ MAL/1/008**RESEARCH REACTOR UTILIZATION**

	COMPLETED: 90-12-19	TOTAL COST: \$50,970
OBJECTIVES:	TO DEVELOP A PROGRAMME FOR RESEARCH REACTOR UTILIZATION IN FUNDAMENTAL AND APPLIED RESEARCH USING THE REACTOR'S NEUTRON BEAM.	
ACHIEVEMENTS:	The 1 MW(th) TRIGA Mark II research reactor was commissioned in 1982. In order to have a balanced programme of utilization of the reactor, the Tun Ismail Atomic Research Centre decided to initiate neutron diffraction spectrometry and to construct a small-angle neutron scattering facility for basic and applied research in materials science, metallurgy, polymer chemistry and biology using one of the horizontal beam tubes of the reactor. Through Agency assistance in the form of six months of expert services, a Small Angle Neutron Scattering (SANS) facility was designed, including the engineering drawings and tendering specifications. The facility is under construction, nearly completed, with the main remaining item being a position-sensitive detector. One project-related fellowship for training abroad, and one scientific visit was granted. A computer system was provided for data analysis. The Government of Malaysia has given a great deal of support to this project, and the facility will additionally be used by a number of Malaysian universities.	

■ MAL/8/008**TRACERS IN HYDROLOGY**

	COMPLETED: 90-12-19	TOTAL COST: \$30,716
OBJECTIVES:	TO STUDY THE FEASIBILITY OF COMPLEMENTING NON-ISOTOPIC ANALYTICAL METHODS WITH ISOTOPE TECHNIQUES IN HYDROGEOLOGICAL STUDIES	
ACHIEVEMENTS:	The project was initiated in 1988 and aimed at improving the analytical capabilities of the Tun Ismail Atomic Research Centre in undertaking isotope analyses of water samples for hydrological studies. Experts provided guidance and on-the-job training for the planning and implementation of field investigations related to groundwater-resource assessment for selected major aquifer systems. The project also included an appraisal of different tracer techniques with a view to their use for hydrogeological assessment of toxic waste sites in Malaysia. Certain minor items of equipment were provided. Experts also assisted with the evaluation of isotope data and gave training in the use of the mass spectrometer provided by the Government. The Centre has now achieved a full analytical capability for isotope applications in hydrology, with a core of staff trained in such investigations. They are capable of undertaking future field investigations within the framework of national activities related to water resource assessment, development and management.	

■ MAL/8/011**RADIATION TECHNOLOGY**

	COMPLETED: 90-12-19	TOTAL COST: \$56,035
OBJECTIVES:	TO PROVIDE ANCILLARY LABORATORY FACILITIES FOR THE RADIATION PROCESSING FACILITY	

ACHIEVEMENTS: The Government sought the assistance of the Agency in setting up a process control and quality control laboratory for industrial radiation sterilization. The Government has invested in an industrial gamma irradiation facility, having an initial loading of 200 kCi of cobalt 60, later to be upgraded to 1000 kCi. The facility's main purpose is to provide irradiation services for locally manufactured medical products. In addition, the Government, through its Nuclear Energy Unit, intends to provide services in quality control of materials and to ensure operation in accordance with good radiation sterilization practice and with the international norms for sterilization services. The project has been designed to be complementary to the project MAL/8/004. The Agency provided a UV/visible light spectrophotometer and an aging oven, to be used for process control dosimetry, and for control of product quality and its suitability for irradiation treatment, especially as it concerns post-irradiation effects. One project-related fellowship was granted for training in the use of analytical techniques for quality control. Since the beginning of 1989, the Unit has been providing routine radiation sterilization services to local industry with appropriate process controls.

■ **MLI/3/005**

URANIUM EXPLORATION

COMPLETED: 90-12-13 **TOTAL COST: \$244,064**

OBJECTIVES: TO EVALUATE THE URANIUM POTENTIAL OF THE COUNTRY AND TO PROVIDE TRAINING.

ACHIEVEMENTS: For 1983, the National Directorate of Geology and Mines, Bamako, sought Agency assistance to provide, primarily, advanced on-the-job training for its staff in uranium exploration techniques and data management and evaluation. Later, during 1987, a Uranium Analytical Laboratory was established that was partly furnished with equipment, including a gamma spectrometer, a scintillometer and a fluorimeter, provided by the Agency. The local training in data compilation was provided by a long-term expert (15 months), while two others assessed uranium favourability and assisted in planning the analytical laboratory, respectively. Four fellowships for training abroad were granted to three of the staff, as was a scientific visit to a senior professional. The project has trained manpower for undertaking a comprehensive evaluation of the country's uranium potential. The assistance provided has permitted the Directorate to compile and organize all available geological and geochemical data on uranium favourability that were generated in past exploration activities, and has upgraded routine analysis of uranium and other mineral samples. A follow-on project (MLI/3/006) to provide and install a computer system suitable for operating a geological data bank was approved from 1991.

■ **MON/0/002**

APPLICATION OF NUCLEAR TECHNOLOGY

COMPLETED: 90-12-19 **TOTAL COST: \$538,232**

OBJECTIVES: TO INCREASE THE ANALYTICAL CAPABILITY OF THE NUCLEAR RESEARCH LABORATORY.

ACHIEVEMENTS: In 1979, the Mongolian Government sought Agency assistance to establish a central laboratory for nuclear techniques at the Nuclear Research Laboratory (NRL) of the Mongolian State University, Ulan Bator. The Agency provided an atomic absorption spectrometer and a complete X-ray fluorescence analy-

sis system, including a detector and associated electronics and a minicomputer system and software for data evaluation. In the course of the long-term project, eleven experts undertook missions to provide training in nuclear instrumentation and to assist in developing applications of nuclear analytical techniques. A project-related fellowship for training abroad was granted. The assistance provided has permitted NRL to provide a range of analytical services, including radioactive isotope and tube-excited X-ray fluorescence analysis, atomic absorption spectrometry, low-level counting, and neutron activation analysis using neutron sources and a neutron generator. As part of the project, a good nuclear electronics laboratory was established. The Agency provided various types of test instrument, and tools and components. Most of the problems in nuclear instrumentation maintenance can now be solved locally, and a number of instrument and interfacing development projects have been completed. This is particularly important in the relatively isolated situation of nuclear science studies in Mongolia. The project has introduced a new approach to nuclear science in the country. Previously, nuclear physics in Mongolia was characterized by the close connections to high-energy studies performed in co-operation with the research institutions of the USSR. The growth of the laboratories at the University prompted a greater use to be made of nuclear techniques to find solutions to practical problems with an impact on the national economy. Hence, the academic studies have received a new orientation. The analytical techniques are also being used for advanced training as well as being applied in routine work for external institutions, for example in analyses of local ores, food and food products and, more recently, in environmental studies.

■ MOR/0/002

NUCLEAR LEGISLATION AND REGULATORY ACTIVITIES

COMPLETED: 90-11-05

TOTAL COST: \$35,176

OBJECTIVES:

TO ESTABLISH AN EFFECTIVE REGULATORY ORGANIZATION IN CONNECTION WITH THE NUCLEAR POWER PROGRAMME AND THE COMMISSIONING OF A RESEARCH REACTOR.

ACHIEVEMENTS:

The Agency assisted the Directorate of Energy of the Ministry of Energy and Mines to establish a legislative framework for the control of the peaceful uses of atomic energy in Morocco and in drafting related legislation and regulations. Three Agency experts in eight missions covered general aspects, the drafting of nuclear legislation, establishment of nuclear material accounting and control, and radiation emergency response arrangements. Draft decrees on radiation protection, licensing and control of nuclear installations, radiation emergencies, safe transport of radioactive materials, civil liability and emergency preparedness were elaborated and submitted to the competent authorities for enactment. One of the counterpart staff was granted a fellowship for training abroad.

■ NER/8/003

RADIOISOTOPES IN HYDROLOGY

COMPLETED: 90-05-29

TOTAL COST: \$195,311

OBJECTIVES:

TO EVALUATE WATER RESOURCES AS PART OF THE DEVELOPMENT PLAN FOR FUTURE HUMAN SETTLEMENTS.

ACHIEVEMENTS: Through this long-term project, first approved from 1981, the Government sought Agency assistance to introduce isotope techniques to assess groundwater resources in selected areas of the country. Initially, interest focused on the Arlit-Agadez and Bilma regions, later on the Zinder region also. Between 1981 and 1989, five experts in eight missions advised on hydrological surveying, water sampling and interpretation of data, and setting up a carbon-14 laboratory (which has since been established), as well as providing on the job training. This training was supplemented by the grant of one project-related and three project-funded fellowships for training abroad. The Agency provided a range of analytical and measuring equipment, including an atomic absorption spectrometer, conductimetric equipment, and a bench as well as a portable spectrophotometer. The studies were also supported by an Agency Research Contract concerned with the origin of high nitrate concentrations in the groundwater of the Zinder region. The equipment and the training provided have permitted a better understanding of recharge, available storage and flow dynamics of aquifers in the various regions, difficult to obtain by conventional methods. Data have already been used to assess the situation regarding deep groundwater resources in the Arlit and Bilma regions, enabling the competent authorities to set up a national programme for exploitation and management of these resources as part of the development plan for future human settlements.

■ **NER/9/005**

RADIATION PROTECTION IN URANIUM MINING AND MILLING

COMPLETED: **90-11-05** TOTAL COST: **\$118,475**

OBJECTIVES: TO ESTABLISH A RADIATION PROTECTION INSPECTORATE, PARTICULARLY IN CONNECTION WITH THE MINING AND MILLING OF URANIUM.

ACHIEVEMENTS: The Government sought Agency assistance to establish a radiation protection inspectorate, with a particular interest in undertaking control measurements related to the safety of workers engaged in uranium mining and milling operations being carried out by foreign companies. The project planning was based on the recommendations of two expert missions (1978 and 1980), and it was approved from 1983. In addition to laboratory equipment, various kinds of sampling and monitoring equipment for use in the field were provided, with a particular emphasis on monitoring and radon and radon daughters. Agency experts advised on radon monitoring and evaluation of data and, later, on establishment of the inspectorate and on the elaboration of radiation protection legislation in connection with mining and milling operations. The legislation has been introduced, and it is being enforced by the inspectorate, which is now fully operational, providing monitoring services on a national scale. Three of the inspectorate's staff were given training abroad on project-related fellowships.

■ **NIR/5/012**

PREVENTING TSETSE FLY RE-INVASION WITH THE SIT

COMPLETED: **90-09-10** TOTAL COST: **\$987,159**

OBJECTIVES: TO DEVELOP AND APPLY THE STERILE-INSECT TECHNIQUE TO PREVENT TSETSE FLY RE- INVASION IN AREAS FROM WHICH THE PEST HAS BEEN ERADICATED.

ACHIEVEMENTS: Following an agreement between the Federal Government of Nigeria and the Agency, the project 'Biological control of tsetse by the sterile insect technique' (BICOT) was initiated in 1979 as project NIR/5/011 with extra-budgetary contributions from Belgium, Federal Republic of Germany, Sweden and United Kingdom. By 1986, most of the target area of 1500 km² has been cleared of the main species of tsetse, *Glossina palpalis palpalis*. In 1983, additional assistance was provided by the Government of Italy at the start of this present project to develop techniques for preventing re-invasion by flies of areas cleared during the first eradication campaign. Thus the main activity undertaken through the continuation project was to intensify mass rearing of flies, to release sterile males at the periphery of the original target area, to place insecticide-treated screens at various vantage points, and to increase surveillance within the project area. These activities were successfully carried out, enabling the first phase of the project to be completed in 1987. Over 15 project personnel were trained locally and a senior staff member benefited from the Agency's fellowship training programme. Of the total funded, some 60% were disbursed for experts' services. Above all, a thriving colony of the target species was established at the project headquarters in Vom. Experimental rearing of a second species was also initiated. These achievements laid the foundation for the further continuation project aimed at expanding the tsetse eradication programme to cover an additional 12,000 km² of agricultural and grazing land (NIR/5/021).

■ **NIR/6/003**

NUCLEAR MEDICINE

COMPLETED: 90-09-10

TOTAL COST: \$42,413

OBJECTIVES:

TO MODERNIZE AND UPGRADE THE FACILITIES FOR WORKING WITH RADIONUCLIDES.

ACHIEVEMENTS:

When the Government of Nigeria requested Agency assistance for 1985 to upgrade facilities at the College of Medicine, University of Ibadan, the country's leading university teaching hospital, the purpose was to improve an existing facility through the supply of modern equipment and training in up-to-date techniques. The laboratory was equipped with an automatic beta/gamma scintillation counter, a refrigerated centrifuge and a desk-top computer system. Three counterpart staff received fellowship training, including a senior technician who is currently responsible for the maintenance and repair of all nuclear/electronic equipment. The expert assignments were carried out by Agency staff, who reviewed the original project request and were thus able to ensure that activities outlined in the plan of action were satisfactorily accomplished. The objectives of the project were additionally supported through project NIR/6/005, funded extrabudgetarily by the United States of America. The Radioisotope Laboratory of the College of Medicine is now able to undertake a range of investigations with radionuclides, and it is expected that it will eventually develop into a major referral centre for radionuclide diagnosis in Nigeria.

■ **PAK/0/004**

NATIONAL WORKSHOP FOR EVALUATION OF PROJECTS

COMPLETED: 90-12-20

TOTAL COST: \$7,603

OBJECTIVES:

TO EVALUATE AGENCY SUPPORTED TECHNICAL ASSISTANCE PROJECTS IN PAKISTAN

ACHIEVEMENTS: Under this project, funded from the Reserve Fund, three Agency staff members successfully conducted a national workshop on the management and evaluation of technical co-operation projects in Pakistan. The workshop was held from 4-8 March 1990 at the Institute of Nuclear Medicine and Oncology, Lahore, and was attended by 34 participants from different institutes under the Pakistan Atomic Energy Commission. The workshop concentrated on discussions of the Agency procedures and techniques in the management and evaluation of projects and on how these are implemented in Pakistan. The lessons learnt from the workshop are expected to contribute to the improvement in the quality of project requests and their implementation in the counterpart institutions in Pakistan.

■ **PAK/1/020**

DEVELOPMENT OF TRACK DOSIMETERS

COMPLETED: **90-12-22** TOTAL COST: **\$104,887**

OBJECTIVES: TO DEVELOP SOLID STATE NUCLEAR TRACK DOSIMETERS FOR PERSONAL DOSIMETRY, ENVIRONMENTAL DOSIMETRY AND FOR URANIUM EXPLORATION.

ACHIEVEMENTS: The Solid-State Nuclear Track Dosimetry Laboratory of the Pakistan Institute of Nuclear Science and Technology (PINSTECH), Islamabad, has designed and manufactured nuclear track detectors and designed radon/thoron personnel dosimeters, the work being given support under an Agency Research Contract. A large number of such detectors are required for personnel dosimetry in uranium exploration and mining, and also for radon/thoron monitoring in uraniumiferous areas. The Agency was requested to assist in developing a capability for the mass production of such dosimeters. Under this multi-year project initiated in 1984, the Agency supplied some equipment, including an optical microscope, a low-level alpha-beta counting system, an annealing furnace, and a desk top computer. An Agency expert advised on the large-scale production of CR-39 detectors and on their use in dosimetry. With the technical assistance provided under the project, the counterpart institute has developed the capability to successfully fabricate thin-layer CR-39 polycarbonate foil nuclear track detectors on a large scale. They are now being extensively used in radon/thoron measurements for personnel and environmental dosimetry and in large scale geological applications in Pakistan, thus reducing the country's dependence on foreign suppliers.

■ **PAK/4/017**

QUALITY ASSURANCE

COMPLETED: **90-12-20** TOTAL COST: **\$94,870**

OBJECTIVES: TO ORGANIZE A COMPREHENSIVE IN-SERVICE INSPECTION OF SELECTED SYSTEM PRESSURE AND NUCLEAR REACTOR COMPONENTS; TO ESTABLISH A FULLY EQUIPPED NON-DESTRUCTIVE EXAMINATION LABORATORY.

ACHIEVEMENTS: The Pakistan Atomic Energy Commission (PAEC) has established a Directorate of Scientific and Industrial Services in Islamabad, in charge of its quality assurance (QA) programme in support of the nuclear power programme. Inspection facilities of a high standard are required, so that all components are properly tested before use and meet the Agency's quality assurance criteria for nuclear power plants. The aim of this multi-year project, first approved under the regular programme for 1978, was to establish a laboratory with

standard equipment for the practical training of engineers and technicians in QA practices. The Agency provided some equipment, such as a helium leak detector, an X-ray tube head, an ultrasonic flow detector, an acoustic ranger and an ultrasonic thickness gauge, together with expert services on QA programmes for nuclear power plants and on training in non-destructive testing (NDT) techniques. A national training course on quality assurance for mechanical equipment was also held in January/February 1990 in which five Agency experts provided lectures on different aspects of QA. There were 36 participants, 11 from PAEC and 25 from leading national industries, both in the private and public sectors. In addition, four counterpart staff were trained abroad under project-related fellowships. The assistance provided through the project has contributed to the establishment of the non-destructive examination laboratory and of the quality assurance programme for nuclear power projects. The local counterparts have provided training on QA and NDT to more than 150 engineers and technicians belonging to about 45 different organizations in the country. The Directorate is now in a position to cater for the quality assurance needs of the nuclear power programme in the country.

■ PAK/4/024

NUCLEAR POWER PLANT ELECTRONICS AND COMPUTER MAINTENANCE

COMPLETED: 90-12-20

TOTAL COST: \$18,383

OBJECTIVES:

TO IMPROVE REACTOR RELIABILITY AND PLANT OPERATION.

ACHIEVEMENTS:

Under this project, some test equipment such as a signature analyser, a programmable function generator and a programmable data communication tester were supplied which are being used in the maintenance of digital equipment and associated electronics of the Karachi Nuclear Power Plant. In addition, three counterpart staff were trained abroad under project-related fellowships.

■ PAK/4/028

HEAVY WATER STANDARDIZATION

COMPLETED: 90-12-20

TOTAL COST: \$14,809

OBJECTIVES:

TO CONTROL THE QUALITY OF THE HEAVY WATER MODERATOR IN NUCLEAR POWER REACTORS.

ACHIEVEMENTS:

Under this project, some primary heavy-water standards were supplied to the Chemical Control Laboratory of the Karachi Nuclear Power Plant (KANUPP). They are being used for preparing the calibration curves needed for making accurate measurements of the isotopic percentage of the heavy water of the KANUPP system using infrared spectrophotometry. This is done on a routine basis to avoid a downgrading of the heavy water system that would render plant operation inefficient.

■ PAK/4/031

RADIOISOTOPE DISPENSING

COMPLETED: 90-12-22

TOTAL COST: \$6,971

OBJECTIVES:

TO INSTALL AND COMMISSION RADIOISOTOPE DISPENSING CELLS PREVIOUSLY SUPPLIED BY THE AGENCY AND TO TRAIN COUNTERPART STAFF IN THEIR OPERATION.

ACHIEVEMENTS: Under a previous project (PAK/4/022), the Agency provided three radioisotope dispensing cells to the Radioisotope Production Laboratory of the Pakistan Institute of Nuclear Science and Technology, Islamabad. Under the present project, approved under the Reserve Fund, the Agency provided the services of an engineer from the supplier company who installed the equipment and provided on-the-job training to the counterpart staff in its use. Another Agency expert conducted a demonstration experiment with a sublimation generator also supplied by the Agency. Many sublimations have since been carried out, yielding useful technetium-99m products which were then used for diagnostic studies in patients in two Atomic Energy Medical Centres.

■ **PAK/5/019**

RADIATION PRESERVATION OF DRIED FRUIT

COMPLETED: **90-12-20** TOTAL COST: **\$43,568**

OBJECTIVES: TO CONDUCT PILOT-SCALE EXPERIMENTS ON RADIATION PRESERVATION OF DRIED FRUITS.

ACHIEVEMENTS: Pakistan is a country which produces abundant quantities of fruits, and dried fruits are used throughout the year for local consumption and export. Preservation of this commodity for a longer time is of economic importance to the country. Under this project, two Agency experts undertook four missions to the Nuclear Institute for Food and Agriculture, Peshawar, and advised on insect disinfestation, quality evaluation and packaging studies of irradiated dried fruits. One fellow was trained abroad under a project-related fellowship, and a scientific visit was also granted. From the research carried out by the Institute, it has been concluded that a low dose of irradiation followed by low temperature storage extends the shelf-life and reduces the post-harvest losses of dried fruits. The scientists of the Institute have gained significant knowledge in irradiation disinfestation and quality evaluation of dried fruits. This knowledge will enable them to conduct further studies leading to the technology transfer of this form of irradiation processing of dried fruits to industry.

■ **PAK/5/024**

TOXIC ELEMENTS IN FOODSTUFFS

COMPLETED: **90-12-20** TOTAL COST: **\$15,579**

OBJECTIVES: TO MEASURE, USING NUCLEAR TECHNIQUES, THE CONCENTRATION OF TRACE ELEMENTS IN CERTAIN FOODSTUFFS IN ORDER TO ESTABLISH BASE-LINE VALUES FOR TOXIC ELEMENTS AND TO ASSESS THE ADEQUACY AND SAFETY OF FOODSTUFFS FOR HUMAN CONSUMPTION.

ACHIEVEMENTS: Under this project, a multichannel pulse height analyser was supplied to the Pakistan Institute of Nuclear Science and Technology, Nilore, Islamabad. It is being used in conjunction with other equipment to measure trace quantities of toxic elements in food and foodstuffs by neutron activation analysis using the research reactor at the Institute. Elements such as aluminium, arsenic and iodine cannot easily be determined in trace quantities by non-nuclear methods. The Institute has now established a sensitive and reliable infrastructure for elemental analysis at trace and ultra-trace levels in food and environmental materials. The study has helped to assess the adequacy and safety of the diet of the inhabitants of the Rawalpindi/Islamabad area. The project was additionally supported by work done under an Agency Research Contract.

■ PAK/8/005

ISOTOPES IN HYDROLOGY

COMPLETED: 90-12-20

TOTAL COST: \$53,423

OBJECTIVES:

EXPANSION OF THE LABORATORY'S CAPABILITIES TO INCLUDE CARBON-14 MEASUREMENTS.

ACHIEVEMENTS:

The Isotope Hydrology Laboratory of the Pakistan Institute of Nuclear Science and Technology, Nilore, Islamabad, has introduced the use of isotope-aided techniques in an effort to solve a number of hydrological problems. It had received Agency support under previous projects. has analytical facilities for assessing stable isotopes and tritium, and it intended to expand its counting facilities to include carbon-14 measurements also. The Agency provided an automatic liquid scintillation counting system which is now being routinely used for measurement of carbon-14 in hydrological samples; an Agency expert advised on carbon-14 dating of groundwater using this equipment. Two counterpart staff were trained abroad under project-related fellowships, while one scientific visit was granted. The laboratory is providing valuable services in support of groundwater hydrology, as part of the studies concerned with making optimum use of the country's groundwater resources.

■ PAK/8/007

WATER RESOURCE STUDIES

COMPLETED: 90-12-20

TOTAL COST: \$49,908

OBJECTIVES:

TO FACILITATE WATER RESOURCE STUDIES BY STRENGTHENING THE CAPABILITY FOR MEASURING TRITIUM IN HYDROLOGICAL SAMPLES.

ACHIEVEMENTS:

Under this project, an automatic liquid scintillation counter was provided to the Pakistan Institute of Nuclear Science and Technology, Nilore, Islamabad, which is being extensively used for routine measurements of tritium and carbon-14 in hydrological samples in connection with water resource studies. This equipment has greatly enhanced the analytical capability of the Tritium Laboratory of the Institute.

■ PAN/2/004

NUCLEAR ANALYTICAL TECHNIQUES

COMPLETED: 90-09-18

TOTAL COST: \$207,327

OBJECTIVES:

TO ESTABLISH A RADIOCHEMISTRY LABORATORY FOR TEACHING AND RESEARCH.

ACHIEVEMENTS:

The Agency approved a four-year project (1985-1988) to establish a radiochemistry laboratory within the School of Chemistry of the University of Panama. This project had been requested by the Government with the aim of improving the analytical services required by the teaching and research programmes in physics and biology. Under the project, a gamma spectrometer, an X-ray fluorescence system with data processing capability, radiation counting equipment, an atomic absorption spectrophotometer, a Moessbauer spectrometer and a liquid-nitrogen-cooled semiconductor detector were the major pieces of equipment supplied. Five expert missions assisted with the installation of the equipment and with training scientists in its use; the experts also designed a radiochemistry course and discussed activities that could be implemented. Three fellows were trained abroad in the fields of radiochemistry, thermoluminescence dosimetry and X-ray fluorescence analysis. Comple-

tion of the project required an extension through the year 1989, when an expert was sent to review the work accomplished. Some spare parts were also provided. The radiochemistry laboratory now forms a part of the Research Centre for Nuclear Techniques in Panama. However, this capability will need further strengthening to enable it to achieve its full potential, and Agency support will be continued through project PAN/2/005, approved for 1991-92, to establish thermoluminescence analysis.

■ PAN/5/003

RADIOISOTOPES IN AGRICULTURE

COMPLETED: 90-09-18

TOTAL COST: \$176,670

OBJECTIVES:

TO IMPROVE FERTILIZER USE AND WATER MANAGEMENT.

ACHIEVEMENTS:

This multi-year project was implemented at the Faculty of Agriculture and Livestock Breeding Sciences of the University of Panama. The project focused on fertilizer use with annual and perennial crops and on pastures, and the evaluation of behaviour of water in the soil with a view to improving water management, including developing better drainage and irrigation practices. The Agency provided neutron moisture meters, a liquid scintillation counter and a complete laboratory for analysing the uptake of nitrogen from nitrogen-15 labelled fertilizer. During the ten years of this project (1981-1990), nine experts provided advice on and on-the-job training in water management, isotope-aided soil fertility studies and analytical techniques. Two fellowships were provided, one funded by the USA. Through the project, the technology to increase efficiency of fertilizer use as well as to improve water management practices has been acquired by the counterparts, and application of the techniques now being studied on a broader scale are expected to improve crop production and save on fertilizer imports.

■ PAN/5/006

RADIOIMMUNOASSAY IN REPRODUCTIVE EFFICIENCY STUDIES

COMPLETED: 90-09-18

TOTAL COST: \$87,684

OBJECTIVES:

RADIOIMMUNOASSAY IN REPRODUCING EFFICIENCY STUDIES.

ACHIEVEMENTS:

This project was approved to support the work being undertaken by the Ministry of Agriculture and Livestock Breeding Development and the University of Panama's Animal Reproduction Biology Research Institute to improve the calving rate and the reproductive efficiency of milk and meat-producing cattle. A complete laboratory to determine progesterone levels in plasma was set up. The Institute adapted an area for the preparation and processing of RIA samples and a separate facility for counting the radioactive samples. Among the equipment provided was a multi-well beta/gamma counting system and a refrigerated centrifuge, as well as laboratory supplies. Five expert missions were provided under the project to assist with installing the equipment, with designing research programmes on reproduction and with introducing quality control concepts in connection with obtaining and interpreting results. The Agency also funded an IAEA Research Contract on evaluation of levels of progesterone in skim-milk of post-partum dual-purpose cattle using radioimmunoassay techniques while, recently, a further Contract on nutrition and its effects on animal production was initiated. With the conclusion of this project, valuable technology and know-how has been transferred, and the practical results of studies will be communicated to stock breeders and farmers.

■ PAN/6/005**NUCLEAR MEDICINE**

COMPLETED: **90-10-08**TOTAL COST: **\$357,705**

OBJECTIVES:

TO ESTABLISH A NUCLEAR MEDICINE DEPARTMENT AT THE SANTO TOMAS HOSPITAL.

ACHIEVEMENTS:

Since 1978, the Agency had been assisting the Santo Tomas Hospital to develop its nuclear medicine services. In 1981, the Government requested assistance to establish the first public clinical nuclear medicine laboratory in the country. Under this project initiated in 1982, the Agency provided equipment including two scanners, a complete dual-probe system for dynamic in-vivo studies, a gamma camera and ancillary equipment to complement the various facilities. Some 80% of the project costs comprise the equipment provided to the Hospital. Two experts assisted with testing the equipment received through the Agency and under bilateral agreements, instituting quality control procedures. Additional expert missions dealing with radiopharmacy and use of gamma cameras were undertaken. Two fellows were trained in the use and maintenance of gamma cameras for dynamic studies. Initially, there was a delay before the Hospital was able to provide appropriate rooms to house the equipment; however, the nuclear medicine centre is now well established and is providing diagnostic services. As a follow-up of this project, approved for the 1991-92 period, the Agency will help to upgrade facilities by providing a single-photon emission computer tomographic (SPECT) system to broaden the range of diagnostic studies offered (PAN/6/007).

■ PAR/2/002**RADIOCHEMISTRY LABORATORY**

COMPLETED: **90-11-19**TOTAL COST: **\$152,635**

OBJECTIVES:

TO IMPROVE TRAINING IN RADIOCHEMISTRY AND RADIOBIOLOGY.

ACHIEVEMENTS:

The project was initiated in 1984 at the Faculty of Chemical Sciences, University of Asuncion. Its main objective was to set up a radiochemistry laboratory with the aim of strengthening the university curriculum in the teaching of nuclear sciences, in particular of radiochemistry. The Agency provided radiation counting and monitoring equipment, and a medium-flux isotopic neutron source, as well as expert services for curriculum design, and advice on installation and utilization of the neutron source. With this source, interesting programmes for practical application have already been established (e.g. activation analysis of mineral ores and other geological as well as biological materials). Teaching and demonstration of radiochemistry are conducted for university students of various disciplines, thus considerably enhancing the various university curricula.

■ PAR/8/004**NON-DESTRUCTIVE TESTING**

COMPLETED: **90-11-19**TOTAL COST: **\$105,276**

OBJECTIVES:

TO SET UP A LABORATORY FOR NON-DESTRUCTIVE TESTING.

ACHIEVEMENTS:

This project was approved in 1986 with the aim of introducing non-destructive testing (NDT) techniques into the engineering curricula of the Faculty of Physics and Mathematical Sciences at the National University of Asuncion.

The Agency was requested to provide NDT equipment and expert services. In the course of three missions, an Agency expert advised on the type of equipment to be purchased, put into operation the major items of equipment, and trained personnel. The NDT laboratory, established in 1986, is now well equipped, with an X-ray system and gamma-ray radiographic equipment using iridium-192 and cobalt-60 sources. The project is contributing to the formation of a cadre of well trained professionals, able to apply NDT techniques in various fields. The Faculty offers inspection and quality-control services to industry and will be offering such services for civil engineering projects of national importance in the future.

■ PER/0/011

DEVELOPMENT OF NUCLEAR RESEARCH CENTRE

COMPLETED: 90-05-28

TOTAL COST: \$216,435

OBJECTIVES:

TO ESTABLISH A DATA PROCESSING INFRASTRUCTURE

ACHIEVEMENTS:

Taking into account the developments in the activities of the Peruvian Nuclear Energy Institute and the need to process data coming from research being undertaken in different fields of the peaceful applications of atomic energy, including the evaluation of parameters coming from the reactor siting and start-up operation at the Huarangal Nuclear Research Centre, it was necessary to establish a data processing infrastructure comprising a mainframe computer system and peripheral equipment. The project was made operational in 1983 through an extrabudgetary contribution of the USA, which continued its support throughout. Experts assisted in commissioning the equipment and ran courses for the staff on computer applications. The establishment of a trained team of professionals competent in nuclear data management and the acquisition of the data processing system made it possible to handle the licensing process for the RP-10 research reactor for operation up to 100 kW, and the computer has been used in the study of different reactor core configurations that needed to be defined in preparation for a power increase and in the safety analysis of the installation. The computer system has also been used for regional training courses sponsored under the ARCAL programme.

■ PHI/1/013

NUCLEAR PHYSICS RESEARCH PLANNING

COMPLETED: 90-12-03

TOTAL COST: \$83,826

OBJECTIVES:

TO UPGRADE AND EXPAND EXISTING RESEARCH FACILITIES AFTER PREPARATION OF A REALISTIC RESEARCH PROGRAMME.

ACHIEVEMENTS:

In line with the recommendations of the Agency programming mission in 1985, the nuclear physics research activities at Philippine Nuclear Research Institute (PNRI) were streamlined and focused on the application of X-ray diffraction and energy-dispersive spectroscopy. The Agency provided X-ray diffraction equipment, computer systems with software, an Si(Li) detector, a multichannel analyser and amplifier, and a liquid nitrogen generator. An expert assisted the counterparts in applying an advanced computer programme for quantitative X-ray analysis. A project related fellowship was granted. The X-ray diffractometer is being regularly used for characterization of different materials, in particular in studies of ferrites. A microcomputer-based controller has been successfully completed and tested, and a computer programme has been developed which allows the controller to collect

X-ray diffraction data from powdered samples. In addition, energy-dispersive X-ray fluorescence spectrometry is being used as a non-destructive method for determination of minor and trace-elements in different types of sample. Several scientific reports have been published on X-ray analysis as a result of development work done and analytical services are being offered to other institutions and industry. The liquid nitrogen generator supplies all liquid nitrogen needed for PNRI and other institutions in Manila for operation of high-sensitivity semiconductor detectors.

■ PHI/8/011

GROUNDWATER HYDROLOGY

COMPLETED: 90-11-19

TOTAL COST: \$22,661

OBJECTIVES:

TO INVESTIGATE THE ORIGIN AND DYNAMICS OF SALT WATER AND GROUNDWATER IN MANILA, BULACAN, PAMPANGA AND CEBU.

ACHIEVEMENTS:

Following recommendations of an Agency technical mission funded by the Asian Development Bank in 1985, this project was initiated in 1986 to support research by the Environmental Management Bureau aimed at elucidating the salt intrusion process and its dynamics in the groundwater of selected areas. The Agency provided borehole water samplers and some supplies for this work, and the Agency's Laboratory at Seibersdorf provided isotope analyses for 377 water samples (deuterium, tritium, oxygen-18 and carbon-14 analyses). An expert provided training on how to interpret and process isotope data, and in isotope techniques as applied to hydrology. Fellowship training was granted for one staff member. The transfer of isotope techniques as used in hydrology was the main achievement of the project. Isotope experiments carried out by the counterparts from 1986 to 1989 successfully determined the source of groundwater salinity, confirmed the existence of carnate water and showed sources of groundwater recharge and flow patterns. A total of 117 wells were studied. The project was primarily supported from the Agency's Reserve Fund.

■ PHI/9/013

NUCLEAR LICENSING AND REGULATION

COMPLETED: 90-12-04

TOTAL COST: \$163,054

OBJECTIVES:

TO ASSIST THE PAEC IN THE REVIEW OF THE FINAL SAFETY ANALYSIS REPORT FOR THE COUNTRY'S FIRST NUCLEAR POWER PLANT; TO ADVISE ON REGULATIONS, LICENSING AND CONTROL RELATED TO RADIATION PROTECTION.

ACHIEVEMENTS:

The Department of Nuclear Regulations and Safeguards of the Philippine Atomic Energy Commission (PAEC) (now the Philippine Nuclear Research Institute) is responsible for licensing and has regulatory authority over the Philippines' first nuclear power plant (PNPP-1). It is also responsible for licensing and controlling all other nuclear facilities and nuclear materials in the country. With the expected commissioning of the PNPP-1 in 1986, the project was initiated in 1983 and supported by an extrabudgetary contribution of US\$46,800 from the United States of America; two project related fellowship were also funded by USA. Subsequent funding was from the Agency's Technical Assistance and Co-operation Fund. The implementation of this project could be divided into two phases. During the first phase, Agency experts assisted PAEC with the pre-operational safety review and licensing of PNPP-1. This resulted in three safety reports and a report on the technical specifi-

cations for PNPP-1. An expert also assisted with the licensing hearings. During the second phase, the aim was to strengthen the Department's capability for regulatory, monitoring, inspection and licensing activities related to radiation protection at the nuclear power plant and elsewhere in the country. In this connection, the last-mentioned expert also advised PAEC on revising its regulations, updating and streamlining its licensing procedures and re-orienting the organization to undertake materials licensing. The Agency also provided equipment that included air and contamination monitoring equipment, and a computer system. In 1987, the Government decided to mothball the reactor, and the emphasis of the project shifted completely to regulatory activities and licensing of radioisotope applications and of facilities using radioactive materials. Improved and more frequent inspections are now conducted, and regulations and radiation protection standards are regularly reviewed for conformity with internationally accepted guidelines.

■ **POL/6/002**

COMPUTERIZED TOMOGRAPHY

COMPLETED: **90-12-22** TOTAL COST: **\$64,628**

OBJECTIVES: TO DEVELOP PARAMETRIC SCINTIGRAPHIC IMAGING IN POLAND.

ACHIEVEMENTS: This multi-year project first approved in 1985 assisted the Lodz Medical Academy, in collaboration with another institution, to introduce parametric scintigraphic imaging. Agency experts assisted in the selection of appropriate computer hardware, which included gamma-camera data acquisition boards to input data to a desk-top computer system. The project helped the Institute to develop a unique concept for application to nuclear medicine diagnostics, using low-cost and universally available add-on equipment for a gamma camera.

■ **POL/9/011**

PRE-OSART MISSION TO ZARNOWIEC NUCLEAR POWER PLANT

COMPLETED: **90-12-22** TOTAL COST: **\$10,700**

OBJECTIVES: TO REVIEW THE CONSTRUCTION OF THE FIRST POLISH NUCLEAR POWER PLANT AT ZARNOWIEC.

ACHIEVEMENTS: Under this Reserve Fund project, ten Agency experts reviewed, from 5 September to 3 October 1989, activities at the construction site of the Zarnowiec Nuclear Power Plant, and the preparations for future plant operation. They also advised on project management, quality assurance, civil engineering works, preparation for start-up and plant operation, training and qualification of personnel, and emergency planning. Their recommendations were submitted to the Government. However, for other reasons, the Government decided recently to postpone further work on the power plant, and implementation of the recommendations is in abeyance.

■ **POL/9/012**

EVALUATION OF SAFETY FOR ZARNOWIEC NUCLEAR POWER PLANT

COMPLETED: **90-12-22** TOTAL COST: **\$10,821**

OBJECTIVES: TO MAKE AN EVALUATION OF SAFETY REQUIREMENTS FOR THE CONTAINMENT AND ACCIDENT LOCALIZATION SYSTEM OF ZARNOWIEC NUCLEAR POWER PLANT THROUGH EXPERT MISSIONS.

ACHIEVEMENTS: Under this Reserve Fund project opened at the request of the Polish Government, five Agency experts evaluated the safety requirements for the containment and accident localization system of the Zarnowiec Nuclear Power Plant. Their recommendations were submitted to the Government for consideration.

■ **POR/6/002**

MEDICAL PHYSICS AND CLINICAL DOSIMETRY

COMPLETED: 90-12-22

TOTAL COST: \$58,097

OBJECTIVES: TO ELABORATE AND IMPLEMENT QUALITY ASSURANCE AND QUALITY CONTROL PROGRAMMES IN CONNECTION WITH RADIOTHERAPY.

ACHIEVEMENTS: In January 1987, a planning mission was organized to assess the needs of the Radiotherapy Service of the Instituto portugues de Oncologia (IPO) and to prepare for implementation of the project. The Service has at its disposal five cobalt-60 teletherapy units, an electron-beam therapy machine and some brachytherapy sources. An Agency expert advised on more effective use of the computerized treatment planning system, and a supporting Agency Research Contract was granted to an investigator at IPO for preparing an atlas of dose distributions for mixed-beam treatments of tumours close to the body surface. A thermoluminescence dosimetry system was provided to improve dose assessment and control, as well as a densitometer for film dosimetry. Assistance made available under this project has enabled IPO to improve the quality of radiation therapy provided for the increasing number of patients undergoing treatment (2500 new patients per year).

■ **ROK/9/033**

OSART MISSION TO WOLSUNG NUCLEAR POWER PLANT

COMPLETED: 90-12-19

TOTAL COST: \$38,045

OBJECTIVES: TO REVIEW THE OPERATIONAL SAFETY OF THE 678 MW(E) NUCLEAR POWER PLANT AT WOLSUNG.

ACHIEVEMENTS: Under this project, funded from the Reserve Fund, an Agency Operational Safety Review Team (OSART) comprising 11 Agency experts visited the 678 MW(e) nuclear power plant, a pressurized heavy-water reactor, at Wolsung from 24 July to 11 August 1989. They reviewed the plant's operational safety indicators and other related documentation, examined procedures and instructions, observed work being carried out in the control room and in the field, and held detailed discussions with the counterparts. The OSART mission provided advice and guidance in relation to management, organization and administration, operator training and qualification, plant operation and maintenance, technical support, radiation protection, and emergency planning and preparedness; the missions's recommendations are being considered by the national authorities. The mission acknowledged the generally high quality and dedicatedness of management of the nuclear power plant, this reflecting full awareness of the responsibility carried for ensuring the health and safety of plant personnel and the general public.

■ **SEN/1/003**

NUCLEAR ANALYTICAL LABORATORY

COMPLETED: 90-05-29

TOTAL COST: \$191,048

OBJECTIVES: TO INTRODUCE NUCLEAR ANALYTICAL METHODS.

ACHIEVEMENTS: The Institute of Applied Nuclear Technology, University of Dakar, was established under a UNDP project executed by the Agency. The project covered radiological protection, nuclear instrumentation, and laboratory work with radioisotopes. The present project was designed to introduce nuclear analytical techniques at the Institute, in particular tube-excited X-ray fluorescence analysis, and gamma spectrometry using highly sensitive lithium-doped germanium detectors. The X-ray equipment and detectors were provided, as was the liquid nitrogen production unit needed for the germanium detectors. Agency experts assisted with equipment installation and gave on-the-job training in radiochemistry and analytical techniques. The project has established a nuclear analytical laboratory and the necessary infrastructural support. Both analytical services and training for graduate students are being provided.

■ **SEN/6/008**

NUCLEAR MEDICINE

COMPLETED: 90-11-05

TOTAL COST: \$93,892

OBJECTIVES: DEVELOPMENT OF SCINTIGRAPHIC IMAGING PROCEDURES AND OF IN-VIVO AND IN-VITRO RADIOISOTOPE TECHNIQUES IN NUCLEAR MEDICINE.

ACHIEVEMENTS: The project supplemented Agency assistance provided under project SEN/6/007 to the A. la Dantec Hospital and the Faculty of Medicine and Pharmacy, University of Dakar, with the aim of developing scintigraphic imaging and in vitro assays in their jointly operated nuclear medicine service. Equipment supplied under the project included two automatic gamma counters and two scintigraphic scanners. An expert provided advice on and on-the-job training in diagnostic methods, and calibration and maintenance of the equipment. The project has strengthened and broadened the range of medical investigations that can be carried out; new scintigraphic imaging procedures were developed and new diagnostic methods have been introduced. These are now being used on a routine basis.

■ **SIN/1/006**

APPLIED NUCLEAR PHYSICS

COMPLETED: 90-11-19

TOTAL COST: \$103,159

OBJECTIVES: TO FACILITATE STUDIES ON THE PROPERTIES AND THE INFLUENCE OF IMPURITIES IN MATERIALS USED IN THE ELECTRONICS INDUSTRY BY CONSTRUCTING A MICROBEAM FACILITY AT THE VAN DE GRAAFF ACCELERATOR THAT WILL PERMIT ANALYTICAL STUDIES INVOLVING CHARGED-PARTICLE SPECTROMETRY

ACHIEVEMENTS: The National University of Singapore sought Agency assistance in constructing a microbeam facility at its Van de Graaff accelerator that would permit analytical studies involving proton-induced X-ray emission (PIXE) and Rutherford back-scattering as analytical methods to determine microquantities of impurities in semiconductor components. The Agency has provided a switching magnet for the accelerator which is capable of providing proton, deuteron and alpha particle beams at energies of up to 2.5 MeV. The microbeam facility has two separate beam lines, at 15 degrees either side of the centre line. An expert initially assisted with construction of the microbeam facility and advised on accelerator technology; a subsequent expert provided on-the-job training in Rutherford back-scattering. With the up-

graded facility, the team at the laboratory of Physics Department is able to measure trace element concentrations by using the target chamber developed for PIXE. They have also carried out a pilot experiment on the measurement of oxygen levels in high- temperature superconductors. A series of back-scattering experiments were carried out to study superconductors, as well as the surface oxide-layer of metallic copper targets following differing surface treatments. These accomplishments have led the research team of the Physics Department into areas that are more complex and technically more demanding.

■ **SRL/5/016**

CROP WATER AND SOIL MANAGEMENT

COMPLETED: 90-11-19

TOTAL COST: \$199,852

OBJECTIVES:

TO SUPPORT INVESTIGATIONS INTO SOIL/PLANT/WATER/FERTILIZER INTERACTIONS AIMED AT ASSESSING FERTILIZER USE EFFICIENCY AND SOIL PRODUCTION POTENTIALS FOR DEVELOPING ECONOMIC CROP AND SOIL MANAGEMENT PRACTICES.

ACHIEVEMENTS:

This project was initiated in 1980 with emphasis on studies of soil moisture and crop water requirements using nuclear techniques. At the request of the Atomic Energy Authority (AEA), the project was continued in 1985 with emphasis on the efficiency of fertilizer utilization and nitrogen fixation. With funding provided by an extrabudgetary contribution (US\$44,552) from the United Kingdom and support from the Agency's the Technical Assistance and Co-operation Fund, neutron moisture probes, soil-water samplers, a beta/gamma counting system, and an emission spectrometer and sample preparation line for nitrogen- 15 analyses, as well as nitrogen-15 labelled fertilizer, have been provided. Experts advised on irrigation practices, on research into soil/plant/water relationships, and on analysis of nitrogen-15 by emission spectroscopy. Two fellowships were granted for training abroad, one in crop water and soil management, and one in nitrogen-15 analysis; one fellowship was funded by the USA. The AEA, in collaboration with eight agricultural institutes and universities, conducted a number of research and field experiments. Extensive data were collected on water conservation practices and irrigation scheduling in coconut and tea plantations, and land quality is being evaluated in a large area which is to be irrigated by the Mahaveli River diversion project for developing economic crops in a dry zone of the country. Nitrogen fixation studies were conducted at various agricultural institutes using nitrogen-15 labelled fertilizer, and current fertilizer practices have been modified as a result. At the Faculty of Agriculture of the University of Peradeniya, courses are being taught in the use of radioisotopes and their application in soil/plant interaction research. Although good progress was made, the departure of staff trained in nitrogen-15 analysis has affected the provision of these analytical services to participating institutions and this is hampering studies; it may be necessary to entrust an appropriately staffed laboratory with the specific responsibility for such analytical support to ensure proper continuity of the studies introduced through this project, and being further supported through project SRL/5/024.

■ **SUD/5/012**

PESTICIDE RESIDUES

COMPLETED: 90-09-12

TOTAL COST: \$117,665

OBJECTIVES:

TO STUDY PESTICIDE RESIDUES IN FOOD CROPS WITH THE AIM OF MINIMIZING THE RISK OF HUMAN EXPOSURE TO PESTICIDES.

ACHIEVEMENTS: The Government of Sudan requested assistance from the Agency to set up a laboratory for studying the behaviour of pesticides in agricultural crops because there was a need to determine the extent to which an increasing use of pesticides for vegetable farming was producing undesirable residual effects on non-target organisms and on human health. The aim was to determine the distribution, metabolic fate and overall persistence of pesticides in tomatoes and other commercially produced vegetables. At a later stage of the project, studies were also undertaken on cotton plants. From 1980, through the provision of expert services, the recipient institute, the Gezira Research Station of the Ministry of Agriculture at Wad Medani was assisted in the planning and execution of isotope-based experiments. Technicians and scientists were given training in isotope handling techniques. A wide range of analytical and other equipment, including an automatic liquid scintillation counter and gas chromatography accessories, as well as chemicals, were supplied. Some 55% of the funding for the project came from an extrabudgetary contribution of the United States of America. Five project staff were trained under the Agency's fellowship programme, one of these being funded by the USA. The Ministry now has, at its main agricultural research station, a functional laboratory for radioisotope-aided research and a protocol for monitoring the residues of pesticides in vegetable and other crops of economic importance.

■ **SUD/6/009**

NUCLEAR MEDICINE

COMPLETED: **90-09-10**

TOTAL COST: **\$92,550**

OBJECTIVES: TO ESTABLISH A SERVICE AND RESEARCH RADIOISOTOPE UNIT AT THE UNIVERSITY HOSPITAL; TO PREPARE REAGENTS FOR RADIOIMMUNOASSAY.

ACHIEVEMENTS: The Faculty of Medicine, University of Khartoum, in collaboration with the Sudan Atomic Energy Commission, established with Agency assistance a laboratory to prepare reagents for radioimmunoassay (RIA) to facilitate medical diagnosis and research, and to provide training. During the ten-year period for which support was provided, seven Sudanese staff were trained at overseas institutions with the aid of Agency fellowships, two each of which were funded extrabudgetarily by Hungary and the United Kingdom. Items provided for the laboratory included a gamma spectrometer, a freeze-drier, a counter and a computer system, as well as miscellaneous supplies. Agency experts who visited the project participated in the training of local personnel and assisted counterpart staff to prepare RIA reagents. A functional, well equipped laboratory with trained personnel is now available to prepare reagents for RIA and to support nuclear medicine diagnostics.

■ **SYR/1/002**

NUCLEAR ANALYTICAL LABORATORY

COMPLETED: **90-09-18**

TOTAL COST: **\$384,248**

OBJECTIVES: TO ESTABLISH A NUCLEAR ANALYTICAL LABORATORY.

ACHIEVEMENTS: The Syrian Atomic Energy Commission sought Agency help to establish an analytical laboratory that was equipped to apply nuclear techniques. Six experts in seven missions assisted in installing and calibrating equipment and provided on-the-job training in the use and maintenance of the devices and in various analytical techniques. Equipment provided included systems for

atomic absorption spectrometry, X-ray fluorescence analysis, gas and liquid chromatography, fluorimetry and low-level alpha, beta and gamma counting; of the US\$310,000 allocated for equipment, some \$37,500 were from extrabudgetary funds donated by the United Kingdom. Five staff members of the counterpart organization received training abroad through project-related Agency fellowships in Hungary, USA and Yugoslavia, and at the Agency's Laboratory at Seibersdorf. The Commission's laboratory is now providing a range of analytical services, including analysis of geological samples for uranium.

■ SYR/9/004

WASTE MANAGEMENT

COMPLETED: 90-12-27

TOTAL COST: \$9,672

OBJECTIVES:

TO ESTABLISH A LOCAL CAPABILITY FOR WASTE MANAGEMENT THROUGH THE CONSTRUCTION OF A PROCESSING PLANT FOR LOW-LEVEL LIQUID AND SOLID RADIOACTIVE WASTES.

ACHIEVEMENTS:

The inclusion of the project in the Agency's Technical Co-operation Programme in 1986 was based on the fact that serious negotiations were then in progress between the Syrian authorities and Soviet suppliers for a 10 MW research reactor. However, the negotiations fell through and the likelihood of the country obtaining a reactor in the near future is slim; the project is therefore being closed for the lack of enough wastes to merit the construction of the radioactive waste processing plant. Under the project, three Agency staff members visited the Syrian Atomic Energy Commission to discuss national plans for radioactive waste management and regulatory policies with local officials; they assisted in the formulation of a workplan and schedule for project activities. The counterpart also undertook a scientific visit to radiation waste processing facilities in Finland and the USSR.

■ SYR/9/005

NUCLEAR SAFETY

COMPLETED: 90-10-11

TOTAL COST: \$93,472

OBJECTIVES:

TO FACILITATE THE SETTING UP OF A REGULATORY BODY RESPONSIBLE FOR ALL SAFETY MATTERS RELATED TO APPLICATIONS OF NUCLEAR ENERGY.

ACHIEVEMENTS:

For 1986, the Government of the Syrian Arab Republic sought the Agency's assistance to set up a regulatory body that would consider all aspects of nuclear safety, in view of the Government's intention to embark upon nuclear power projects to meet the increasing demand for energy. Expert missions were organized to train local specialists in various aspects of nuclear safety, specifically on the siting of nuclear power plants and on the preparation, *implementation and review of safety analysis reports*. Six staff members of the Commission received fellowship training abroad in pertinent areas of nuclear safety. As negotiations regarding purchase of nuclear power plants had stalled, the Agency found it pertinent to transfer the funds remaining in the project to the Syrian initiative on a miniature neutron-source reactor, a research reactor project that has been approved for inclusion in the 1991-92 programme.

COMPLETED: 90-12-28

TOTAL COST: \$448,219

OBJECTIVES:

TO ESTABLISH A NEUTRON ACTIVATION LABORATORY AND A GRADUATE PROGRAMME.

ACHIEVEMENTS:

This multi-year project, first approved for 1982, established a new Fast Neutron Research Facility at the Department of Physics, Chiang Mai University, and promoted the development of manpower in the nuclear field. The Agency provided equipment that included a neutron generator, an irradiation sample transfer system, a magnet system, an X-ray fluorescence spectrometer, a hyperpure semiconductor detector with associated multichannel analyser and computer-based data acquisition system, and a liquid nitrogen plant. Agency experts assisted with the installation, testing and commissioning of the neutron generator and advised on its operation, maintenance and utilization and on fast neutron dosimetry. Agency experts also trained local staff in radiochemistry, fast-neutron activation analysis and X-ray fluorescence analysis. One project-funded and four project-related fellowships were granted to teaching and research staff for training abroad, which contributed to development of qualified staff in the nuclear field. The Fast Neutron Research Facility comprises the following laboratories: a neutron generator laboratory; an X-ray analysis laboratory; a solid-state nuclear track detection laboratory; and a nuclear instrumentation laboratory. The Department of Physics is now able to provide neutron activation analysis and X-ray fluorescence analysis services for various users. The over 20 staff of the facility teach university students and graduates nuclear physics, and fundamental and applied nuclear studies. Since 1984, 25 articles have been published or presented at international meetings, and 29 master theses have been prepared by the graduate students. The Facility represents the best university training centre for applied nuclear physics in Thailand, and the Agency has held four interregional and regional training courses and a co-ordinated Research Programme meeting there. There are plans to develop the Facility as a regional training centre.

COMPLETED: 90-05-29

TOTAL COST: \$129,093

OBJECTIVES:

TO ESTABLISH LABORATORY FACILITIES FOR TEACHING OF RADIO-CHEMISTRY.

ACHIEVEMENTS:

A radiochemistry course has been offered throughout the 1980s by the Department of Chemistry of the Prince of Songkla University, with a large number of students enrolled. However, a lack of laboratory facilities made it impossible to give demonstrations or to undertake experiments. With some 75% of the funding provided by an extrabudgetary contribution from the United States of America, the remainder from the Agency's Technical Assistance and Co-operation fund, a gamma spectrometer and a X-ray fluorescence (XRF) system for energy dispersive spectrometry with data processing capability were provided to the Department of Chemistry. Agency expert assisted counterparts in setting up the equipment and provided training. Two fellowships were granted for training in Singapore. The equipment provided under the project is being used to demonstrate radiochemistry experiments to students, who also do some practical work. In addition, the gamma-ray spectrometer has been used for several small research projects by senior

students in the Department. The XRF system, now back in working condition, will be used for research, as well as to provide analysis of samples from a local mining plant.

■ **THA/8/009**

RADIATION STERILIZATION OF MEDICAL SUPPLIES

COMPLETED: 90-11-20

TOTAL COST: \$49,839

OBJECTIVES:

TO UNDERTAKE A FEASIBILITY STUDY FOR RADIATION STERILIZATION OF MEDICAL SUPPLIES AND TISSUE GRAFTS.

ACHIEVEMENTS:

To cater for the growing demand for disposable medical supplies and tissue grafts, the Office of Atomic Energy for Peace (OAEP) sought Agency assistance for introducing radiation sterilization. This project was initiated in 1982 and financed extrabudgetarily by France (US\$20,637 for equipment) and Saudi Arabia (US\$8000 for expert services), and from the Agency's Technical Assistance and Co-operation fund. The main items of equipment provided to the laboratory of the Biological Science Division of OAEP included an autoclave, a freeze dryer, a laminar flow hood and a phase-contrast microscope for microbiological studies. Three experts assisted the counterparts in preparing an economic feasibility study concerned with the establishment of human tissue banking and establishment of an irradiation plant for disposable medical supplies. Experts also advised on studies in connection with radiation sterilization of tissue grafts and tissue transplantation. Fellowship training was granted for a staff member of the Division in tissue banking and sterilization. A microbiological laboratory has been established at OAEP for providing the microbiological testing required for radiation sterilization of tissue grafts, and regular radiation sterilization services are provided for hospitals with tissue banks. A private, commercial irradiation plant, Gammatron, has been established to produce and irradiate disposable medical supplies. The annual throughput of the plant is 60,000 cartons of 84-litre capacity. Tissue banks have been established at three major hospitals (Siriraj, Ramathibodi, Pramongkutklao) in Bangkok in collaboration with OAEP for tissue transplants for patients from throughout the country. Work on developing radiation sterilization is continuing. This service not only brings an improvement in public health standards, but also reduces the need to import such medical supplies.

■ **TUN/8/009**

HYDROLOGY

COMPLETED: 90-11-05

TOTAL COST: \$72,230

OBJECTIVES:

TO SUPPORT HYDROLOGICAL STUDIES RELATED TO CONTINUOUS MEASUREMENT OF SEDIMENT TRANSPORT IN SURFACE WATERS.

ACHIEVEMENTS:

The Directorate of Water Resources of the Ministry of Agriculture sought Agency assistance with studies of surface water resources. The Agency provided a turbidity gauge for continuous measurement of sediment transport in reservoirs and rivers and expert services to train the staff in its use and maintenance. Additional training for five staff was provided through four project-related fellowships and a scientific visit. The equipment has been installed on the main river in the country and studies are being carried out to determine the balance between erosion, transport and sedimentation. The results of the studies will be used to define measures to control erosion and sedimentation in reservoirs.

■ TUR/3/006**EXPLOITATION OF URANIUM RESOURCES**

COMPLETED: 90-05-28**TOTAL COST: \$150,449****OBJECTIVES:**

TO ASSIST THE TURKISH AUTHORITIES IN DEVELOPING THE EXPLOITATION OF VARIOUS URANIUM RESOURCES.

ACHIEVEMENTS:

This project with the Turkish Atomic Energy Authority and the Ministry of Energy and Natural Resources covered various aspects of the exploitation of indigenous uranium resources. An airborne survey of eastern Anatolia carried out under a sub-contract with the Riso National Laboratory, Denmark, provided preliminary data on uranium deposits that were then developed in detail in a parallel project TUR/3/007. ETIBANK, a state-owned enterprise operated under the aegis of the Ministry, started feasibility studies for production of yellow cake from ore from the Koprubasi deposits after pilot exploration demonstrated a certain favourability. Nine experts advised on exploratory drilling, feasibility studies, and ore processing, and one workshop on ore-reserve estimation was held. Training abroad through two project-related fellowships was granted, as were four scientific visits. The Agency supplied certain equipment including extraction equipment for the activities related to the technological work on the uranium ores and provided expert services for the feasibility study. The activities have been completed and were summarized in the report "Technical and Economical Aspects for Exploration of Uranium Resources in Turkey". The work on exploration of uranium resources in Turkey is being continued with the support of the Turkish State Planning Organization.

■ TUR/3/007**AERIAL SPECTROMETRY**

COMPLETED: 90-09-18**TOTAL COST: \$331,840****OBJECTIVES:**

TO ASSIST IN CARRYING OUT AERIAL SPECTROMETRIC SURVEYS IN SUPPORT OF URANIUM EXPLORATION.

ACHIEVEMENTS:

The General Directorate of Mineral Research and Exploration sought Agency assistance from 1986 for more detailed exploration for and evaluation of uranium deposits in Turkey, this being a continuation of 300,000 km² of aerial surveys conducted with Agency and UNDP assistance since the 1950s. The Agency provided a sensitive airborne spectrometer, a calibration source and accessories, following which Agency experts assisted with the initiation of the surveys, use of calibration pads, and processing and evaluation of survey data, using the microcomputer system provided. During 1987-88, some 30,000 km² of Central Anatolia were surveyed. Of the radio-anomalies identified, 88 were investigated by ground survey and drilling. A gamma spectrometer was provided for these studies. Training abroad was granted to selected Directorate staff through one project-funded fellowship, as well as three project-related fellowships that were funded by USA. Two scientific visits were also granted. The necessary capability to prepare radiometric maps, and to continue assessment of uranium favourability has been developed. This project complemented activities carried out under TUR/3/006.

■ TUR/8/008**NON-DESTRUCTIVE TESTING**

COMPLETED: **90-08-06** TOTAL COST: **\$188,216**

OBJECTIVES: TO DEVELOP CAPABILITIES FOR THE CERTIFICATION OF NDT PERSONNEL.

ACHIEVEMENTS: In particular with the aim of using local manufacturers to supply components for Turkey's nuclear energy programme, the Cekmece Nuclear Research and Training Centre of the Turkish Atomic Energy Authority sought to broaden its quality control activities by adding other forms of non-destructive testing (NDT) to its gamma-radiography capability. Seven experts in ten missions advised on planning for national NDT activities, radiographic, ultrasonic and eddy current testing, and quality assurance. Various items of related test equipment were provided. A committee for NDT and a national certification body were established, while capabilities for the certification of NDT personnel were developed. Systematic training is being continued under a UNDP project.

■ TUR/9/005**NUCLEAR SAFETY**

COMPLETED: **90-03-08** TOTAL COST: **\$719,843**

OBJECTIVES: TO STRENGTHEN THE LOCAL CAPABILITY FOR NUCLEAR SAFETY ASSESSMENT.

ACHIEVEMENTS: This long-term project, approved from 1980, concentrated on the safety aspects of siting for proposed nuclear power plants in Turkey. Emphasis was primarily on training, using experts' missions, national training courses and fellowships. Nine project-funded fellowships accounted for US\$ 160,000, including a contribution by Canada. Of the 33 project-related fellowships, 12 were funded by USA and one by the Federal Republic of Germany; the remainder were funded from the Agency's general fellowship allocation of the Technical Co-operation and Assistance Fund. Six scientific visits were also granted. Twenty-five experts undertook 48 missions, covering, inter alia: meteorology, seismic hazards and criteria, quality assurance, and evaluation of micro- and other earthquake data as they relate to siting; probabilistic safety assessment; loading and transport of spent fuel; and review of siting studies. Four training courses were held, one in Vienna. Equipment totalling US\$ 150,000 was provided, including a computer system suitable for site and safety studies, together with appropriate software. A considerable transfer of expertise on safety in connection with nuclear power plants was transferred, and a basis for a national infrastructure for regulation and licensing was created. In addition, comprehensive site studies for two potential nuclear power plant sites were performed. However, with the recent governmental decision to defer construction of nuclear power plants, the project activities were suspended and the project was closed.

■ TUR/9/007**RADIOACTIVE WASTE MANAGEMENT**

COMPLETED: **90-09-18** TOTAL COST: **\$97,159**

OBJECTIVES: TO FORMULATE AND IMPLEMENT A NATIONAL PROGRAMME FOR THE TREATMENT AND DISPOSAL OF RADIOACTIVE WASTE; TO CONSTRUCT A PROCESSING PLANT FOR LIQUIDS AND SOLID WASTES.

ACHIEVEMENTS: For 1985, the Turkish Government sought Agency assistance to treat and dispose of low-level liquid and solid radioactive wastes coming from hospitals, industrial establishments, laboratories and universities, and the Turkish Atomic Energy Authority's facilities. Four expert missions in 1985 provided advice regarding a waste disposal programme and the design and operation of a waste disposal plant. The plant was constructed by the Government at the Cekmece Nuclear Research and Training Centre, and a compactor and cementation plant, together with major items of glassware, were provided by the Agency in 1987. The project was supported by three Agency Research Contracts; they were concerned with studies on cement additives and cold-hardening, on sorption/desorption using soil samples from throughout Turkey, and on processes using inorganic sorbents - the last-mentioned being funded by USA. One project-related fellowship was also USA funded. The Turkish Authorities prepared the Safety Analysis Report based on current international practice; the Agency provided supporting expertise. The plant is now operational.

■ **URT/5/006**

ACARICIDE RESIDUES IN MEAT AND MILK

COMPLETED: **90-04-25** TOTAL COST: **\$167,679**

OBJECTIVES: TO DEVELOP THE CAPABILITY TO USE RADIOLABELLED PESTICIDES TO IMPROVE THE QUALITY AND QUANTITY OF MEAT, MILK AND GRAINS IN TANZANIA.

ACHIEVEMENTS: This project, first approved in 1983, assisted the Tropical Pesticides Research Institute (TPRI), Arusha, to establish a low-level radioisotope laboratory to study, inter alia, acaricide residues in cattle resulting from tick-control measures and efficacy of pesticides used for tsetse-fly control. Equipment including a liquid scintillation counter and a gas chromatograph, isotopes and laboratory supplies was provided. Agency experts advised on programme design and trained the professional and two technicians allocated to these studies on how to (i) analyse acaricides in cattle dips, (ii) analyse acaricide residues in milk, and (iii) investigate residues of a number of pesticides in agricultural produce. One project-related scientific visit and two fellowships were approved: the visit enabled the counterpart professional to visit the Agency, the Federal Republic of Germany and the United Kingdom to gain an insight into current practice in pesticide residue studies, while the fellowships were for the senior technician, who was trained for 12 months in the Agrochemicals Unit at the Agency's Laboratory, and the electronics technician, who attended a regional training course on instrumentation in Zambia in 1989, and received further specialized training at the Agency's Laboratory in 1990. Work is continuing with the aim of phasing out pesticides that are not "environmentally friendly". A follow-up project (URT/5/010) has been approved for 1991-92 that awaits extra-budgetary funding.

■ **URU/0/007**

NUCLEAR TECHNOLOGY CENTRE

COMPLETED: **90-06-07** TOTAL COST: **\$337,274**

OBJECTIVES: TO ASSIST IN THE PREPARATORY PHASE FOR THE ESTABLISHMENT OF A NUCLEAR RESEARCH CENTRE.

ACHIEVEMENTS:

An Agency advisory mission visited Uruguay in 1983 to evaluate a proposal of the National Atomic Energy Commission (CNEA) for the establishment of a nuclear research centre. On the basis of recommendations presented and with Agency support, CNEA initiated, in 1984, preparatory work on the establishment of an adequate infrastructure. Through this project, an electronics laboratory and a low-background gamma spectrometry laboratory with a capability for elemental analysis by means of X-ray fluorescence have been made operational, as has a nuclear information service that forms part of a national information network in science and technology. The project also assisted in establishing the bases for an environmental monitoring programme; the X-ray fluorescence analysis laboratory is offering services to local industry. Some three quarters of the funding was used to provide equipment to initiate the activities, including tube-excited X-ray analytical equipment, computer equipment, a multichannel and a single-channel analyser, counters, a freeze dryer and radioactivity monitoring devices. Experts helped to set up the equipment and give on-the-job instruction. Two Agency fellowships for training abroad and a scientific visit were also granted. In 1985, a team of experts undertook an evaluation of the national plans to set up a Nuclear Technology Centre, and this enabled the Uruguayan Government to take a series of basic decisions. An Agency expert financed by an interregional project (INT/0/045) will assist in an evaluation concerned with the future development and funding of the Centre, including a possible contribution from the Agency under its regular Technical Co-operation Programme.

■ URU/3/007**URANIUM PROSPECTION****COMPLETED: 90-05-28****TOTAL COST: \$102,591****OBJECTIVES:**

TO CHECK AREAS OF POSSIBLE URANIUM OCCURRENCES AND TO UPGRADE THE ANALYTICAL LABORATORY IN SUPPORT OF THE URANIUM EXPLORATION PROGRAMME.

ACHIEVEMENTS:

The project supported continuing work on possible uranium occurrences in the country and the upgrading of data processing in support of the uranium exploration programme. Uranium prospecting, though not continuous, was initiated by the National Directorate of Mining and Geology in 1949; during the 1960s, exploration for radioactive ores was also undertaken through contractors. Starting in 1980, upon the request of the counterpart, these activities were supported by the Agency through provision of various items of equipment, including systems for undertaking aerial surveys, and, from 1984, through the services of experts. They evaluated data previously obtained and recommended a long-term exploration programme that was to aim at defining, first, more promising areas, and then at concentrating efforts in areas deemed to be the most promising. In 1987, additional advisory services helped to specify such areas: the palaeozoic Godwanae Basin and the geological formations belonging to the Upper Precambian, these having been defined through airborne and car-borne surveys and uranium analysis of sediments and soils. In 1987, an expert specifically recommended 13 000 km² of a selected geological environment for study in order to complete the airborne gamma spectrometry, after which a detailed, systematic prospection was to be carried out, particularly in La Calera. A fellowship was granted for training in management and evaluation of data. The Directorate is now in a position to assess uranium ore favourability.

COMPLETED:	90-05-01	TOTAL COST: \$23,082
OBJECTIVES:	TO APPLY RADIOISOTOPE TECHNIQUES IN DETERMINING THE PHOTOSYNTHETIC CHARACTERISTICS OF VARIOUS WINE GRAPE VARIETIES.	
ACHIEVEMENTS:	<p>The project was carried out at the University of Labour, School of Wine and Grape Growing, El Colorado, while the facilities at the Faculty of Agronomy and at the Centre for Nuclear Studies (CIN), both at the University of the Republic, Montevideo, were used for counting samples. Studies in grapevine photosynthesis have been in progress since 1975; the project permitted the expansion of these studies to new grape varieties being introduced into the country. Data obtained have shown that it is possible to determine quantitatively the photosynthetic yield in situ by the techniques chosen, using carbon-14 labelled compounds. New procedures using alpha autoradiography are in progress. It has been found feasible to correlate the amount of "green material" as determined from the mass of dry matter and leaf surface, and the total amount of sugar in grapes, with photosynthetic activity. Efforts have also been made to relate the effects on photosynthesis and its rate of change to disease in grape plants infected by viral diseases. These studies on photosynthesis in plants have applications to other crops, including those that are being considered as a "renewable energy source".</p>	

COMPLETED:	90-12-22	TOTAL COST: \$214,527
OBJECTIVES:	TO UNDERTAKE CARDIOVASCULAR STUDIES USING RADIONUCLIDES; TO IMPROVE DIAGNOSIS AND TREATMENT CAPABILITY IN RADIOIMMUNOASSAY AND RECEPTOR ASSAY.	
ACHIEVEMENTS:	<p>The counterpart institute was the Nuclear Medicine Centre of the Montevideo Clinical Hospital that is jointly operated by the Ministry of Health and the Faculty of Medicine of the National University. This long-term project was approved in 1980 with the aim of providing some assistance to integrate efforts which had been initiated under three other related IAEA technical co-operation projects. The primary aim was to upgrade existing facilities to allow of 3-dimensional and dynamic patient diagnostics. Expert advice served to establish procedures to assure the clinical usefulness of single-photon emission computer tomography (SPECT), and to decide on its pitfalls, quality control and interpretation of images for routine studies. A data processing system, a matrix image formatter, software, a collimator and calibration equipment were provided to supplement previously existing equipment. The capability to undertake radioimmunoassay was also substantially improved, Agency experts providing advice on radiopharmacy (kit preparation) and the procedures themselves; a two-month period of on-the-job-training with an associated course was implemented. Two project related fellowships were granted, and funded by the USA. The Nuclear Medicine Center at the Clinical Hospital in Montevideo is now the focus of nuclear medicine practice in Uruguay and neighbouring countries, thanks to the enthusiasm with which the project counterpart led his staff to utilize the resources which were made available through this project.</p>	

■ URU/9/004

RADIATION PROTECTION LEGISLATION

COMPLETED: 90-05-28

TOTAL COST: \$6,562

OBJECTIVES:

TO ASSIST IN SETTING UP NEW REGULATIONS NEEDED FOR THE IMPLEMENTATION OF THE NATIONAL RADIATION PROTECTION SYSTEM.

ACHIEVEMENTS:

The establishment of the National Directorate of Nuclear Energy as a Department of the Ministry of Energy and Mines of Uruguay made it necessary to upgrade legislation on radiation protection to cover national needs. A project was established within the 1990 Reserve Fund of the Agency to satisfy the request for expert services to assist in the establishment of comprehensive radiation protection regulations in order to satisfy the requirements of the law that created this Directorate. An Agency expert assisted the local authorities in defining the appropriate infrastructure needed in support of the regulations, in developing norms for the control and licensing of radioactive sources and materials as they apply to users and installations where ionizing radiation is being employed, in establishing a legal mechanism for the operation of a personnel dosimetry system, and in preparing for inspection of installations. The documents have already been approved by the Government; an Agency RAPAT Mission has given further advice in 1990 on the procedures to be adopted to fulfil the terms of the proposed legislation.

■ VIE/4/006

COMPUTER CENTRE FOR REACTOR PHYSICS

COMPLETED: 90-12-28

TOTAL COST: \$39,832

OBJECTIVES:

TO DEVELOP A SMALL COMPUTER CENTRE AND A LOCAL CAPABILITY FOR THE APPLICATION OF COMPUTER METHODS IN REACTOR PHYSICS RESEARCH

ACHIEVEMENTS:

This project, initiated in 1987, was established by the Government of Vietnam at Vinatom, Hanoi. Most of the expenditure under the project has been made for purchase of computer equipments initially comprising three PC workstations and networking software. The expert services of an Agency staff member were used to discuss problems related to the installation of the computer network. Subsequently two additional PCs were provided together with computer peripheral and support equipment. The project counterpart was trained through participation in a one week Regional Symposium on Reactor Physics Calculations using Personal Computers at Jakarta in 1989. The computing centre has developed very rapidly and has accomplished much in three years. Numerous PC computer codes have been developed, as well as large mainframe codes adapted for use on PCs. Vinatom has been awarded two Agency Research Contracts for PC software development through the Agency's Department of Research and Isotopes. One significant accomplishment has been the development of a version of the well-known and widely used WIMS code for use on an AT type computer.

COMPLETED: 90-12-28

TOTAL COST: \$33,374

OBJECTIVES:

TO INSPECT THE REACTOR TANK, CORE COMPONENTS AND STRUCTURES OF THE DALAT RESEARCH REACTOR USING A SPECIAL OPTICAL VIEWING DEVICE AND TO PROPOSE SOLUTIONS FOR ANY PROBLEMS RELATED TO CORROSION THAT MAY BE DETECTED.

ACHIEVEMENTS:

The research reactor of the Dalat Nuclear Research Institute was constructed in 1963, initially as a Triga Mark II. During the period 1968-1978, maintenance conditions were difficult and finally, in 1983, it was reconstructed to use a completely new type of fuel element, namely the Soviet VVR-SM, but with other essential components retained unchanged. Some safety concerns had been expressed about the integrity of the older components of the "re-conditioned" reactor, such as the reactor tank, graphite reflector, thermal column and horizontal beam tubes. At the request of the Government of Vietnam, a Reserve Fund project was approved to facilitate the underwater telescopic examination of the reactor tank, core components and, in particular, the welded joints between the beam tubes or the thermal column and the reactor tank. The approval of the project was preceded by a preparatory mission, and an INSAAR mission carried out under the regular programme of the Agency. Consultations were also held with the bilateral donor (USSR) on the project. A three-man team undertook a three-week mission at the reactor and carried out a detailed examination of the various structural components. The mission report and its evaluation were submitted to the Government. Agency assessment of the mission is that there is no immediate safety concern. Further detailed inspection of core components will be required after clean-up of the reactor, which has already been initiated.

COMPLETED: 90-08-20

TOTAL COST: \$146,205

OBJECTIVES:

TO DEVELOP A QUALIFICATION PROGRAMME TO IDENTIFY ITEMS FOR WHICH QUALIFICATION IS REQUIRED, TO ESTABLISH QUALIFICATION REQUIREMENTS AND TO DEVELOP ANALYTICAL AND TESTING CAPABILITIES FOR PROGRAMME IMPLEMENTATION.

ACHIEVEMENTS:

The Institute for Electricity Generation Development and Research sought Agency assistance to develop domestic capabilities in qualification of various items of equipment for nuclear power plants in Yugoslavia by analysis and qualification testing. Under this 1988 project, funded by the USA, expert services were provided on qualification procedures and a workshop was organized on equipment qualification. High accuracy pressure and temperature gauges and the necessary precise calibration equipment for a meteorology laboratory were also provided. Subsequently, the Yugoslav Government ordered a moratorium on the construction of nuclear power plants (1989) which caused a significant drop of interest in local industry for manufacture of nuclear-class equipment. This, and the concomitant cuts in funds for the project, caused the Institute to request closure of the project.

■ YUG/9/018**REACTOR SAFETY STUDIES**

COMPLETED: 90-03-08

TOTAL COST: \$536,256

OBJECTIVES:

TO INCREASE THE COMPUTATIONAL CAPACITY OF THE INSTITUTE AND STRENGTHEN ITS CAPABILITY FOR COMPUTER-ASSISTED REACTOR SAFETY ANALYSIS AND TRAINING.

ACHIEVEMENTS:

The computational capacity of the Jozef Stefan Institute, Ljubljana, and the Faculty of Electrical Engineering of the University of Zagreb were upgraded to enable them to undertake state-of-the-art safety analyses for nuclear installations and to provide training in the field. A mini-computer system and various specialized items of software for such calculations were provided by the Agency. Twenty-four experts in 28 missions gave training on modelling techniques for various fault and transient conditions using computer codes such as RELAP, ALMOD and WIMS-S and D. A training course on safety and reliability of nuclear power plant operation was given in 1986 involving 14 lecturers. Much of the work was done with specific reference to the Krsko Nuclear Power Plant. Two project-funded and two project-related fellowships provided opportunities for local staff to receive training abroad; ten scientific visits were also granted. The project was further supported by approval of two Agency Research Contracts dealing with loop transient computer codes and a simplified two-loop facility for code assessment. There has been a successful transfer of knowledge on nuclear safety from advanced countries which has strengthened local capabilities for undertaking safety analysis for the Krsko Plant. This has resulted in valuable support for the regulatory body in assessing safety implications, of, for example, steam generator plugging, the long-term subcriticality margin, evaluation of plant technical specifications and probabilistic and other safety analyses.

■ YUG/9/022**RADIATION PROTECTION**

COMPLETED: 90-08-20

TOTAL COST: \$132,881

OBJECTIVES:

TO STRENGTHEN THE NATIONAL CAPABILITY FOR RADIATION PROTECTION IN ACCORDANCE WITH INTERNATIONALLY RECOGNIZED STANDARDS.

ACHIEVEMENTS:

The project resulted in strengthening the national capabilities in radiation protection by upgrading the laboratories of the Jozef Stefan Institute, Ljubljana, and the Institute for Medical Research and Occupational Health, Zagreb. Both institutes have a major role in radiation protection work in Yugoslavia. The equipment provided, such as a radon detector, an alpha/beta spectrometer, a Ge(Li) detector and a low-level alpha/beta counter, is being used for radiation protection surveillance and environmental monitoring. Moreover, assessment of the radiation measurements and evaluation of the Zirovski Vrh uranium mine's impact on the environment was carried out under the project with the support of Agency experts.

■ ZAM/8/005**GROUNDWATER STUDIES**

COMPLETED: 90-07-24

TOTAL COST: \$37,030

OBJECTIVES:

TO DETERMINE THE REPLENISHMENT PROCESSES AND FLOW DYNAMICS OF THE LUSAKA AND KABWE AQUIFERS.

ACHIEVEMENTS: The project, which was approved in 1986, aimed to obtain a clearer understanding of the origin and replenishment process of the aquifers in the Lusaka and Kabwe areas of Zambia by means of environmental isotopes. Three institutes were involved in these hydrogeological field investigations, the Department of Water Affairs, the University of Zambia and the Water Resources Research Unit of the National Council for Scientific Research (NCSR). The methodology of using environmental isotopes was introduced and used for the first time in Zambia. The data obtained from the reconnaissance samplings indicated that the methodology would prove useful in studying the origin and replenishment of major groundwater aquifers in dolomitic limestone formations. Samples were collected from shallow and deep boreholes in the Lusaka and Kabwe areas. The analyses of oxygen-18, deuterium and tritium were carried out by the Agency's Laboratory at Seibersdorf, while the hydrochemical analyses of the samples were done at NCSR. One geologist from the University of Zambia was trained in isotope analysis and interpretation of isotope data in the Isotope Hydrology Section of the Agency. As no interest was shown in the use of portable nuclear well-logging equipment for making a detailed study of the stratigraphic conditions in the major aquifers of the Lusaka and Kabwe areas, this equipment (which was originally foreseen for the project) was not provided. The data are now being analysed and evaluated; the laboratory is able to continue studies, though certain analyses still have to be carried out abroad.

■ **ZIM/5/003**

NUCLEAR TECHNIQUES IN BIOCHEMISTRY

COMPLETED: 90-09-10 **TOTAL COST: \$27,290**

OBJECTIVES: TO STRENGTHEN CAPABILITY FOR RESEARCH INTO MAJOR HEALTH AND AGRICULTURAL PROBLEMS.

ACHIEVEMENTS: In order to upgrade facilities in the Department of Biochemistry, University of Zimbabwe, and to introduce nuclear techniques into biochemical research, the Government requested Agency assistance to acquire a liquid scintillation counter and some laboratory supplies and chemicals. The equipment is being used by the staff of the Department in their research programmes.

■ **ZIM/5/004**

TSETSE FLY MOVEMENT AND BEHAVIOUR

COMPLETED: 90-09-12 **TOTAL COST: \$57,776**

OBJECTIVES: TO DEVELOP RADIATION MONITORING TECHNIQUES THAT WOULD PERMIT THE USE OF RADIOTRACERS FOR FOLLOWING THE MOVEMENT AND BEHAVIOUR OF TSETSE FLIES IN THE WILD.

ACHIEVEMENTS: The request by the Government of Zimbabwe was based on the need to augment existing methods for tsetse control, in particular to obtain accurate information on fly movement and behaviour; such information is vital to the development of control strategies. Largely through the provision of a variety of equipment (e.g. monitoring units, counters, a computer system) and radioisotopes and other chemicals, it was possible to set up a laboratory suitable for labelling with radiotracers. This one year project called for expert services, which were provided in early 1989. The assignment was to assist in developing techniques for injecting microlitre quantities of isotope (iron-59) into live flies and estimating the rate of loss in the fly and quantities present in the larvae. The techniques were well developed, and fly recapture data

gave a good indication of fly movement and behaviour in the field. The project staff were trained on the job to apply the new techniques and to set up, use and maintain the equipment provided. Practical training in radiation safety was also achieved.

■ ZIM/6/002

NUCLEAR TECHNIQUES IN HAEMATOLOGICAL DIAGNOSIS

COMPLETED: 90-09-10

TOTAL COST: \$22,937

OBJECTIVES:

TO STRENGTHEN THE LOCAL CAPABILITY FOR HAEMATOLOGICAL DIAGNOSIS THROUGH THE TRAINING OF TECHNICAL STAFF.

ACHIEVEMENTS:

The Department of Haematology of the Godfrey Higgins School of Medicine, University of Zimbabwe, has been using radionuclides in diagnosis of haematological disorders for some time. They requested Agency assistance to obtain training in current techniques and to fund the provision of some small items of related equipment, including a scintillation probe and counter, a manual gamma counter, a dose calibrator and a personal computer. Through seminars and practical ward sessions, an expert trained project staff on the job during a two-month assignment. In addition, one senior staff member of the University of Zimbabwe School of Medicine was granted a four-month fellowship for training overseas. The improvement in facilities together with the training of staff has enabled the School of Medicine to improve its application of and teaching programmes in haematological diagnosis using radioisotopes.

IMPLEMENTATION SUMMARY I ALL FUNDS *

	Adjusted programme	Share of total pro- gramme	New obligations	Implemen- ation rate	Earmarkings
	(\$)	(%)	(\$)	(%)	(\$)
Current year					
Area breakdown					
Africa	14,063,361	22.5	9,737,811	69.2	4,325,550
Asia & Pacific	16,638,318	26.6	11,268,819	67.7	5,369,499
Middle East & Europe	10,985,224	17.6	5,661,606	51.5	5,323,618
Latin America	14,897,958	23.8	10,505,851	70.5	4,392,107
Interregional	5,498,253	8.8	4,800,592	87.3	697,661
Global	475,022	0.7	465,627	98.0	9,395
Total	62,558,136	100.0	42,440,306	67.8	20,117,830
Component breakdown					
Experts	17,532,491	28.0	9,994,971	57.0	7,537,520
Equipment	23,564,330	37.7	15,647,674	66.4	7,916,656
Fellowships	9,704,290	15.5	6,785,108	69.9	2,919,182
Training courses	9,626,232	15.4	8,340,599	86.6	1,285,633
Sub-contracts	1,527,954	2.5	1,108,858	72.6	419,096
Direct costs	23,022	0.0	0	0.0	23,022
Miscellaneous	579,817	0.9	563,096	97.1	16,721
Total	62,558,136	100.0	42,440,306	67.8	20,117,830
Fund breakdown					
TACF	46,880,397	74.9	33,422,585	71.3	13,457,812
UNDP	3,223,083	5.2	2,855,764	88.6	367,319
Extrabudgetary	11,687,023	18.7	5,888,500	50.4	5,798,523
Funds in trust	767,633	1.2	273,457	35.6	494,176
Total	62,558,136	100.0	42,440,306	67.8	20,117,830
Current and future years					
Current	62,558,136	83.1	42,440,306	67.8	20,117,830
Future	12,685,140	16.9	1,211,835	9.6	11,473,305
GRAND TOTAL	75,243,276	100.0	43,652,141		31,591,135

* As at 31 December 1990.

IMPLEMENTATION SUMMARY II

TECHNICAL ASSISTANCE AND CO-OPERATION FUND *

	Adjusted programme	Share of total pro- gramme	New obligations	Imple- mentation rate	Earmarkings
	(\$)	(%)	(\$)	(%)	(\$)
Current year					
Area breakdown					
Africa	11,149,732	23.8	8,149,193	73.1	3,000,539
Asia & Pacific	11,220,206	24.0	7,726,510	68.9	3,493,696
Middle East & Europe	9,297,340	19.8	5,153,253	55.4	4,144,087
Latin America	9,807,703	20.9	7,450,760	76.0	2,356,943
Interregional	4,925,468	10.5	4,469,238	90.7	456,230
Global	479,948	1.0	473,631	98.7	6,317
Total	46,880,397	100.0	33,422,585	71.3	13,457,812
Component breakdown					
Experts	12,434,179	26.5	7,723,482	62.1	4,710,697
Equipment	17,439,837	37.2	12,077,881	69.3	5,361,956
Fellowships	8,505,972	18.1	6,137,943	72.2	2,368,029
Training courses	7,582,522	16.2	6,835,908	90.2	746,614
Sub-contracts	369,352	0.8	103,691	28.1	265,661
Miscellaneous	548,535	1.2	543,680	99.1	4,855
Total	46,880,397	100.0	33,422,585	71.3	13,457,812
Current and future years					
Current	46,880,397	79.0	33,422,585	71.3	13,457,812
Future	12,467,540	21.0	1,198,156	9.6	11,269,384
GRAND TOTAL	59,347,937	100.0	34,620,741		24,727,19

* As at 31 December 1990.

IMPLEMENTATION SUMMARY IIIA

ALL FUNDS BY DEPARTMENT AND DIVISION *

	Adjusted programme	Share of total pro- gramme	New obligations	Imple- mentation rate	Earmarkings
	(\$)	(%)	(\$)	(%)	(\$)
Current year					
DEPARTMENT OF RESEARCH AND ISOTOPES					
Joint FAO/IAEA Division	11,687,809	18.7	7,928,305	67.8	3,759,504
Division of Life Sciences	6,663,201	10.6	3,964,200	59.5	2,699,001
Division of Physical and Chemical Sciences	17,887,275	28.6	11,700,571	65.4	6,186,704
The Agency's Laboratories	3,382,193	5.4	2,383,594	70.5	998,599
Laboratory of Marine Radioactivity, Monaco	259,837	0.4	146,560	56.4	113,277
Total	39,880,315	63.7	26,123,230	65.5	13,757,085
DEPARTMENT OF NUCLEAR ENERGY AND SAFETY					
Division of Nuclear Safety	9,584,793	15.3	6,621,928	69.1	2,962,865
Division of Nuclear Power	4,479,527	7.2	2,898,078	64.7	1,581,449
Division of Scientific and Technical Information	297,280	0.5	202,643	68.2	94,637
Division of Nuclear Fuel Cycle and Waste Management	3,128,838	5.0	2,077,511	66.4	1,051,327
Total	17,490,438	28.0	11,800,160	67.5	5,690,278
DEPARTMENT OF ADMINISTRATION					
Legal Division	18,985	0.0	4,181	22.0	14,804
DEPARTMENT OF SAFEGUARDS					
Division of Operations A	26,829	0.0	8,670	32.3	18,159
Division of Development and Technical Support	74	0.0	74	100.0	0
Total	26,903	0.0	8,744	32.5	18,159
DEPARTMENT OF TECHNICAL CO-OPERATION					
Evaluation Section	190,127	0.3	190,127	100.0	0
Programme Co- ordination Section	434,988	0.7	266,770	61.3	168,218
Division of Technical Co- operation Programmes	4,024,045	6.5	3,564,957	88.6	459,088
Division of Technical Co- operation Implementation	17,314	0.0	16,511	95.4	803
Total	4,666,473	7.5	4,038,364	86.5	628,109
GLOBAL					
Not distributed by Department	475,022	0.8	465,627	98.0	9,395
GRAND TOTAL	62,558,136	100.0	42,440,306	67.8	20,117,830

* As at 31 December 1990

**IMPLEMENTATION SUMMARY IIIB
IMPLEMENTATION AGAINST FUTURE YEARS
ALL FUNDS BY DEPARTMENT AND DIVISION ***

	Adjusted programme	Share of total programme	New obligations	Implementation rate	Earmarkings
	(\$)	(%)	(\$)	(%)	(\$)
Future years					
DEPARTMENT OF RESEARCH AND ISOTOPES					
Joint FAO/IAEA Division of Nuclear Techniques in Food and Agriculture	2,123,259	16.8	78,144	3.7	2,045,115
Division of Life Sciences	2,003,985	15.8	149,160	7.4	1,854,825
Division of Physical and Chemical Sciences	4,405,935	34.7	771,348	17.5	3,634,587
The Agency's Laboratories	455,400	3.6	19,829	4.4	435,571
Total	8,998,579	70.9	1,018,481	11.3	7,970,098
DEPARTMENT OF NUCLEAR ENERGY AND SAFETY					
Division of Nuclear Safety	2,071,080	16.3	33,758	1.6	2,037,322
Division of Nuclear Power	916,548	7.2	83,348	9.1	833,200
Division of Nuclear Fuel Cycle and Waste Management	628,933	5.0	76,248	12.1	552,685
Total	3,616,561	28.5	193,354	5.3	3,423,207
DEPARTMENT OF TECHNICAL CO-OPERATION					
Evaluation Section	80,000	0.6	0	0.0	80,000
GRAND TOTAL	12,685,141	100.0	1,211,836	9.6	11,473,305

* As at 31 December 1990.

Explanatory Notes to Figures

Figure 1. Resources available for Agency technical co-operation programmes: 1984-1990

This figure shows all resources made available to the Agency for technical co-operation activities from all funds for the programme years 1984-90. 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 1984-90 include resources made available by the UNDP-administered United Nations Fund for Science and Technology for Development and, starting in 1984, those for projects for which the IAEA acts as associated agency. Amounts shown as extrabudgetary funds refer to resources made available for activities planned for execution in the year shown. Adjustments to prior-year amounts can therefore take place in this category when planned activities are cancelled. It should be noted that the amounts shown in Figure 1 do not include resources made available for future years.

Figure 2. Disbursements by Agency programme area: 1990

This figure shows, by component and by Agency programme area, the distribution of all assistance provided in 1990, irrespective of the source of funds. It should be noted that fellowships under the manpower training projects have been individually assigned to an Agency programme area and their costs are accounted for accordingly.

Figure 3. Disbursements by programme component: 1981-1990

The total assistance provided during the ten year period 1981-1990 (\$350,605,100) 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: 1990

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: 1990

Total disbursements for equipment, grouped by origin and recipient regions, are shown in this figure; individual recipient countries are shown in Table 7. The list at the bottom of the page excludes countries in which the total purchase volume was less than \$50,000.

Figure 6. Summary data on training programmes: 1990

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: 1990

This figure, which refers only to the Technical Assistance and Co-operation Fund, gives total disbursements for 1990 broken down by region and for convertible and non-convertible currencies.

Figure 8. Distribution of technical co-operation disbursements by Agency programme area and region: 1990

The table in the middle gives in thousands of US\$ disbursements by Agency Programme (AAPC) for each of the geographical areas involved. The bar charts at the top illustrate the different emphasis to the various Agency Programmes (AAPC) in each region. (Please note that the scales are different for each region). At the bottom, the overall expenditures by Agency Programme are shown in a summary bar chart.

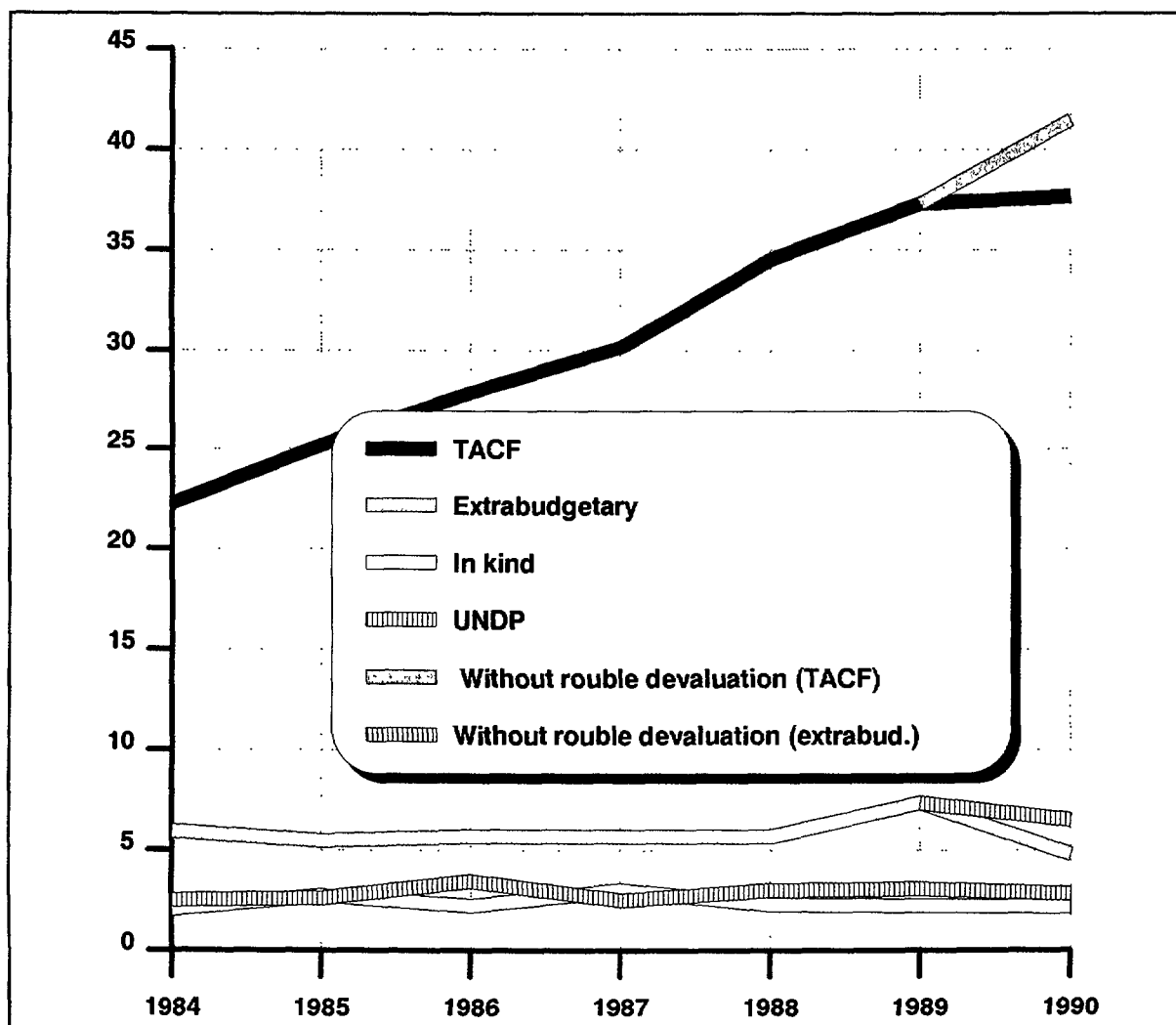
Figure 9. Distribution of technical co-operation disbursements by source and region: 1990

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

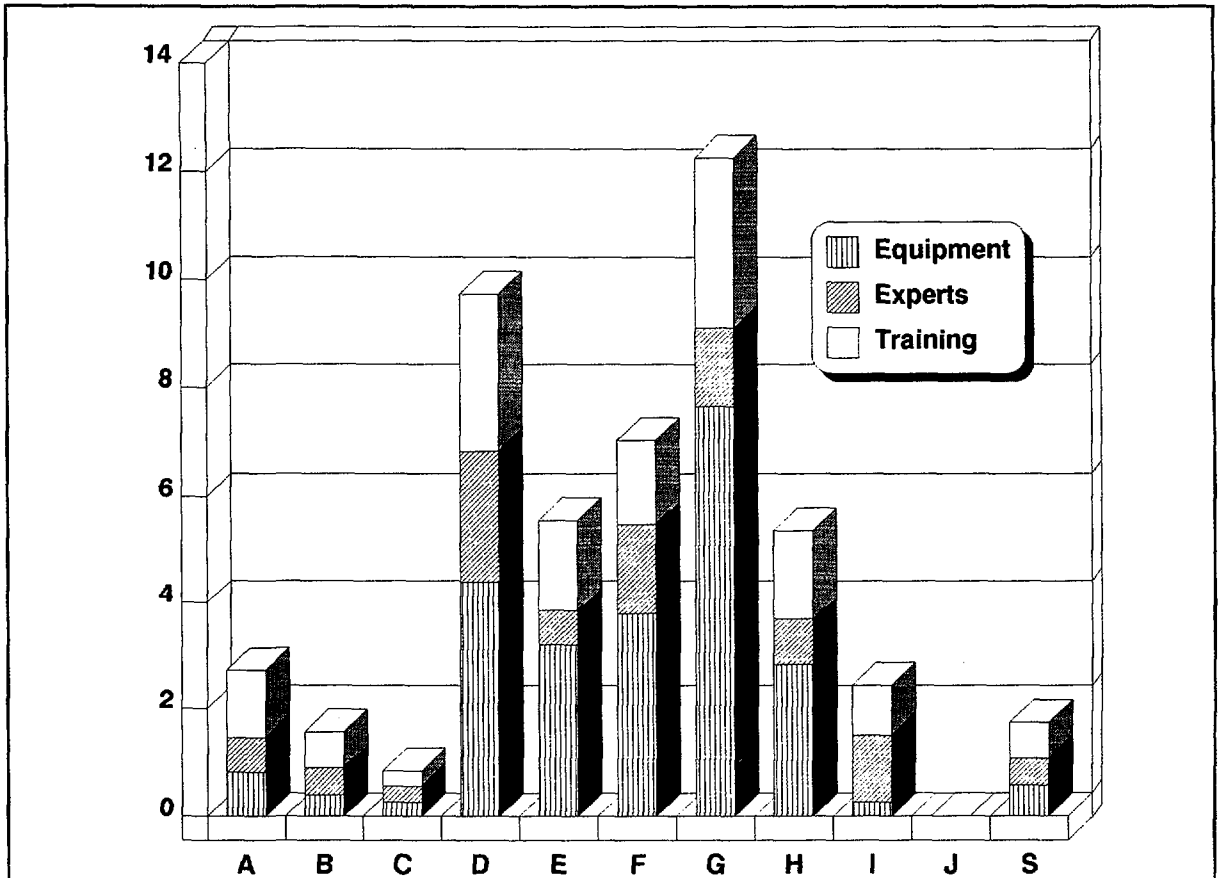
The bar chart shows, over a ten-year period, the total resources available to the Technical Assistance and Co-operation Fund year by year - each year including the unobligated and unspent funds of prior years - as well as the disbursements and obligations incurred against these resources as at 31 December of each year. Obligations incurred against future years for approved multi-year projects are shown separately, reflecting the status at the end of 1990. The graph below it shows, in per cent, the unobligated balance, unliquidated obligations and disbursements for the same ten-year period.

FIGURE 1
RESOURCES AVAILABLE FOR AGENCY
TECHNICAL CO-OPERATION PROGRAMMES
 (in millions of dollars)



TACF	22.232	25.197	27.860	30.153	34.510	37.312	34.660
Extra-budgetary funds	5.964	5.484	5.702	5.700	5.710	7.375	4.820
Assistance in kind	2.066	2.765	2.282	3.066	2.322	2.295	2.214
UNDP	2.541	2.654	3.480	2.568	3.051	3.106	2.856
TOTAL	32.803	36.100	39.324	41.487	45.593	50.088	44.550

FIGURE 2
DISBURSEMENTS BY AAPC: 1990
(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**

FIGURE 3
DISBURSEMENTS BY COMPONENT: 1981-1990
(in millions of dollars)

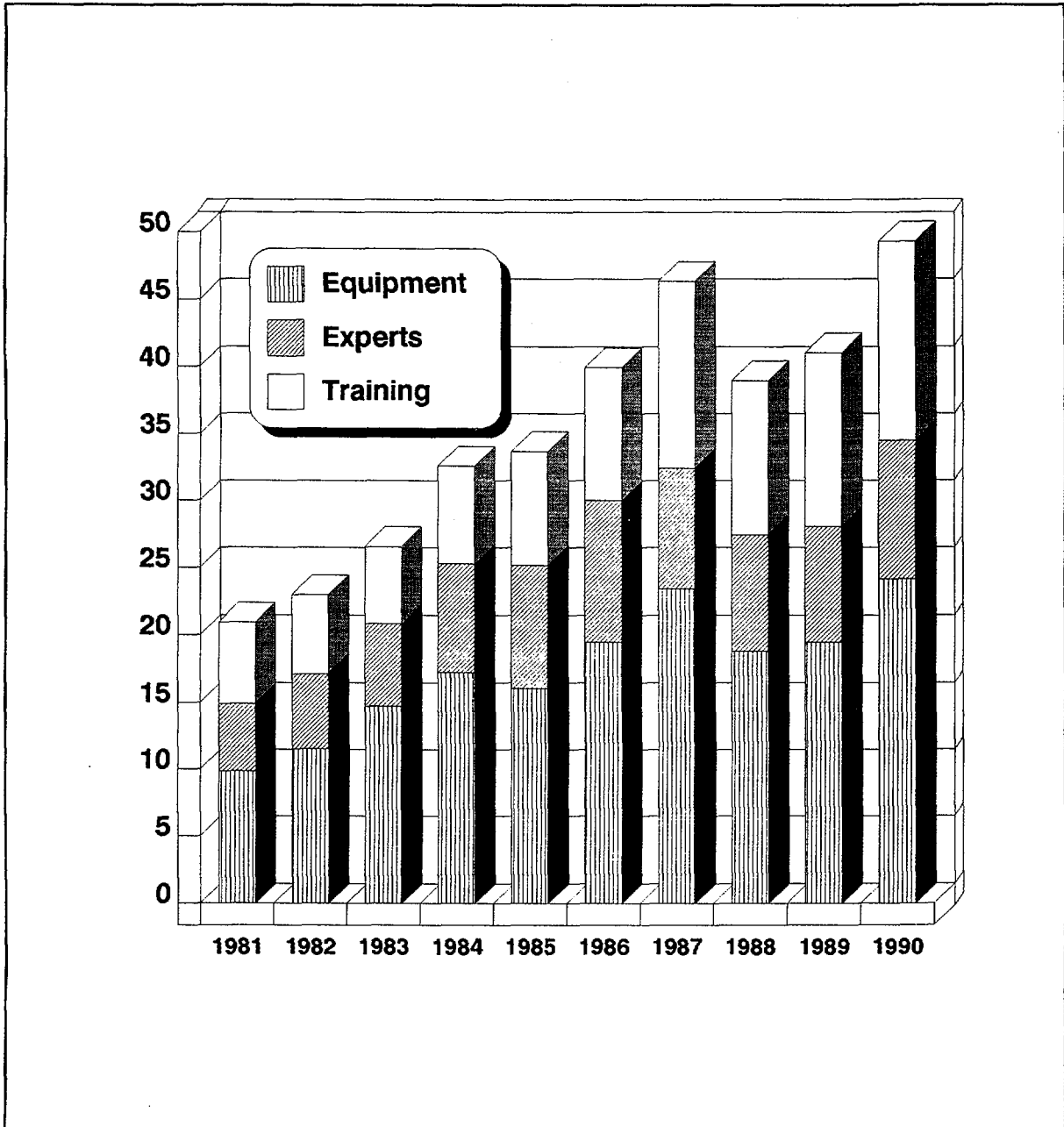
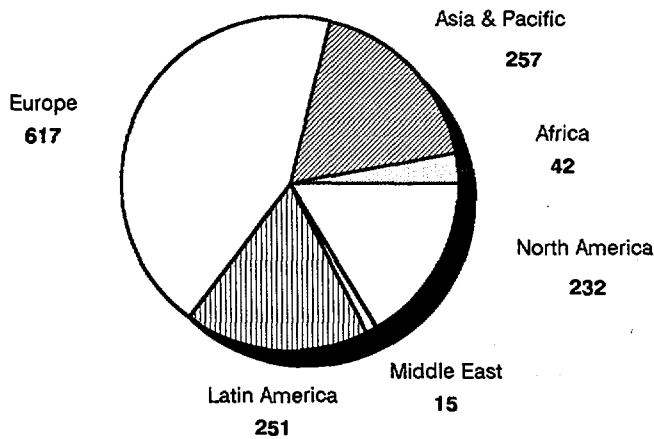
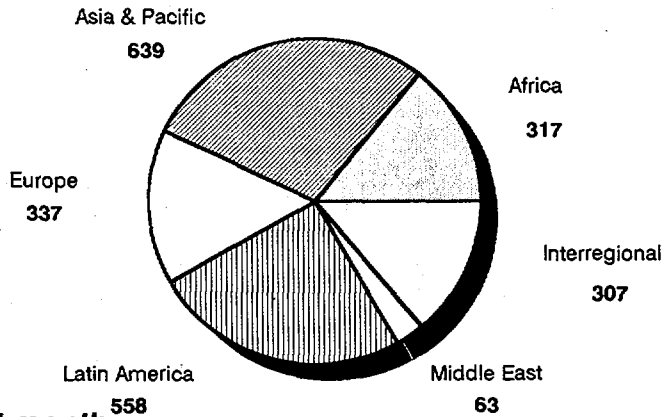


FIGURE 4
TECHNICAL CO-OPERATION
PERSONNEL SERVICES BY REGION: 1990

Where they came from: 1414



Where they went: 2221 assignments



For how long: 1217 months

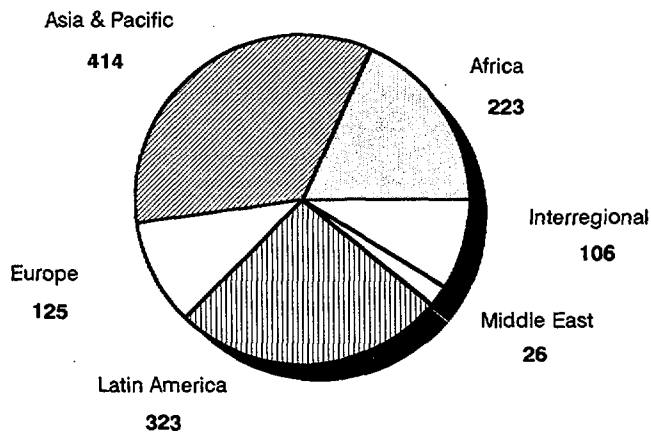
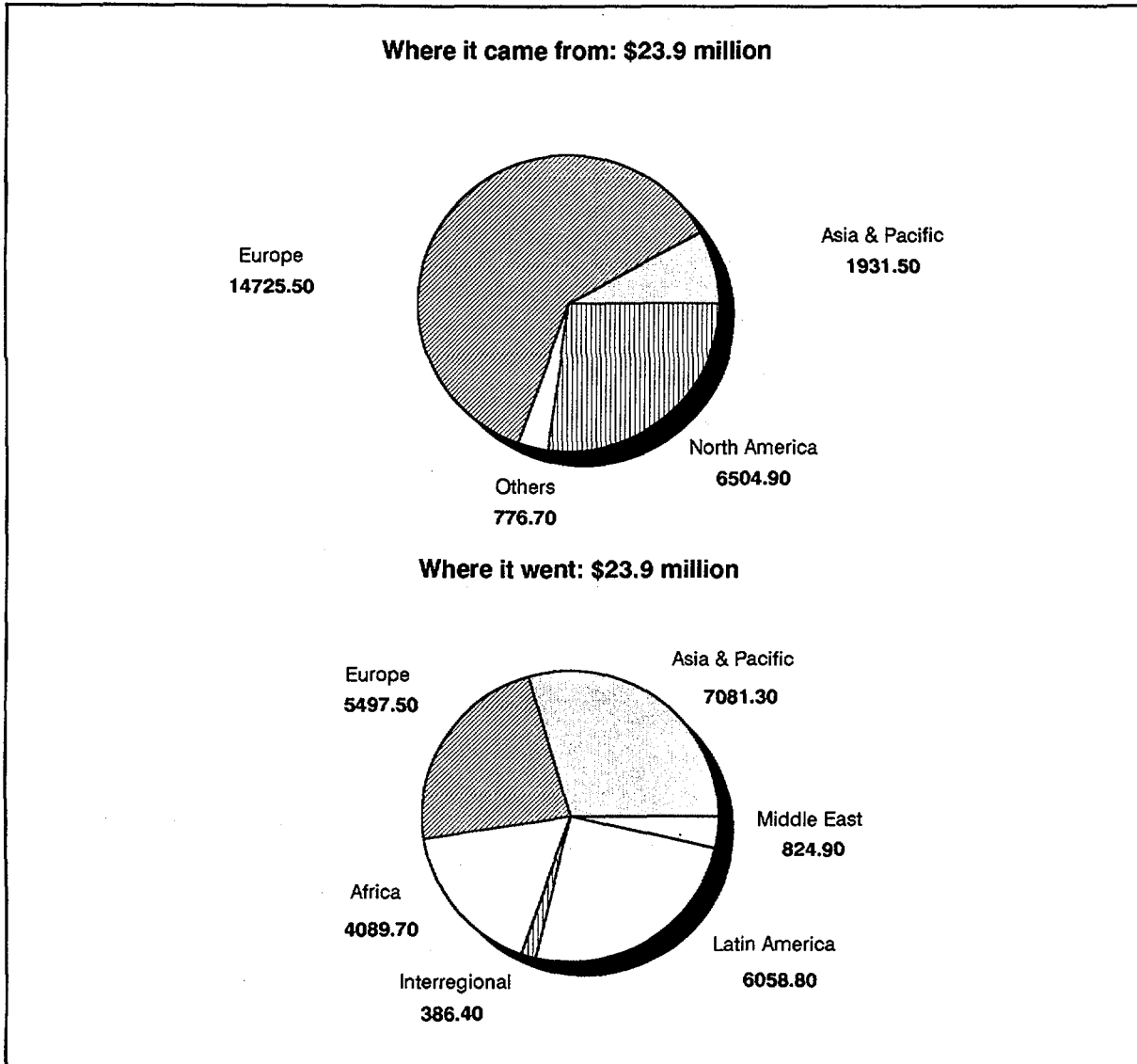


FIGURE 5
DISTRIBUTION OF EQUIPMENT DISBURSEMENTS
BY REGION: 1990
(in thousands of dollars)

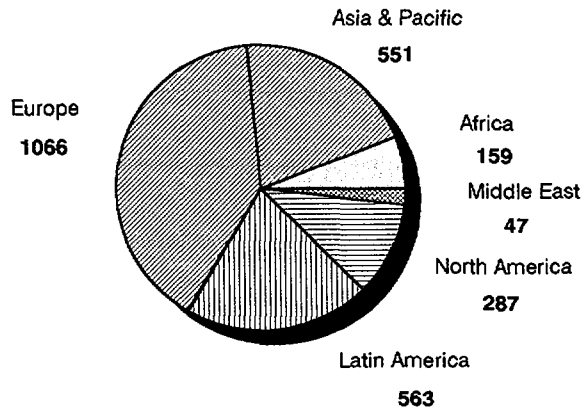


Where equipment was purchased:

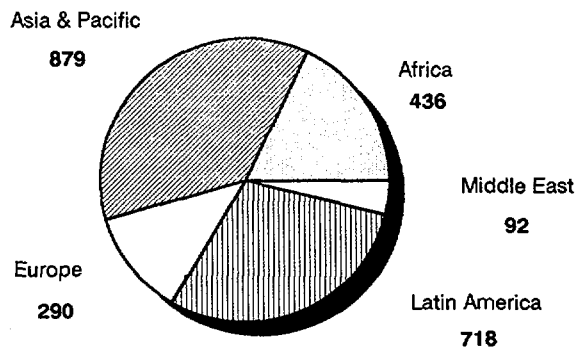
Australia	466.8	Italy	57.3
Austria	1,220.8	Japan	548.1
Bulgaria	62.0	Netherlands	120.1
Canada	251.2	Norway	109.6
China	186.6	Poland	56.4
Czech & Slovak F.R.	244.0	Sweden	162.2
Finland	81.1	Switzerland	144.8
France	1,300.3	UK (Hong Kong)	350.2
Germany	3,675.4	UK	2,090.9
Hungary	309.8	USA	6,253.7
India	279.1	USSR	4,934.3
Ireland	53.9		

FIGURE 6
SUMMARY DATA ON TRAINING PROGRAMMES: 1990

Where training was given:
 2673 places of study



Where trainees came from:
 2415 persons



Amount of training received:
 4595 months

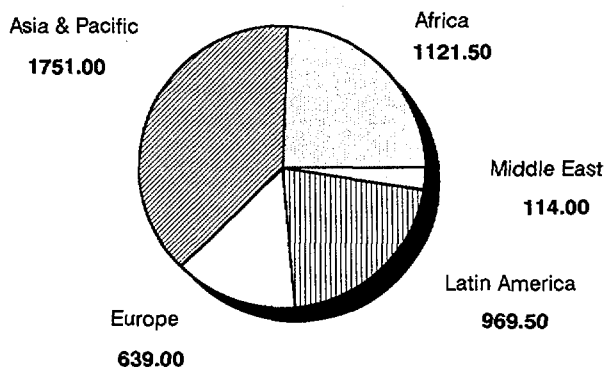


FIGURE 7
TECHNICAL ASSISTANCE AND CO-OPERATION FUND
DISBURSEMENTS BY TYPE OF CURRENCY AND REGION: 1990

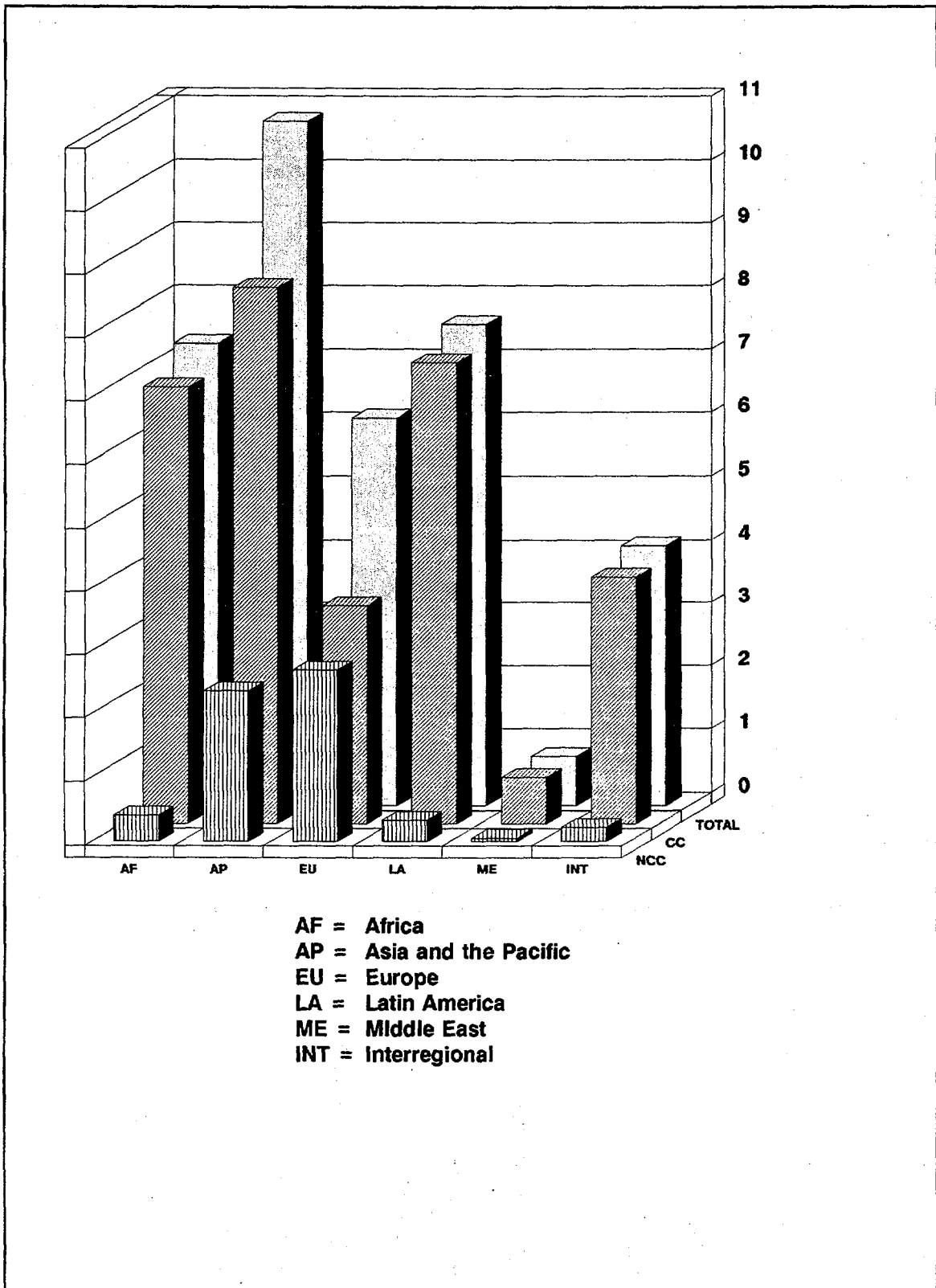
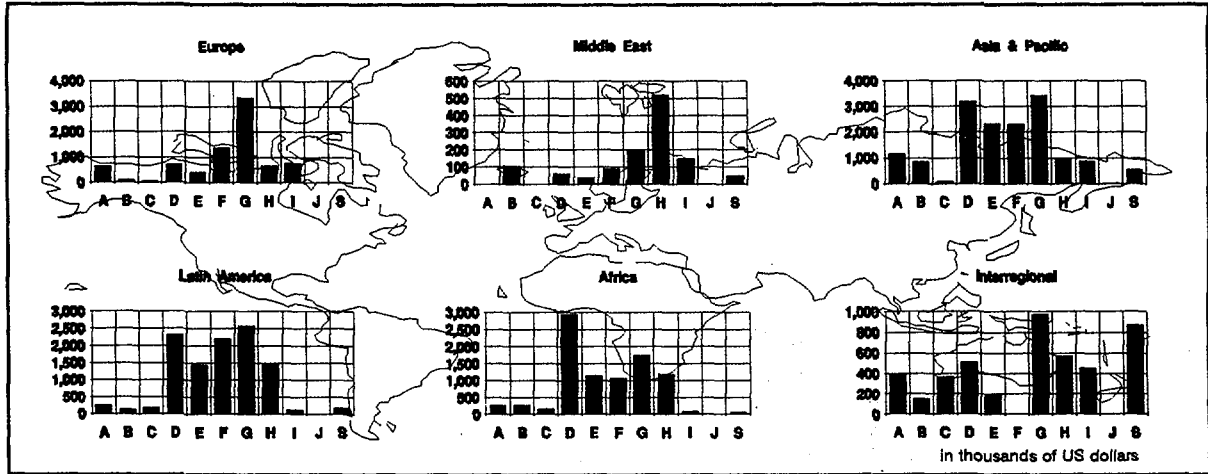


FIGURE 8
TECHNICAL ASSISTANCE AND CO-OPERATION
DISBURSEMENTS BY AAPC: 1990



AAPC	Interregional	Africa	Asia & Pacific	Europe	Latin America	Middle East	Total
A. Nuclear Power	399.9	277.1	1,162.8	627.2	248.6	0.0	2,715.6
B. Nuclear Fuel Cycle	149.2	259.9	838.6	99.4	121.3	104.9	1,573.3
C. Radioactive Waste Management	371.0	162.1	96.8	49.7	172.5	0.0	852.1
D. Food and Agriculture	512.0	2,942.1	3,184.7	723.0	2,321.7	57.2	9,740.7
E. Human Health	187.1	1,153.6	2,328.0	409.1	1,449.5	35.2	5,562.5
F. Industry and Earth Sciences	0.0	1,078.4	2,308.7	1,367.9	2,209.2	88.3	7,052.5
G. Physical and Chemical Sciences	980.0	1,741.7	3,422.9	3,340.4	2,588.1	201.2	12,274.3
H. Radiation Protection	574.4	1,186.0	948.3	658.3	1,499.5	519.0	5,385.5
I. Safety of Nuclear Installations	457.7	75.8	862.8	768.4	127.5	148.1	2,440.3
J. Safeguards	0.0	0.0	8.7	0.0	0.7	0.0	9.4
S. Direction and Support	872.1	74.1	548.8	18.0	184.5	48.0	1,745.5
Total	4,503.4	8,950.8	15,711.1	8,061.4	10,923.1	1,201.9	49,351.7

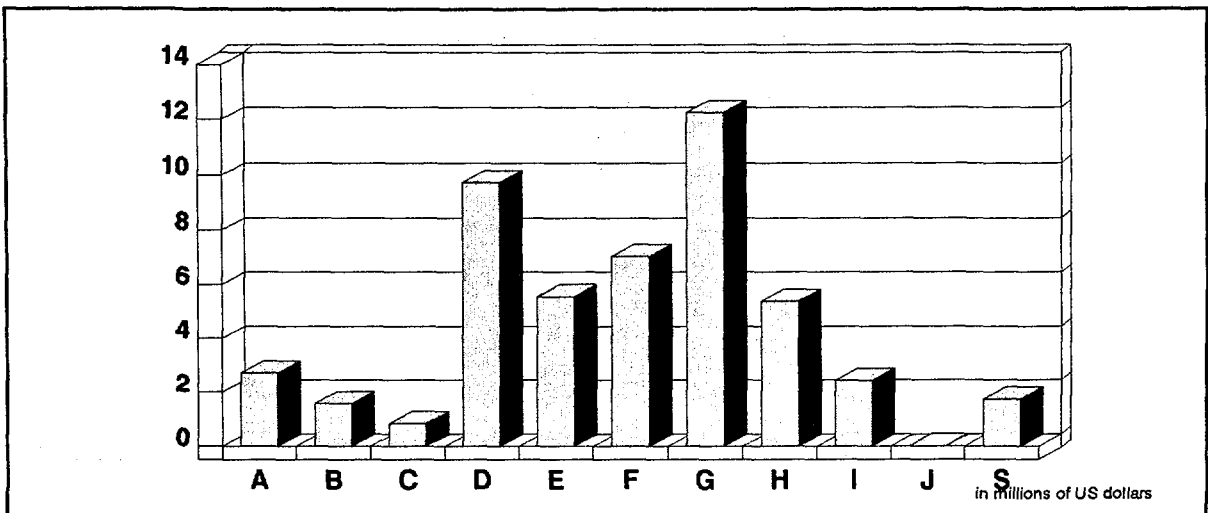


FIGURE 9
DISTRIBUTION OF TECHNICAL CO-OPERATION
DISBURSEMENTS BY SOURCE AND REGION: 1990
(in thousands of dollars)

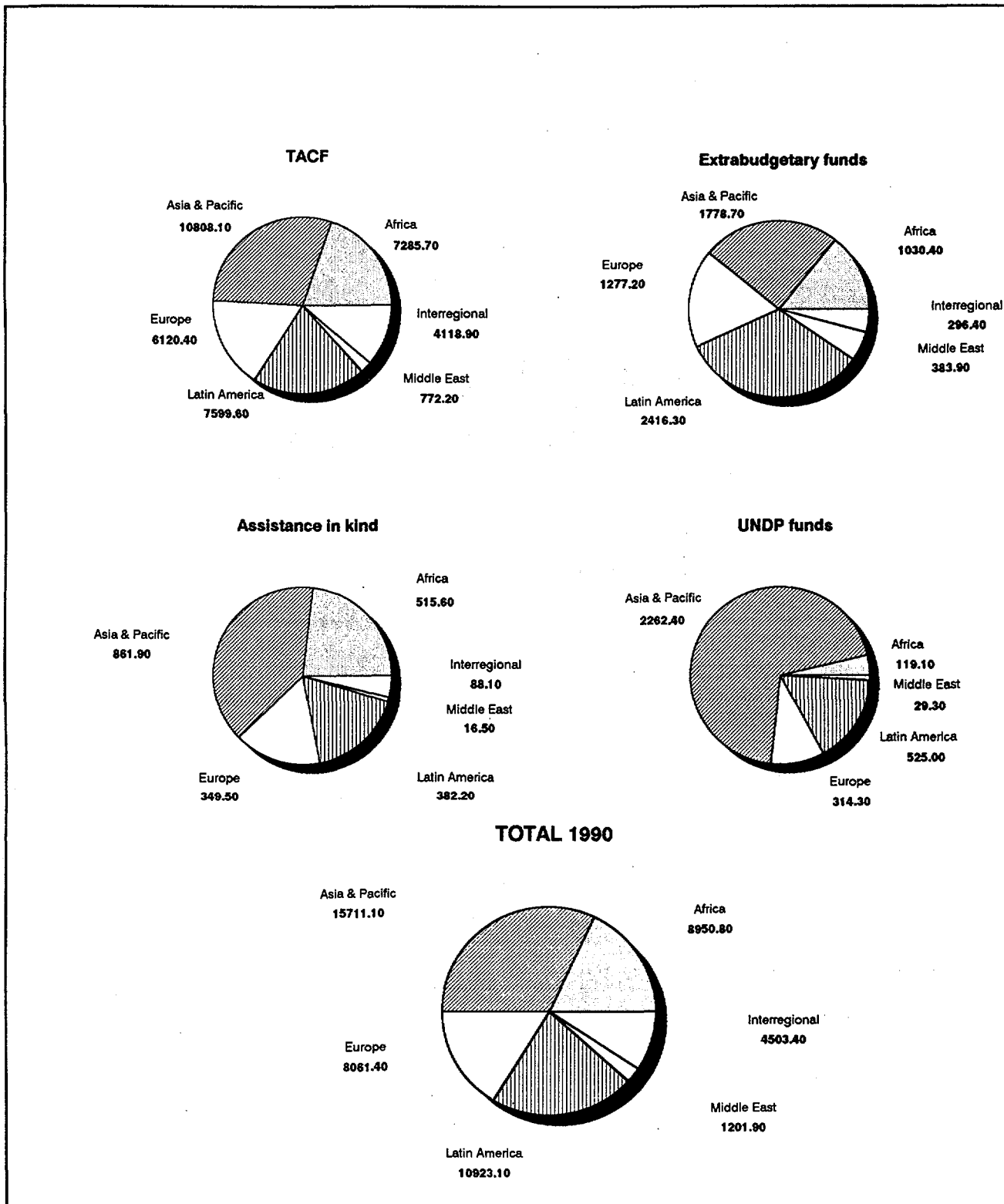
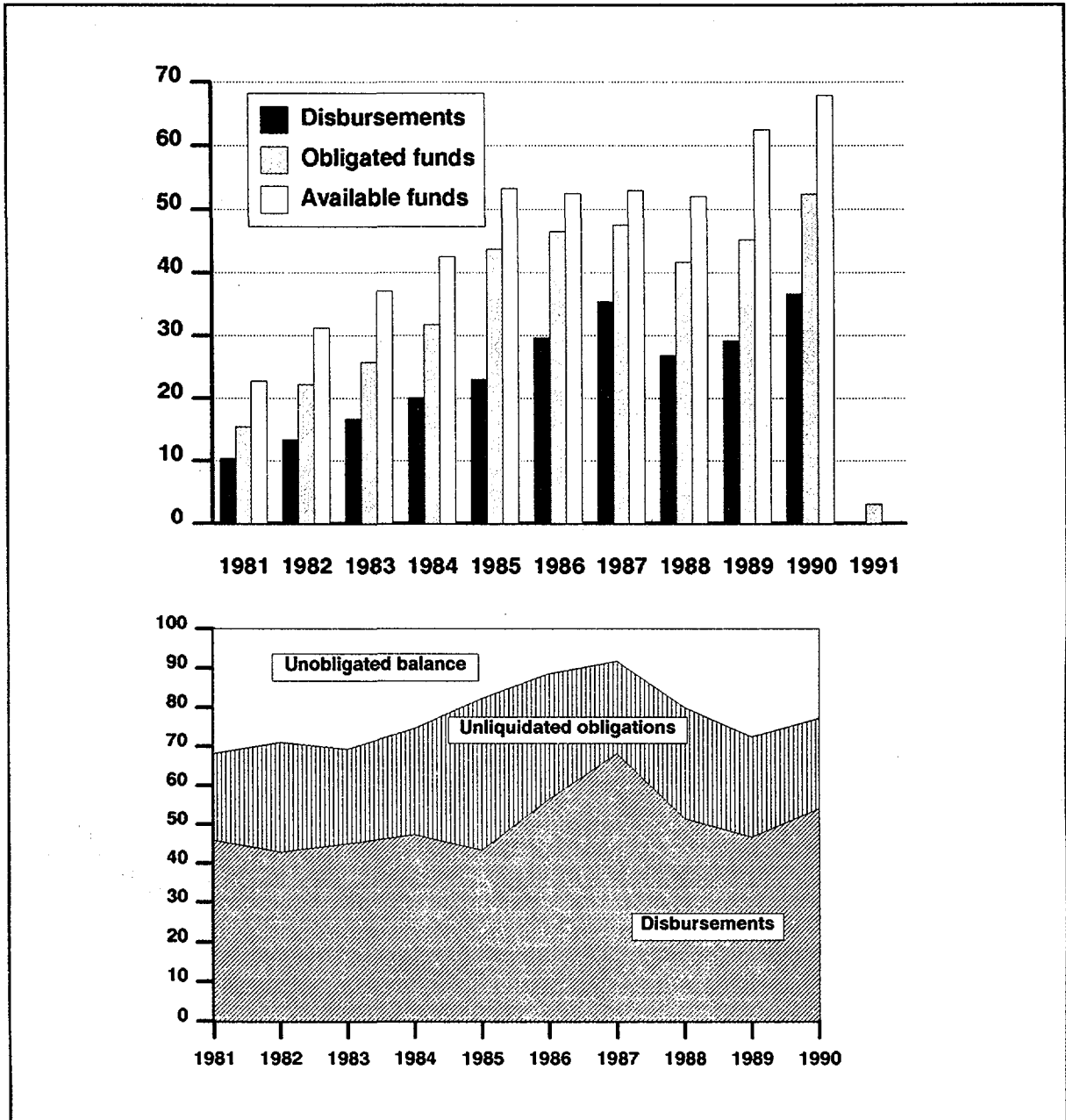


FIGURE 10
UTILIZATION OF THE TECHNICAL ASSISTANCE
AND CO-OPERATION FUND
(status at year-end)



Values in upper figure expressed in millions of dollars.
 Values in lower figure expressed in per cent.

Explanatory Notes to Tables

Table 1. Available resources: 1981-1990

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 1990, please see text paragraph 123.

Table 2. Technical Assistance and Co-operation Fund: 1981-1990

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 1990). It should be noted that, in this table, voluntary contributions are shown not by the year in which they became available but for the programme year for which they are pledged. The graphic presentation below it shows, for a ten-year period, the percentages 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: 1990

This table shows the number of individuals, both international and national, who undertook technical co-operation assignments during 1990. They came from 89 countries. Information on 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: 1990

A breakdown is given for trainees (fellows, training course participants and visiting scientists) based on the place of study. There were 77 places of study involved.

Table 4. Distribution of technical co-operation disbursements by type: 1986-1990

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 man-months of training beyond the end of 1990 for fellows who had already started their studies in 1990. "Miscellaneous" refers to disbursements in all components for telex charges, health insurance, copying fees and for other minor items or services. In 1990, it also included a charge for radiation protection services.

Table 5. Extrabudgetary funds for technical co-operation activities by donor as at 31 December 1990

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 b, e, and g are not included in the Agency's Accounts as these are future receivable amounts, as explained in the footnotes.

Table 6A. Technical co-operation personnel services: 1990

A list is given of 78 recipient countries showing the number of assignments undertaken and man-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: 1990

The list shows the 98 recipient countries, number of trainees and the total man-months of training received in 1990.

Table 7. Financial summary: 1990

This major table shows, by type of assistance and by source, the total technical assistance furnished to 84 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: 1958-1990

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 1989 and 1990.

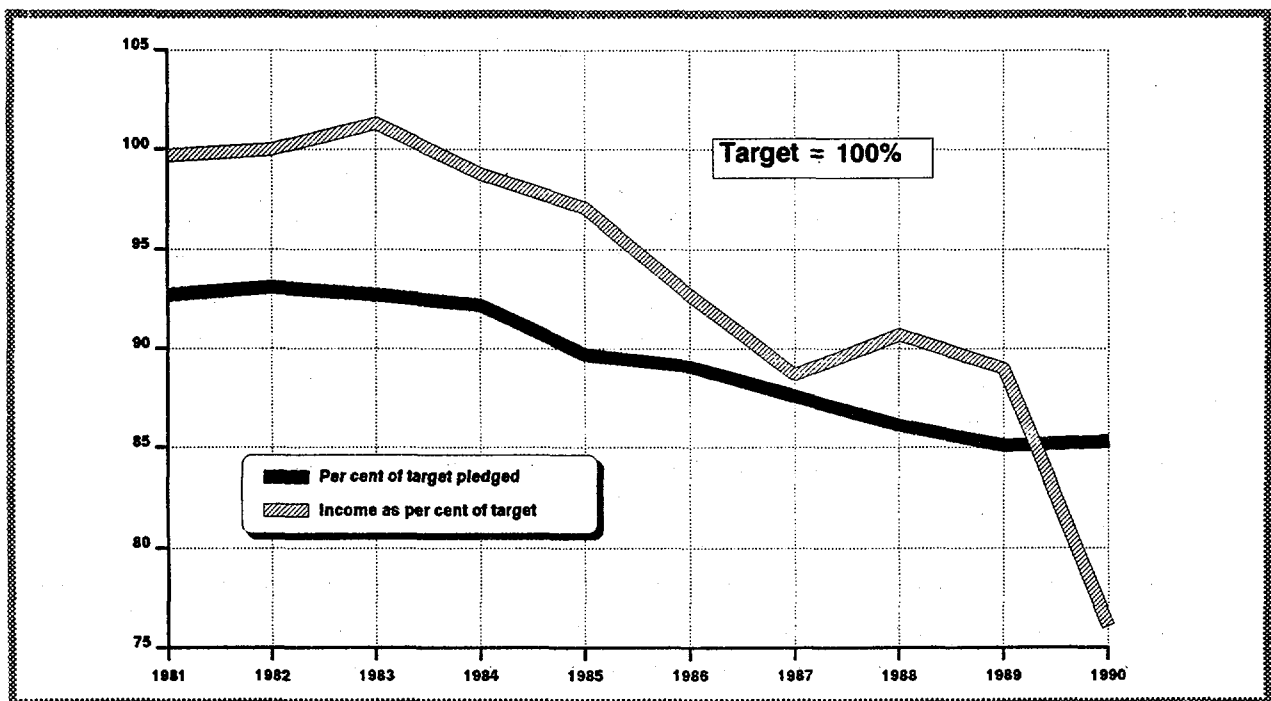
TABLE 1
AVAILABLE RESOURCES: 1981-1990
(in thousands of dollars)

Year	Technical Assistance and Co-operation Fund				Other resources				Grand total (1 + 5)
	Voluntary contributions		Miscellaneous income	Sub-total	Ex-trabudgetary funds	Assistance in kind	UNDP	Sub-total	
	Convertible currency	Non-convertible currency							
	(1a)	(1b)	(1c)	(1)	(2)	(3)	(4)	(5)	
1981	9,873	2,181	902	12,956	3,519	2,788	5,186	11,493	24,449
1982	12,112	2,789	1,102	16,003	4,413	2,493	4,631	11,537	27,540
1983	14,169	3,447	1,625	19,241	8,101	2,172	3,706	13,979	33,220
1984	17,213	3,524	1,495	22,232	5,964	2,066	2,541	10,571	32,803
1985	19,282	3,976	1,939	25,197	5,484	2,765	2,654	10,903	36,100
1986	21,348	5,431	1,081	27,860	5,702	2,282	3,480	11,464	39,324
1987	24,571	5,178	404	30,153	5,700	3,066	2,568	11,334	41,487
1988	26,889	5,854	1,767	34,510	5,710	2,322	3,051	11,086	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
1981-1990	206,931	45,436	7,757	260,124	56,788	24,463	33,779	115,030	375,154

TABLE 2
TECHNICAL ASSISTANCE AND CO-OPERATION FUND: 1981-1990

Programme year	Target for voluntary contributions to the Technical Assistance and Co-operation Fund	Amount pledged	Per cent of target pledged	Income available for technical co-operation programmes	Income as per cent of target
1981	13,000,000	12,054,910	92.7	12,956,894	99.7
1982	16,000,000	14,901,346	93.1	16,003,198	100.0
1983	19,000,000	17,621,272	92.7	19,246,803	101.3
1984	22,500,000	20,735,931	92.2	22,231,347	98.8
1985	26,000,000	23,311,501	89.7	25,250,382	97.1
1986	30,000,000	26,732,785	89.1	27,813,735	92.7
1987	34,000,000	29,768,762	87.6	30,172,431	88.7
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	38,797,255	85.3	34,607,506	76.1

PLEDGES AND INCOME TO THE TACF: 1981 -1990
(in per cent)



**TABLE 3A
PROJECT PERSONNEL BY PLACE OF ORIGIN: 1990**

Place of origin	Total individuals ^a	Assignments				Total
		International experts ^b	National experts	Lecturers ^c	Other project personnel	
Afghanistan	1	-	1	-	-	1
Albania	3	-	3	-	-	3
Algeria	1	2	-	-	-	2
Argentina	58	40	-	49	4	93
Australia	37	44	-	15	-	59
Austria	32	51	-	10	7	68
Bangladesh	11	13	-	3	-	16
Barbados	2	3	-	-	-	3
Belgium	18	23	-	5	-	28
Bolivia	10	13	-	4	-	19
Brazil	47	26	-	34	7	67
Bulgaria	21	4	22	1	-	27
Canada	48	52	-	16	-	68
Chile	22	16	-	11	-	27
China	14	22	-	2	-	24
Colombia	13	16	-	2	-	18
Costa Rica	6	8	-	-	-	8
Cuba	8	6	-	4	-	10
Czech and Slovak Fed. Rep.	19	9	18	3	-	30
Dem. P.R. Korea	1	1	-	-	-	1
Denmark	6	12	-	2	-	14
Dominican Republic	2	3	-	-	-	3
Ecuador	8	13	-	1	-	14
Egypt	12	18	5	-	-	23
Ethiopia	2	5	-	-	-	5
Finland	11	17	-	1	-	18
France	68	70	-	21	-	91
German D.R.	4	4	-	1	-	5
Germany	88	113	-	22	-	135
Ghana	7	9	-	2	-	11
Greece	2	3	-	-	-	3
Guatemala	8	10	-	1	-	11
Guyana	2	3	-	-	-	3
Hungary	39	38	16	9	-	63
Iceland	1	1	-	-	-	1
India	42	66	-	23	-	89
Indonesia	15	17	-	2	1	20
Iran, Islamic Rep.	9	11	6	-	-	17
Ireland	6	4	-	3	-	7
Israel	7	6	-	4	-	10
Italy	26	38	-	4	-	42

Place of origin	Total individuals ^a	Assignments				Total
		International experts ^b	National experts	Lecturers ^c	Other project personnel	
Jamaica	6	5	-	2	-	7
Japan	39	36	-	15	-	51
Jordan	1	2	-	-	-	2
Kenya	2	3	-	1	-	4
Korea, Rep.	10	9	-	2	-	11
Kuwait	1	1	-	-	-	1
Lebanon	1	1	-	-	-	1
Libyan Arab J.	1	2	-	-	-	2
Malaysia	13	10	-	3	-	13
Mali	1	1	-	-	-	1
Mexico	23	20	-	14	1	35
Morocco	4	2	2	1	-	5
Myanmar	1	1	-	-	-	1
Netherlands	17	27	-	3	-	30
New Zealand	3	4	-	-	-	4
Nigeria	4	7	-	-	-	7
Norway	4	5	-	-	-	5
Pakistan	20	17	5	2	-	24
Panama	1	1	-	-	-	1
Paraguay	3	5	-	-	-	5
Peru	14	13	-	5	2	20
Philippines	7	6	-	2	1	9
Poland	36	42	20	4	-	66
Portugal	5	1	-	4	-	5
Romania	11	2	12	-	-	14
Senegal	2	1	1	-	-	2
Singapore	2	2	-	-	-	2
South Africa	1	-	-	-	1	1
Spain	25	29	-	9	-	38
Sri Lanka	11	16	-	8	-	24
Sweden	19	29	-	3	-	32
Switzerland	5	5	-	-	-	5
Syrian Arab Rep.	5	2	2	1	-	5
Thailand	16	17	9	-	2	28
Togo	1	-	-	1	-	1
Trinidad and Tobago	2	3	-	-	-	3
Tunisia	1	1	-	-	-	1
Turkey	6	30	-	1	-	31
Ukrainian SSR	1	-	-	1	-	1
USSR	19	21	-	5	-	26
UK	93	108	-	25	-	133
United Rep. Tanzania	2	3	1	-	-	4
USA	184	240	-	35	1	276
Uruguay	10	15	-	4	-	19
Venezuela	6	8	-	5	-	13

Place of origin	Total individuals ^a	Assignments				Total
		International experts ^b	National experts	Lecturers ^c	Other project personnel	
Viet Nam	5	6	-	-	-	6
Yugoslavia	32	69	2	17	-	88
Zaire	1	1	-	-	-	1
TOTAL	1,414 ^a	1,639 ^b	125	428 ^c	27	2,221

^a Includes 174 IAEA staff members and 7 other international organization members. ^b Includes 394 assignments of IAEA staff members and 4 assignments of other international organization members as international experts. ^c Includes 118 assignments of IAEA staff members and 3 assignments of other international organization members as lecturers.

**TABLE 3B
TRAINEES IN THE FIELD BY PLACE OF STUDY: 1990**

Place of study	Fellows	Training course participants	Visiting scientists	Total
Algeria	-	-	3	3
Argentina	12	96	12	120
Australia	22	42	7	71
Austria	21	-	8	29
Belgium	13	-	7	20
Brazil	24	76	9	109
Bulgaria	1	-	1	2
Burkina Faso	1	-	-	1
Canada	23	-	8	31
Chile	2	18	1	21
China	7	44	7	58
Colombia	3	20	-	23
Costa Rica	1	-	-	1
Cote d'Ivoire	-	17	-	17
Cuba	5	56	24	85
Czech & Slovak F.R.	11	-	2	13
Denmark	5	-	6	11
Ecuador	1	9	-	10
Egypt	7	-	1	8
El Salvador	-	-	2	2
Ethiopia	-	11	-	11
Finland	9	-	5	14
France	48	34	31	113
Germany	78	47	39	164
Ghana	1	30	-	31
Greece	3	20	1	24
Guatemala	4	26	-	30
Honduras	-	-	1	1
Hungary	47	-	22	69
India	28	52	10	90
Indonesia	3	70	4	77
Iraq	-	5	-	5
Israel	3	-	1	4
Italy	16	17	13	46
Jamaica	-	14	-	14
Japan	21	48	14	83
Jordan	1	8	-	9
Kenya	1	-	-	1
Korea, Republic of	1	39	-	40
Kuwait	2	7	-	9
Malaysia	5	23	5	33

Place of study	Fellows	Training course participants	Visiting scientists	Total
Mali	-	6	-	6
Mexico	13	80	4	97
Monaco	1	17	1	19
Morocco	1	18	2	21
Netherlands	12	-	12	24
New Zealand	1	-	1	2
Nigeria	-	18	1	19
Norway	1	-	2	3
Pakistan	4	21	4	29
Paraguay	-	18	-	18
Peru	-	27	-	27
Philippines	1	17	1	19
Poland	24	-	7	31
Portugal	-	-	2	2
Romania	-	-	1	1
Saudi Arabia	-	-	1	1
Singapore	2	-	-	2
Spain	21	12	7	40
Sudan	-	-	1	1
Sweden	17	-	10	27
Switzerland	3	-	5	8
Syrian A.R.	-	19	-	19
Thailand	6	33	4	43
Tunisia	-	23	-	23
Turkey	-	16	-	16
Uganda	-	16	-	16
USSR	20	30	5	55
UK	82	-	22	104
UK (Hong Kong)	4	-	-	4
USA	89	139	28	256
Uruguay	2	-	-	2
Venezuela	1	-	2	3
Yugoslavia	11	24	10	45
Zimbabwe	1	-	-	1
IAEA	99	36	45	180
European Nuclear Res. Center	5	-	1	6
TOTAL	851	1,399	423	2,673

^a The difference between the number of trainees (2,415) and the number of places of study (2,673) is due to the fact that a number of fellows, training course participants and visiting scientists went to more than one country/place.

TABLE 4
DISTRIBUTION OF TECHNICAL CO-OPERATION DISBURSEMENTS
BY TYPE: 1986-1990

Year	Source	Experts		Equipment		Fellowships		Scientific visits		Training courses		Sub-contracts		Miscellaneous		TOTAL		Unliquida ted obliga- tions	In-kind balance	TOTAL
		\$	%	\$	%	\$	%	\$	%	\$	%	\$	%	\$	%	\$	\$			
1986	UNDP funds	940.7	31.4	1,285.1	43.0	160.7	5.4	49.0	1.6	426.4	14.3	71.1	2.4	57.6	1.9	2,990.6	100.0	0.0	0.0	2,990.6
	Agency funds	6,437.0	21.7	14,068.9	47.4	4,060.1	13.7	728.0	2.4	3,831.9	12.9	410.7	1.4	146.0	0.5	29,682.6	100.0	0.0	0.0	29,682.6
	Extrabudgetary funds	1,459.4	29.1	2,759.1	54.9	131.8	2.6	1.4	0.0	338.4	6.7	335.1	6.7	0.0	0.0	5,025.2	100.0	0.0	0.0	5,025.2
	Assistance in kind	427.3	18.7	0.0	0.0	1,504.5	65.9	0.0	0.0	350.1	15.4	0.0	0.0	0.0	0.0	2,281.9	100.0	0.0	0.0	2,281.9
	Total	9,264.4	23.2	18,113.1	45.3	5,857.1	14.7	778.4	1.9	4,946.8	12.4	816.9	2.0	203.6	0.5	39,980.3	100.0	0.0	0.0	39,980.3
1987	UNDP funds	983.8	29.5	1,423.7	42.7	319.4	9.6	127.1	3.8	292.3	8.8	182.0	5.5	3.5	0.1	3,331.8	100.0	0.0	0.0	3,331.8
	Agency funds	6,746.7	19.0	18,518.5	52.2	5,904.3	16.7	369.6	1.0	3,539.0	10.0	212.0	0.6	170.1	0.5	35,460.2	100.0	0.0	0.0	35,460.2
	Extrabudgetary funds	954.8	21.3	3,043.4	67.8	89.9	2.0	8.5	0.2	288.7	6.4	101.9	2.3	0.0	0.0	4,487.2	100.0	0.0	0.0	4,487.2
	Assistance in kind	171.5	5.6	0.0	0.0	2,514.6	82.0	0.0	0.0	376.8	12.3	2.9	0.1	0.0	0.0	3,065.8	100.0	0.0	0.0	3,065.8
	Total	8,856.8	19.1	22,985.6	49.6	8,828.2	19.0	505.2	1.1	4,496.8	9.7	498.8	1.1	173.6	0.4	46,345.0	100.0	0.0	0.0	46,345.0
1988	UNDP funds	855.7	34.7	664.3	26.9	327.4	13.3	128.9	5.2	324.8	13.2	123.0	5.0	42.3	1.7	2,466.4	100.0	0.0	0.0	2,466.4
	Agency funds	6,077.3	22.7	11,948.8	44.6	4,049.2	15.1	405.2	1.5	3,663.9	13.6	262.7	1.0	403.2	1.5	26,810.3	100.0	0.0	0.0	26,810.3
	Extrabudgetary funds	1,077.3	20.0	3,391.8	62.9	(38.4)	(0.7)	9.8	0.2	554.8	10.3	391.8	7.3	0.0	0.0	5,387.1	100.0	0.0	0.0	5,387.1
	Assistance in kind	290.0	12.5	55.7	2.4	1,542.5	66.4	0.0	0.0	434.3	18.7	0.0	0.0	0.0	0.0	2,322.5	100.0	0.0	0.0	2,322.5
	Total	8,300.3	22.4	18,060.6	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	1,478.5	0.0	4,728.6
	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	17,147.1	0.0	53,852.0
	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	7,182.8	100.0	3,644.9	0.0	10,827.8
	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	282.2	2,496.0
	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	22,270.5	282.2	71,904.4
1986-1990	UNDP funds	4,444.3	30.0	5,300.2	35.8	1,999.1	13.5	573.9	3.9	1,812.0	12.2	531.2	3.6	142.0	1.0	14,802.7	100.0	1,478.5	0.0	16,281.2
	Agency funds	32,467.7	20.6	76,801.1	48.5	23,071.3	14.6	3,146.4	2.0	19,614.6	12.4	1,287.3	0.8	1,734.0	1.1	157,922.4	100.0	17,147.1	0.0	175,069.5
	Extrabudgetary funds	6,126.6	21.3	17,443.1	60.5	585.3	2.0	77.4	0.3	2,935.0	10.2	1,655.2	5.7	0.0	0.0	28,822.8	100.0	3,644.9	0.0	32,467.5
	Assistance in kind	1,520.7	12.5	198.7	1.6	8,301.3	68.2	44.9	0.4	2,110.1	17.3	2.9	0.0	0.0	0.0	12,178.6	100.0	0.0	282.2	12,460.8
	Total	44,559.3	20.8	99,543.1	48.6	33,957.0	15.9	3,842.8	1.8	26,471.7	12.4	3,476.6	1.6	1,876.0	0.9	213,726.3	100.0	22,270.5	282.2	236,279.0

TABLE 5
EXTRABUDGETARY FUNDS FOR TECHNICAL CO-OPERATION
ACTIVITIES BY DONOR
(as at 31 December 1990)

Donor	Funds available 1 January 1990	New funds in 1990	Total funds available	Disbursements in 1990	Unliquidated obligations at year-end	Unobligated balance
Part A: Funds for activities where donor is not recipient						
Australia	298,571	605,337	903,908	272,460	46,148	585,300
Asian Dev. Bank	-2,443	3,343	900	900	0	0
Belgium	104,674	186,345	291,019	56,442	2,400	232,177
Canada	1,510	0	1,510	0	0	1,510
Chile	5,200	6,000	11,200	9,565	0	1,635
Colombia ^a	0	10,000	10,000	10,000	0	0
CEC	15,661	120,318	135,979	44,281	46,084	45,614
Finland	174,376	0	174,376	12,773	113,473	48,130
France	402,157	460,908	863,065	370,287	173,828	318,950
Germany, F.R.	1,630,469	1,355,741 ^b	2,986,210	1,522,202	609,155	854,853
Italy	795,001	546,600	1,341,601	339,142	502,664	499,795
Japan	229,522	290,000 ^c	519,522	213,809	106,137	199,576
Korea, Rep. of	150,000	0	150,000	16,064	1,700	132,236
Kuwait	11,577	0	11,577	9,161	735	1,681
Norway	505	0	505	0	0	505
Saudi Arabia	4,229	0	4,229	0	0	4,229
Spain	92,005	199,668	291,673	147,360	144,312	1
Sweden	253,792	526,423	780,215	333,167	164,752	282,296
USSR	3,613,660	-2,403,736 ^d	1,209,924	610,921	598,242	761
UK	1,653,358	829,135 ^e	2,482,493	687,959	489,197	1,305,337
USA	3,181,056	1,200,000 ^f	4,381,056	2,048,313	547,964	1,784,779
Sub-total	12,614,880	3,936,082	16,550,962	6,704,806	3,546,791	6,299,365
Part B: Funds for activities where donor is recipient						
Chile	1,844	0	1,844	0	0	1,844
Colombia	514	0	514	0	0	514
Ecuador	2,627	0	2,627	326	2,300	1
Ghana	43,787	0	43,787	28,072	6,419	9,296
Hungary	9,293	15,245	24,538	15,547	0	8,991
Iran, Islamic Rep.	3,822	5,000	8,822	0	4,921	3,901
Ireland	10,000	0	10,000	0	11,346	-1,346
Libyan Arab J.	-659	51,920	51,261	35,188	0	16,073
Malaysia	570	0	570	65	0	505
Mexico	115	0	115	0	0	115
Pakistan	3,409	63,500	66,909	0	41,000	25,909
Poland	26,281	0	26,281	13,276	6,891	6,114
Portugal	3,130	16,633	19,763	0	0	19,763
Syrian Arab Rep.	80,360	103,322 ^g	183,682	38,837	15,577	129,268
Thailand	1,983	0	1,983	1,980	0	3
U.A. Emirates	542,046	0	542,046	335,837	2,300	203,909
Yugoslavia	94,354	0	94,354	18,980	7,404	67,970
Sub-total	823,476	255,620	1,079,096	488,108	98,158	492,830
TOTAL	13,438,356	4,191,702	17,630,058	7,192,914	3,644,949	6,792,195

^a Included under the TACF in the Agency's Accounts and in this report (Figures 7, 9, 10 and Tables 4, 7 and 8). ^b Includes \$160,100 as future-year project provisions.
^c Additional funds provided under non-TC programmes for the RCA project in Asia. ^d Consists of \$1,698,406 loss on exchange for funds received in earlier years and reversal of receivable of \$705,330. ^e Includes receivable of \$418,580. ^f Includes \$57,500 as future-year project provisions. ^g Includes \$100,000 letter of credit.

TABLE 6A
TECHNICAL CO-OPERATION PERSONNEL SERVICES: 1990

Recipient	Number of assignments	Number of months
Afghanistan	1	0.5
Albania	12	5.0
Algeria	10	7.0
Argentina	4	4.0
Bangladesh	12	6.0
Bolivia	9	5.0
Brazil	30	37.0
Bulgaria	41	19.0
Cameroon	1	0.5
Chile	19	11.0
China	48	25.0
Colombia	18	10.0
Costa Rica	3	3.0
Côte d'Ivoire	11	5.5
Cuba	12	8.5
Cyprus	6	2.5
Czech & Slovak F.R	31	12.5
Dem. P.R. Korea	5	5.0
Dominican Republic	5	3.0
Ecuador	17	10.5
Egypt	42	17.0
El Salvador	8	3.0
Ethiopia	11	6.0
Gabon	1	2.0
Ghana	14	11.0
Greece	6	4.0
Guatemala	7	4.0
Haiti	3	1.5
Hungary	3	1.0
Iceland	1	0.5
Indonesia	54	71.0
Iran, Islamic Rep.	33	19.0
Iraq	25	9.0
Ireland	1	0.5
Jamaica	6	2.0
Jordan	12	7.0
Kenya	4	7.0
Korea, Rep. of	43	21.5
Libyan Arab J.	10	12.0
Madagascar	1	1.0
Malaysia	32	20.0
Mali	5	4.5

Recipient	Number of assignments	Number of months
Mexico	47	22.5
Mongolia	14	12.0
Morocco	23	13.0
Myanmar	8	9.0
Nicaragua	2	1.5
Niger	6	3.0
Nigeria	26	13.5
Pakistan	31	16.5
Panama	6	4.0
Paraguay	8	7.0
Peru	15	19.0
Philippines	14	7.0
Poland	11	4.5
Portugal	15	6.0
Romania	52	19.5
Saudi Arabia	4	1.0
Senegal	7	3.0
Sierra Leone	3	2.5
Singapore	3	3.0
Sri Lanka	9	5.5
Sudan	7	3.5
Syrian Arab Rep.	17	7.0
Thailand	34	49.0
Tunisia	16	4.5
Turkey	19	9.5
United Arab Emirates	4	2.0
UK (Hong Kong)	4	2.5
United Rep. Tanzania	12	8.0
Uganda	7	5.0
Uruguay	7	5.5
Venezuela	18	13.5
Viet Nam	22	15.5
Yugoslavia	32	8.5
Zaire	5	3.5
Zambia	10	7.5
Zimbabwe	7	6.0
Sub-total	1,142	729.0
Intercountry projects	651	372.5
Training courses	428	115.5
Sub-total	1,079	488.0
TOTAL	2,221	1,217.0

TABLE 6B
RECIPIENTS OF TRAINING ABROAD: 1990

Recipient	Fellows		Visiting scientists		Training course participants		Total	
	(1)	(2)	(1)	(2)	(1)	(2)	(1)	(2)
Afghanistan	0	0.0	0	0.0	2	2.0	2	2.0
Albania	8	24.5	6	5.0	5	5.0	19	34.5
Algeria	10	25.0	5	2.5	17	11.0	32	38.5
Angola	0	0.0	0	0.0	1	1.0	1	1.0
Argentina	4	5.0	11	7.0	44	31.5	59	43.5
Bangladesh	28	129.0	4	2.5	35	33.0	67	164.5
Barbados	0	0.0	0	0.0	3	0.5	3	0.5
Benin	0	0.0	0	0.0	2	2.0	2	2.0
Bhutan	0	0.0	0	0.0	1	1.0	1	1.0
Bolivia	2	20.0	1	0.5	25	30.0	28	50.5
Brazil	14	25.5	15	6.5	55	70.0	84	102.0
Bulgaria	24	110.0	9	8.0	14	12.5	47	130.5
Burkina Faso	0	0.0	0	0.0	2	2.0	2	2.0
Burundi	0	0.0	0	0.0	2	2.0	2	2.0
Cameroon	5	13.0	0	0.0	8	5.0	13	18.0
Central African Rep.	0	0.0	0	0.0	1	1.5	1	1.5
Chad	0	0.0	0	0.0	1	1.0	1	1.0
Chile	13	35.0	3	1.0	59	47.0	75	83.0
China	79	291.0	24	15.5	54	39.0	157	345.5
Colombia	16	58.0	0	0.0	31	25.5	47	83.5
Costa Rica	2	2.0	3	1.0	23	18.0	28	21.0
Côte d'Ivoire	3	7.0	4	2.0	5	5.0	12	14.0
Cuba	13	34.0	9	6.5	13	31.0	35	71.5
Cyprus	0	0.0	1	0.5	2	4.0	3	4.5
Czech & Slovak F.R.	9	43.0	0	0.0	15	15.0	24	58.0
Dem. P.R. Korea	9	38.0	0	0.0	6	3.0	15	41.0
Dominican Republic	2	4.5	0	0.0	12	4.5	14	9.0
Ecuador	19	42.0	2	1.0	29	23.5	50	66.5
Egypt	24	121.5	3	2.5	16	16.5	43	140.5
El Salvador	6	12.5	0	0.0	9	11.5	15	24.0
Ethiopia	11	54.0	0	0.0	4	3.0	15	57.0
Gabon	0	0.0	0	0.0	3	2.5	3	2.5
Gambia	0	0.0	0	0.0	1	1.0	1	1.0
Ghana	13	61.5	1	1.0	10	7.0	24	69.5
Greece	5	27.0	3	3.0	6	10.0	14	40.0
Guatemala	10	36.5	2	3.0	13	9.0	25	48.5
Guinea	0	0.0	0	0.0	1	1.0	1	1.0
Guinea-Bissau	0	0.0	0	0.0	1	1.0	1	1.0
Guyana	0	0.0	0	0.0	5	1.0	5	1.0
Haiti	1	2.0	0	0.0	2	4.0	3	6.0
Hungary	15	42.5	3	1.5	13	11.0	31	55.0
Honduras	0	0.0	0	0.0	1	2.0	1	2.0
India	1	5.0	0	0.0	32	20.0	33	25.0
Indonesia	27	102.0	10	7.0	45	29.0	82	138.0
Iran	17	70.0	2	0.5	14	12.5	33	83.0
Iraq	4	16.0	8	5.0	14	8.5	26	29.5
Ireland	0	0.0	2	1.0	1	0.5	3	1.5
Jamaica	0	0.0	0	0.0	7	3.5	7	3.5

Recipient	Fellows		Visiting scientists		Training course participants		Total	
	(1)	(2)	(1)	(2)	(1)	(2)	(1)	(2)
Jordan	4	12.0	0	0.0	22	18.5	26	30.5
Kenya	9	49.5	0	0.0	9	8.0	18	57.5
Korea, Republic of	13	83.0	8	5.5	33	24.0	54	112.5
Kuwait	0	0.0	0	0.0	4	1.5	4	1.5
Libyan Arab J.	20	77.0	0	0.0	10	6.0	30	83.0
Madagascar	3	15.0	1	0.5	7	5.5	11	21.0
Malaysia	16	37.0	5	3.0	43	32.0	64	72.0
Mali	4	17.0	0	0.0	6	7.0	10	24.0
Mauritius	3	4.5	0	0.0	3	2.0	6	6.5
Mexico	11	36.5	17	6.0	46	52.0	74	94.5
Mongolia	14	52.5	1	1.0	4	3.0	19	56.5
Morocco	4	11.0	1	1.0	12	12.0	17	24.0
Myanmar	2	2.5	0	0.0	1	2.0	3	4.5
Nepal	0	0.0	0	0.0	2	2.0	2	2.0
Nicaragua	4	29.0	0	0.0	0	0.0	4	29.0
Niger	3	16.0	0	0.0	9	7.5	12	23.5
Nigeria	31	195.0	3	2.0	7	7.0	41	204.0
Pakistan	25	87.5	9	5.5	45	33.0	79	126.0
Panama	2	8.0	2	1.0	6	4.0	10	13.0
Paraguay	5	11.5	0	0.0	13	6.0	18	17.5
Peru	9	30.5	5	5.0	37	40.5	51	76.0
Philippines	13	51.5	2	2.0	26	18.0	41	71.5
Poland	22	118.0	5	3.0	22	25.0	49	146.0
Portugal	3	6.5	3	1.0	8	10.0	14	17.5
Romania	4	13.5	16	7.0	15	18.0	35	38.5
Saudi Arabia	0	0.0	0	0.0	3	5.0	3	5.0
Senegal	5	12.0	1	0.5	10	7.0	16	19.5
Sierra Leone	2	8.5	0	0.0	5	4.5	7	13.0
Singapore	2	10.0	0	0.0	10	9.0	12	19.0
Somalia	0	0.0	0	0.0	1	1.0	1	1.0
Spain	1	3.0	0	0.0	0	0.0	1	3.0
Sri Lanka	5	20.0	2	2.0	30	26.5	37	48.5
Sudan	12	77.5	1	1.0	8	8.5	21	87.0
Syrian A.R.	11	35.0	2	1.0	13	8.5	26	44.5
Thailand	29	112.0	7	4.5	44	28.5	80	145.0
Togo	0	0.0	0	0.0	3	4.0	3	4.0
Trinidad and Tobago	0	0.0	0	0.0	6	1.5	6	1.5
Tunisia	3	9.0	4	2.0	9	11.0	16	22.0
Turkey	15	51.0	5	2.0	16	17.0	36	70.0
Uganda	3	8.0	0	0.0	7	6.0	10	14.0
United Arab Emirates	0	0.0	0	0.0	7	3.0	7	3.0
U.K. (Hong Kong)	0	0.0	1	0.5	1	0.5	2	1.0
U.R. Tanzania	13	63.0	1	0.5	8	7.0	22	70.5
Uruguay	5	21.0	1	0.5	27	36.0	33	57.5
Venezuela	15	47.0	4	2.0	24	15.0	43	64.0
Viet Nam	51	254.0	3	2.0	42	36.0	96	292.0
Yugoslavia	6	31.0	1	1.0	7	9.0	14	41.0
Zaire	5	26.5	1	0.5	11	10.0	17	37.0
Zambia	10	35.5	0	0.0	7	5.0	17	40.5
Zimbabwe	3	14.0	0	0.0	4	3.0	7	17.0
TOTAL	814	3,259.5	243	147.5	1,358	1,188.0	2,415	4,595.0

(1) Number of trainees. (2) Number of months of training received.

TABLE 7
FINANCIAL SUMMARY: 1990
(in thousands of dollars)

Recipient	Assistance provided, by type						Assistance provided, by source						Unli- quid. oblig.	TOTAL
	Experts	Equip- ment	Fellows- hips	Group training	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)		
AFGHANISTAN	1.3	0.0	1.0	0.0	0.0	2.3	0.0	1.3	1.0	0.0	0.0	2.3	1.4	3.7
ALBANIA	44.9	46.4	72.7	12.0	0.0	176.0	62.0	97.4	4.2	0.0	12.4	176.0	10.8	186.8
ALGERIA	67.0	359.6	78.4	0.0	0.0	505.0	0.0	383.9	118.2	0.0	2.9	505.0	333.2	838.2
ARGENTINA	22.7	46.4	65.8	0.0	0.0	134.9	115.8	10.4	4.0	0.0	4.7	134.9	25.2	160.1
BANGLADESH	74.9	725.5	235.7	0.0	0.0	1,036.1	0.0	608.7	246.5	128.2	52.7	1,036.1	526.4	1,562.5
BOLIVIA	46.1	449.1	17.5	0.0	0.0	512.7	0.0	396.2	37.8	78.3	0.4	512.7	85.8	598.5
BRAZIL	334.3	748.3	146.5	0.0	0.0	1,229.1	0.0	628.7	0.0	592.7	7.7	1,229.1	272.4	1,501.5
BULGARIA	111.3	544.3	211.0	0.0	0.0	866.6	0.0	378.3	457.7	0.0	30.6	866.6	490.1	1,356.7
BYELORUSSIAN SSR	0.0	48.8	0.0	0.0	0.0	48.8	0.0	48.8	0.0	0.0	0.0	48.8	0.0	48.8
CAMEROON	22.7	58.1	33.7	0.0	0.0	114.5	0.0	89.1	0.0	25.4	0.0	114.5	88.6	203.1
CHILE	107.5	465.1	94.9	0.0	0.0	667.5	0.0	653.0	7.7	0.0	6.8	667.5	185.1	852.6
CHINA	341.0	698.1	965.9	0.0	0.0	2,005.0	974.7	807.5	20.0	93.2	109.6	2,005.0	712.5	2,717.5
COLOMBIA	81.9	514.4	84.5	0.0	0.0	680.8	0.0	398.9	34.3	212.6	35.0	680.8	149.3	830.1
COSTA RICA	27.0	72.3	15.1	0.0	0.0	114.4	0.0	95.4	19.0	0.0	0.0	114.4	0.0	114.4
COTE D'IVOIRE	68.7	92.5	29.0	0.0	0.0	190.2	0.0	165.8	0.0	24.4	0.0	190.2	34.4	224.6
CUBA	58.2	622.5	126.8	0.0	0.0	807.5	336.9	437.6	21.3	0.0	11.7	807.5	765.9	1,573.4
CYPRUS	32.6	93.8	5.5	0.0	0.0	131.9	0.0	91.8	0.0	40.1	0.0	131.9	62.9	194.8
CZECH & SLOVAK F.R.	31.1	0.0	107.0	0.0	0.0	138.1	0.0	108.1	0.0	0.0	30.0	138.1	35.9	174.0
DEM. P.R. KOREA	39.4	1,047.5	69.3	0.0	0.0	1,156.2	0.0	177.1	979.1	0.0	0.0	1,156.2	791.2	1,947.4
DOMINICAN REP.	31.4	125.0	10.0	0.0	0.0	166.4	0.0	161.6	4.8	0.0	0.0	166.4	8.0	174.4
ECUADOR	91.3	387.5	111.4	0.0	8.8	599.0	0.0	338.0	46.5	162.5	52.0	599.0	157.2	756.2
EGYPT	180.6	483.2	279.0	28.5	61.7	1,033.0	77.7	505.6	171.6	219.4	58.7	1,033.0	752.6	1,785.6
EL SALVADOR	38.1	195.3	19.3	0.0	0.0	252.7	0.0	211.5	3.4	37.8	0.0	252.7	43.5	296.2
ETHIOPIA	67.5	190.8	77.2	0.0	0.0	335.5	0.0	304.4	0.0	5.4	25.7	335.5	158.1	493.6
GABON	22.5	2.9	0.0	0.0	0.0	25.4	0.0	25.4	0.0	0.0	0.0	25.4	0.0	25.4
GHANA	84.2	306.0	146.2	0.0	0.0	536.4	0.0	320.6	21.5	138.2	55.1	536.4	123.6	660.0
GREECE	31.0	199.0	83.5	0.0	0.0	313.5	0.0	244.8	3.3	38.6	26.8	313.5	59.6	373.1
GUATEMALA	31.1	208.4	67.9	0.0	70.8	378.2	0.0	259.3	3.0	115.9	0.0	378.2	292.7	670.9
HAITI	7.6	43.4	3.2	0.0	0.0	54.2	0.0	54.2	0.0	0.0	0.0	54.2	5.6	59.8
HUNGARY	10.2	251.9	94.2	0.0	0.0	356.3	21.5	64.5	109.4	128.4	31.5	356.3	316.4	672.7
ICELAND	5.8	6.0	0.0	0.0	0.0	11.8	0.0	11.8	0.0	0.0	0.0	11.8	3.3	15.1
INDIA	0.0	0.0	12.8	0.0	0.0	12.8	0.0	0.0	0.0	12.8	0.0	12.8	0.0	12.8
INDONESIA	698.4	430.9	275.3	0.0	8.0	1,412.6	110.1	764.9	21.0	431.9	84.7	1,412.6	520.9	1,933.5
IRAN, I.R.	271.5	506.8	155.9	0.0	80.2	1,014.4	-2.0	808.0	150.0	0.0	58.4	1,014.4	228.1	1,242.5
IRAQ	122.0	77.3	67.6	0.0	0.0	266.9	0.0	259.6	7.3	0.0	0.0	266.9	6.3	273.2
IRELAND	3.0	26.6	9.7	0.0	0.0	39.3	0.0	37.8	-0.0	0.0	1.5	39.3	14.1	53.4
JAMAICA	22.6	12.1	0.0	0.0	0.0	34.7	0.0	34.7	0.0	0.0	0.0	34.7	1.3	36.0
JORDAN	65.8	159.5	32.4	0.0	0.0	257.7	0.0	257.7	0.0	0.0	0.0	257.7	63.3	321.0
KENYA	51.5	104.5	134.3	0.0	0.0	290.3	41.4	197.7	0.0	5.5	45.7	290.3	64.0	354.3
KOREA, REP. OF	342.1	65.6	267.7	0.0	0.0	675.4	42.5	387.1	0.0	131.7	114.1	675.4	133.6	809.0
LIBYAN A.J.	110.8	123.9	179.8	0.0	0.0	414.5	0.0	262.7	9.5	117.7	24.6	414.5	303.2	717.7
MADAGASCAR	30.5	101.9	42.7	0.0	0.0	175.1	0.0	168.0	7.1	0.0	0.0	175.1	32.3	207.4
MALAYSIA	235.8	318.5	121.6	0.0	0.0	675.9	0.0	568.9	39.6	40.3	27.1	675.9	219.0	894.9
MALI	46.3	76.8	49.7	0.0	0.0	172.8	0.0	172.3	0.5	0.0	0.0	172.8	29.1	201.8
MAURITIUS	0.0	31.0	19.2	0.0	0.0	50.2	0.0	50.2	0.0	0.0	0.0	50.2	0.0	50.2
MEXICO	239.8	220.6	189.4	0.0	-4.7	645.1	-0.0	390.2	54.9	128.7	71.3	645.1	752.6	1,397.7
MONGOLIA	102.9	188.2	85.1	0.0	0.0	376.2	0.0	306.8	58.2	0.0	11.2	376.2	352.4	728.6
MOROCCO	128.1	171.9	29.2	0.0	0.0	329.2	0.0	245.6	0.0	83.6	0.0	329.2	135.3	464.5
MYANMAR	52.3	41.5	11.1	0.0	0.0	104.9	0.0	101.8	3.1	0.0	0.0	104.9	38.1	143.0
NICARAGUA	14.6	121.5	31.9	0.0	0.0	168.0	0.0	146.1	21.9	0.0	0.0	168.0	50.6	218.6
NIGER	30.5	81.6	35.4	0.0	0.0	147.5	0.0	143.7	0.0	0.0	3.8	147.5	28.5	176.0
NIGERIA	119.1	524.6	395.3	0.0	91.2	1,130.2	0.0	688.4	19.3	251.3	171.2	1,130.2	533.1	1,663.3

Recipient	Assistance provided, by type						Assistance provided, by source						Unli- quid. oblig.	TOTAL
	Experts	Equip- ment	Fellow- ships	Group training	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)		
PAKISTAN	142.2	385.3	172.0	0.0	0.0	699.5	0.0	634.5	58.9	0.0	6.1	699.5	817.7	1,317.2
PANAMA	26.9	96.5	21.1	0.0	0.0	144.5	0.0	142.0	0.0	2.5	0.0	144.5	79.5	224.0
PARAGUAY	53.5	113.1	26.9	0.0	0.0	193.5	0.0	188.5	0.0	5.0	0.0	193.5	30.0	223.5
PERU	85.7	395.8	96.9	0.0	0.0	578.4	0.0	511.5	4.2	56.4	6.3	578.4	422.0	1,000.4
PHILIPPINES	85.2	368.6	145.6	0.0	0.0	599.4	0.0	572.9	0.0	2.5	24.0	599.4	167.8	767.2
POLAND	31.1	2,034.9	242.1	0.0	0.0	2,308.1	0.0	361.5	1,200.8	624.2	121.6	2,308.1	312.8	2,620.9
PORTUGAL	65.9	164.9	13.5	0.0	0.0	244.3	0.0	189.5	-17.1	69.3	2.6	244.3	595.7	840.0
ROMANIA	154.6	284.9	59.3	0.0	0.0	498.8	145.8	322.6	29.0	0.0	1.4	498.8	329.3	828.1
SAUDI ARABIA	6.8	0.0	0.0	0.0	0.0	6.8	0.0	6.8	0.0	0.0	0.0	6.8	0.6	7.4
SENEGAL	37.1	59.6	42.4	0.0	0.0	139.1	0.0	139.1	0.0	0.0	0.0	139.1	46.9	186.0
SIERRA LEONE	20.7	7.8	14.8	0.0	0.0	43.3	0.0	43.3	0.0	0.0	0.0	43.3	71.1	114.4
SINGAPORE	30.6	157.7	23.3	0.0	0.0	211.6	0.0	211.6	0.0	0.0	0.0	211.6	3.9	215.5
SPAIN	0.0	55.3	6.6	0.0	0.0	61.9	0.0	61.9	0.0	0.0	0.0	61.9	7.3	69.2
SRI LANKA	56.9	350.6	56.7	0.0	0.0	464.2	0.0	347.8	0.0	116.4	0.0	464.2	101.1	565.3
SUDAN	29.7	80.7	132.2	0.0	0.0	242.6	0.0	201.9	6.8	9.9	24.0	242.6	244.4	487.0
SYRIAN A.R.	92.5	201.9	72.0	0.0	0.0	366.4	18.0	227.1	56.8	48.0	16.5	366.4	538.8	905.2
THAILAND	314.8	466.4	362.0	-0.4	0.0	1,142.8	179.5	610.3	15.5	283.7	53.8	1,142.8	297.7	1,440.5
TUNISIA	39.3	157.9	46.5	0.0	0.0	243.7	0.0	160.3	0.0	64.4	19.0	243.7	32.2	275.9
TURKEY	85.4	361.7	95.7	0.0	0.0	542.8	85.0	442.2	11.4	0.0	4.2	542.8	825.4	1,368.2
UGANDA	40.3	84.3	18.7	0.0	0.0	143.3	0.0	142.2	1.1	0.0	0.0	143.3	68.5	211.8
UK (HONG KONG)	27.0	4.8	3.6	0.0	0.0	35.4	0.0	35.4	0.0	0.0	0.0	35.4	3.9	39.3
UKRAINIAN SSR	0.0	50.0	0.0	0.0	0.0	50.0	0.0	50.0	0.0	0.0	0.0	50.0	0.0	50.0
URUGUAY	46.2	248.6	62.3	0.0	0.0	357.1	0.0	232.6	-9.6	132.6	1.5	357.1	34.1	391.2
USSR	0.0	50.0	0.0	0.0	0.0	50.0	0.0	50.0	0.0	0.0	0.0	50.0	0.0	50.0
U.A. EMIRATES	19.1	378.9	0.0	0.0	0.0	398.0	0.0	62.1	0.0	335.9	0.0	398.0	27.2	425.2
U.R. TANZANIA	87.2	176.9	163.7	0.0	0.0	427.8	0.0	332.6	12.6	25.7	56.9	427.8	90.4	518.2
VENEZUELA	98.1	274.0	135.2	12.4	0.0	519.7	72.4	422.0	0.0	22.4	2.9	519.7	279.3	799.0
VIET NAM	116.1	1,060.6	412.5	0.0	0.0	1,589.2	0.0	775.7	743.1	0.0	70.4	1,589.2	622.2	2,211.4
YUGOSLAVIA	106.5	1,039.8	76.2	0.0	0.0	1,222.5	0.0	134.4	799.0	228.3	60.8	1,222.5	920.3	2,142.8
ZAIRE	42.4	112.3	61.8	0.0	0.0	216.5	0.0	201.9	11.6	0.0	3.0	216.5	73.1	289.6
ZAMBIA	105.9	241.9	81.8	0.0	0.0	429.6	0.0	401.1	28.5	0.0	0.0	429.6	120.2	549.8
ZIMBABWE	45.6	85.9	31.6	0.0	0.0	163.1	0.0	144.7	0.0	0.0	18.4	163.1	141.5	304.6
SUB-TOTAL	6,894.8	21,969.0	8,075.3	52.5	316.0	37,307.6	2,281.3	22,431.9	5,659.3	5,273.8	1,661.3	37,307.6	17,102.4	54,410.0
Intercountry projects														
INTERREGIONAL	659.3	122.0	0.0	3,190.8	0.0	3,972.1	0.0	3,369.5	218.1	296.4	88.1	3,972.1	1,608.6	5,580.7
REGIONAL AFRICA	594.5	373.1	0.6	483.8	0.0	1,452.0	0.0	1,386.9	0.0	58.5	6.6	1,452.0	884.4	2,336.4
REGIONAL EUROPE	182.5	239.2	0.0	225.1	173.6	820.4	0.0	573.6	73.4	147.3	26.1	820.4	427.7	1,248.1
REG. ARAB ST. (ME)	4.0	7.3	0.0	0.0	0.0	11.3	11.3	0.0	0.0	0.0	0.0	11.3	0.0	11.3
REG. ASIA & PACIFIC	770.5	264.7	94.1	1,305.8	137.2	2,572.3	957.6	805.3	21.6	538.0	249.8	2,572.3	974.1	3,546.4
REG. LATIN AMERICA	674.1	698.9	46.4	1,181.0	84.3	2,684.7	-0.1	1,556.4	77.6	868.9	181.9	2,684.7	1,260.9	3,945.6
SUB-TOTAL	2,884.9	1,705.2	141.1	6,366.5	395.1	11,512.8	968.8	7,691.7	390.7	1,909.1	552.5	11,512.8	5,155.7	16,668.5
MISCELLANEOUS	105.9	264.4	87.9	71.5	1.6	531.3	0.0	531.3	0.0	0.0	0.0	531.3	12.4	543.7
GRAND TOTAL	9,885.6	23,938.6	8,304.3	6,510.5	712.7	49,351.7	3,250.1	30,654.9	6,050.0	7,182.9	2,213.8	49,351.7	22,270.5	71,622.2

TABLE 8
FINANCIAL SUMMARY: 1958-1990
(in thousands of dollars)

Recipient	Assistance provided, by type						Assistance provided, by source				
	Experts	Equip- ment	Fellow- ships	Group training	Sub- contracts	Total	UNDP	Agency	Extra- bud. a)	In kind	Total
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)
AFGHANISTAN	385.3	441.5	137.2	0.0	0.0	964.0	92.9	789.3	0.0	81.8	964.0
ALBANIA	236.4	1,827.2	294.7	38.5	0.0	2,396.8	233.1	2,113.7	0.0	50.0	2,396.8
ALGERIA	567.6	2,001.0	504.5	0.0	0.0	3,073.1	21.7	2,900.3	0.0	151.1	3,073.1
ARGENTINA	3,453.4	2,566.5	1,341.9	0.0	0.0	7,361.8	5,110.6	1,690.9	17.5	542.8	7,361.8
BANGLADESH	1,182.7	5,337.8	3,023.5	0.0	0.0	9,544.0	63.8	6,560.2	1,398.8	1,521.2	9,544.0
BOLIVIA	646.4	2,191.5	456.7	5.7	0.0	3,300.3	159.5	2,416.5	546.7	177.6	3,300.3
BRAZIL	6,300.2	7,115.5	2,654.2	0.0	0.0	16,069.9	5,660.4	7,095.9	2,478.5	835.1	16,069.9
BULGARIA	271.8	4,298.6	2,772.2	0.0	0.0	7,342.6	543.9	5,794.2	312.6	691.9	7,342.6
BYELORUSSIAN SSR	0.0	48.8	0.0	0.0	0.0	48.8	0.0	48.8	0.0	0.0	48.8
CAMEROON	478.7	424.0	110.4	0.0	0.0	1,013.1	297.3	608.5	88.3	19.0	1,013.1
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	2,941.9	3,741.5	1,759.6	0.0	0.0	8,443.0	3,615.1	4,299.6	23.0	505.3	8,443.0
CHINA	1,622.0	2,159.3	2,799.0	0.0	8.1	6,588.4	2,324.0	3,523.5	440.9	300.0	6,588.4
COLOMBIA	1,535.1	3,631.3	1,172.1	0.0	0.0	6,338.5	1,693.6	3,297.3	603.7	743.9	6,338.5
COSTA RICA	960.3	1,276.0	329.4	0.0	7.0	2,572.7	618.1	1,527.7	234.3	192.6	2,572.7
COTE D'IVOIRE	521.8	933.8	196.4	0.0	0.0	1,652.0	73.4	1,445.1	103.3	30.2	1,652.0
CUBA	737.8	6,270.1	571.5	0.0	0.0	7,579.4	2,240.2	5,142.0	39.2	158.0	7,579.4
CYPRUS	158.6	809.1	207.8	0.0	0.0	1,175.5	24.1	811.0	74.7	165.7	1,175.5
CZECH & SLOVAK F.R.	47.9	149.9	1,229.1	0.0	0.0	1,426.9	6.2	1,001.2	12.9	406.6	1,426.9
DEM. P.R. KOREA	232.5	4,003.5	841.2	0.0	0.0	5,077.2	0.0	4,546.2	52.6	478.4	5,077.2
DOMINICAN REP.	221.1	813.9	202.9	0.0	0.0	1,237.9	0.0	1,201.8	3.9	32.2	1,237.9
ECUADOR	1,533.6	4,166.8	822.0	0.0	16.9	6,539.3	547.5	4,508.0	1,025.3	458.5	6,539.3
EGYPT	3,821.1	11,790.2	4,389.6	99.6	1,162.0	21,262.5	1,861.2	8,994.0	7,768.6	2,638.7	21,262.5
EL SALVADOR	278.5	884.1	211.5	0.0	0.0	1,374.1	14.1	1,006.1	176.1	177.8	1,374.1
ETHIOPIA	604.1	1,031.7	538.3	0.0	0.0	2,174.1	437.5	1,598.7	5.4	132.5	2,174.1
GABON	79.5	89.2	29.3	0.0	0.0	198.0	0.0	185.4	0.0	12.6	198.0
GHANA	838.0	2,666.3	2,637.2	0.0	0.0	6,141.5	354.5	3,747.5	563.7	1,475.8	6,141.5
GREECE	1,989.0	2,190.8	1,325.5	0.0	0.0	5,505.3	1,561.9	2,759.8	512.1	671.5	5,505.3
GUATEMALA	409.0	1,699.8	338.6	0.0	154.1	2,601.5	56.2	1,931.9	495.8	117.6	2,601.5
HAITI	36.9	103.5	14.8	0.0	0.9	156.1	0.9	155.2	0.0	0.0	156.1
HONDURAS	0.0	0.0	0.7	0.0	0.0	0.7	0.0	0.7	0.0	0.0	0.7
HUNGARY	128.5	8,027.6	1,946.6	0.0	0.0	10,102.7	717.7	8,126.8	916.5	341.7	10,102.7
ICELAND	76.6	737.0	152.3	0.0	0.0	965.9	0.0	830.3	8.5	127.1	965.9
INDIA	1,015.8	3,801.6	2,706.4	0.0	0.0	7,523.8	2,920.3	1,292.3	2,149.0	1,162.2	7,523.8
INDONESIA	3,997.3	4,494.9	2,546.2	7.2	33.0	11,078.6	2,383.9	6,091.9	1,524.6	1,078.2	11,078.6
IRAN, I.R.	1,362.9	2,868.7	1,455.2	0.0	211.7	5,898.5	2,122.8	3,040.9	351.3	383.5	5,898.5
IRAQ	881.0	1,314.5	1,022.6	0.0	18.3	3,236.4	242.5	2,536.1	25.0	432.8	3,236.4
IRELAND	3.0	26.6	19.4	0.0	0.0	49.0	0.0	47.5	0.0	1.5	49.0
ISRAEL	257.8	819.8	438.7	0.0	0.0	1,516.3	170.9	900.6	18.0	426.8	1,516.3
JAMAICA	264.8	683.6	61.4	0.0	55.0	1,064.8	15.3	870.4	108.3	70.8	1,064.8
JORDAN	665.4	1,091.8	322.2	0.0	0.0	2,079.4	89.3	1,784.9	100.6	104.6	2,079.4
KENYA	962.1	1,546.5	1,150.9	0.0	0.0	3,659.5	74.6	2,345.9	733.7	505.3	3,659.5
KOREA, REP. OF	3,896.1	2,153.5	4,238.4	0.0	0.0	10,288.0	1,206.8	5,315.2	1,448.7	2,317.3	10,288.0
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.	457.7	681.8	1,010.2	0.0	0.0	2,149.7	7.3	1,916.1	133.9	92.4	2,149.7
MADAGASCAR	1,364.7	1,728.6	316.2	0.0	0.0	3,409.5	1,436.6	1,681.4	244.2	67.3	3,409.5
MALAWI	5.1	0.0	0.0	0.0	0.0	5.1	5.1	0.0	0.0	0.0	5.1
MALAYSIA	1,838.3	3,653.9	1,387.0	0.0	0.0	6,879.2	1.6	5,174.1	1,111.0	592.5	6,879.2
MALI	818.5	1,253.4	378.4	0.0	0.0	2,450.3	13.4	2,204.7	143.4	88.8	2,450.3
MAURITIUS	109.1	262.0	60.2	0.0	0.0	431.3	0.0	427.5	3.8	0.0	431.3
MEXICO	3,101.1	1,653.3	1,621.8	0.0	564.8	6,941.0	419.3	4,418.9	1,200.5	902.3	6,941.0
MONGOLIA	473.0	1,493.4	188.7	0.0	0.0	2,155.1	0.0	2,119.7	10.6	24.8	2,155.1

Recipient	Assistance provided, by type						Assistance provided, by source				
	Experts	Equip-ment	Fellow-ships	Group training	Sub-contracts	Total	UNDP	Agency	Extra-bud. a)	In kind	Total
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)
MOROCCO	1,955.4	1,820.9	526.1	0.0	18.0	4,320.4	909.8	2,685.8	448.4	266.6	4,320.4
MYANMAR	856.9	1,841.4	249.5	0.0	0.0	2,747.8	537.0	2,107.2	0.0	103.6	2,747.8
NICARAGUA	123.2	651.8	118.8	0.0	0.0	891.6	0.0	891.6	0.0	0.0	891.6
NIGER	396.2	807.3	160.4	0.0	0.0	1,363.9	0.0	1,301.6	0.0	62.3	1,363.9
NIGERIA	3,113.4	3,400.8	1,771.4	0.0	121.6	8,407.2	980.9	2,903.5	3,551.1	971.7	8,407.2
PAKISTAN	2,004.7	3,948.0	3,956.7	0.0	5.2	9,914.6	1,842.0	6,477.2	174.2	1,421.2	9,914.6
PANAMA	422.1	1,231.7	276.3	0.0	0.0	1,930.1	4.1	1,590.6	194.3	141.1	1,930.1
PARAGUAY	322.3	1,284.8	326.8	0.0	0.0	1,933.9	0.0	1,683.9	145.3	104.7	1,933.9
PERU	3,742.7	6,691.4	1,505.6	2.7	58.6	12,001.0	3,907.2	4,440.7	2,828.8	824.3	12,001.0
PHILIPPINES	2,520.2	4,084.5	3,920.6	0.0	90.8	10,616.1	1,964.4	5,073.3	1,301.5	2,276.9	10,616.1
POLAND	251.5	5,492.4	3,298.4	0.0	0.0	9,042.3	202.9	7,214.5	864.5	760.4	9,042.3
PORTUGAL	438.1	3,540.0	424.7	0.0	0.0	4,402.8	0.0	3,272.0	852.6	178.2	4,402.8
ROMANIA	1,172.8	5,172.9	986.9	0.0	134.5	7,467.1	2,946.5	4,211.0	52.2	257.4	7,467.1
SAUDI ARABIA	80.5	11.9	25.4	0.0	0.0	117.8	0.0	110.8	0.0	7.0	117.8
SENEGAL	498.1	1,308.7	264.7	0.0	0.0	2,071.5	345.8	1,498.7	154.7	72.3	2,071.5
SIERRA LEONE	457.7	276.8	215.6	0.0	0.0	949.9	174.5	646.7	12.4	116.3	949.9
SINGAPORE	455.0	1,201.2	164.7	0.0	0.0	1,820.9	0.0	1,651.1	103.3	66.5	1,820.9
SPAIN	382.6	65.6	105.0	0.0	0.0	553.2	0.0	474.1	56.0	23.1	553.2
SRI LANKA	1,080.9	3,252.2	1,853.7	0.0	0.0	6,186.8	307.9	4,569.7	699.4	609.8	6,186.8
SUDAN	900.4	2,264.5	2,108.9	0.0	13.4	5,287.2	296.7	3,707.7	580.2	702.6	5,287.2
SYRIAN A.R.	868.1	2,122.0	721.5	0.0	208.9	3,920.5	693.2	2,569.1	547.9	110.3	3,920.5
THAILAND	3,049.5	5,270.8	5,450.0	13.8	3.8	13,787.9	1,942.2	6,694.3	2,384.5	2,768.9	13,787.9
TUNISIA	789.1	1,589.1	418.7	0.0	0.0	2,796.9	141.2	2,127.4	356.2	172.1	2,796.9
TURKEY	2,298.4	3,134.9	3,511.3	0.0	22.2	8,966.8	1,874.4	4,996.5	130.8	1,965.1	8,966.8
UGANDA	390.5	583.7	423.6	0.0	0.0	1,397.8	131.0	1,211.6	0.0	55.2	1,397.8
UKRAINIAN SSR	0.0	50.0	0.0	0.0	0.0	50.0	0.0	50.0	0.0	0.0	50.0
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	68.6	504.1	15.9	0.0	0.0	588.6	0.0	251.9	336.7	0.0	588.6
UK (HONG KONG)	124.8	133.7	42.3	0.0	0.0	300.8	0.0	291.8	0.0	9.0	300.8
U.R. TANZANIA	678.8	1,513.5	894.8	0.0	0.0	3,087.1	9.6	2,801.7	87.0	188.8	3,087.1
URUGUAY	882.3	2,634.0	574.0	0.0	0.0	4,090.3	193.1	2,672.4	902.0	322.8	4,090.3
VENEZUELA	1,385.4	1,597.1	522.9	18.6	0.0	3,524.0	383.6	2,775.1	180.0	185.3	3,524.0
VIET NAM	545.2	4,734.7	2,171.3	0.0	0.0	7,451.2	31.4	6,509.5	139.5	770.8	7,451.2
YUGOSLAVIA	1,459.5	6,391.3	2,740.0	0.0	37.3	10,628.1	3,061.7	5,238.8	1,424.3	903.3	10,628.1
ZAIRE	744.1	1,951.8	910.6	0.0	0.0	3,606.5	578.8	2,424.2	204.7	398.8	3,606.5
ZAMBIA	1,504.7	2,833.7	815.5	0.0	0.0	5,153.9	152.5	4,548.3	180.9	272.2	5,153.9
ZIMBABWE	83.8	272.7	101.0	0.0	0.0	457.5	0.0	433.8	0.0	23.7	457.5
OTHER COUNTRIES ^{b)}	593.8	266.2	1,468.3	0.0	0.0	2,328.3	565.5	902.4	8.5	851.9	2,328.3
SUB-TOTAL	90,780.6	197,064.9	95,104.2	186.1	2,946.1	386,081.9	63,819.9	236,489.2	46,242.8	39,530.0	386,081.9
Inter-country projects											
REGIONAL AFRICA	2,344.1	1,728.1	348.9	1,467.5	40.0	5,928.6	332.8	5,331.2	193.8	70.8	5,928.6
REGIONAL ARAB STATES	26.9	7.3	33.8	7.0	0.0	75.0	75.0	0.0	0.0	0.0	75.0
REGIONAL ASIA & PACIFIC	6,480.4	4,161.5	2,561.7	4,715.5	218.3	18,137.4	7,863.3	5,237.5	3,351.5	1,685.1	18,137.4
REGIONAL EUROPE	811.3	760.4	70.4	485.1	1,308.3	3,435.5	59.5	3,134.7	157.3	84.0	3,435.5
REGIONAL LATIN AMERICA	5,703.3	4,927.4	1,386.5	4,163.3	749.3	16,929.8	2,991.3	8,337.0	3,570.9	2,030.6	16,929.8
REGIONAL MIDDLE EAST	5.8	1.2	5.3	0.0	0.0	12.3	12.3	0.0	0.0	0.0	12.3
INTERREGIONAL	12,444.3	5,186.2	17,041.9	10,500.4	482.1	45,654.9	1,790.5	36,873.7	4,153.0	2,837.7	45,654.9
SUB-TOTAL	27,816.1	16,772.1	21,448.5	21,338.8	2,798.0	90,173.5	13,124.7	58,914.1	11,426.5	6,708.2	90,173.5
MISCELLANEOUS	651.2	1,119.8	419.7	208.2	22.8	2,421.7	23.2	2,398.5	0.0	0.0	2,421.7
TOTAL	119,247.9	214,956.8	116,972.4	21,733.1	5,766.9	478,677.1	76,967.8	297,801.8	57,669.3	46,238.2	478,677.1

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, the Federal Republic of Germany, Italy, Japan, Kuwait, Monaco, the Netherlands, New Zealand, Niue, Norway, St. Christopher, Somalia, South Africa, Sweden, Switzerland, and the United States of America.

TABLE 9
WOMEN'S PARTICIPATION IN TECHNICAL CO-OPERATION

	1981			1989			1990		
	Total	of which women	% of women	Total	of which women	% of women	Total	of which women	% of women
Fellows	570	97	17.0	732	161	22.0	814	182	22.4
Visiting scientists	65	7	10.8	192	34	17.7	243	45	18.5
Training course participants	519	64	12.3	1265	212	16.8	1358	261	19.2
Project counterparts	511	46	9.0	1208	127	10.5	1121	140	12.5
International experts	319	7	2.2	948	61	6.4	1032	47	4.6
National experts	12	0	0.0	49	5	10.2	88	10	11.4
Lecturers	119	2	1.7	322	19	5.9	286	20	6.7
Other project personnel	11	9	81.8	17	13	76.5	16	12	75.0
TC Professional staff ^a	34	5	14.7	50	15	30.0	55	15	27.3
TC General services staff ^a	54	48	88.8	86	81	94.2	85	80	94.1

^a Excluding the staff of Printing Section and Publishing Section.

Explanatory Notes to Annexes

Annex I. Disbursement of extrabudgetary and in-kind contributions: 1990

Related to Table 5, this Annex shows, by donor and by type, the technical assistance disbursements made during 1990 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: 1990

All courses organized by the Agency in 1990 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: 1990

Technical co-operation project reports published in 1990 are listed by country.

Annex IV. Voluntary contributions pledged and paid to the Technical Assistance and Co-operation Fund for 1990

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 1990.

Annex V. Cost-free fellowships offered and awarded: 1990

Information is made available in this table on the number of cost-free fellowships offered by Member States and the number of awards.

Annex VI. Approved and on-going UNDP projects as at 31 December 1990

This table includes one project being implemented for the United Nations Fund for Science and Technology for Development. Those projects for which IAEA acts only as an associated agency are shown separately.

Annex VII. Footnote-a/projects made operational or extended during 1990

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 1990

Information is provided on Reserve Fund approvals for new and existing projects.

Annex IX. Net programme changes by recipient: 1990

The Secretariat is obliged to furnish information on changes to approved projects under the provisions of the Revised Guiding Principles. As eight hundred forty five projects were involved, the list only shows the net changes that took place in each country. The amounts given in the existing approval column refer to those projects which were affected by programme changes. Detailed data by project are available on request.

Annex X. Projects rephased during 1990

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 or future years. This mechanism, known as "rephasing", may be invoked in cases where project requirements differ from those originally foreseen, so as to keep project plans realistic. The Annex shows only net changes per country to projects rephased in 1990.

Annex XI. Extrabudgetary contributions for activities relating to technical co-operation which are not included in the technical co-operation programme: 1990

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 now 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: 1990
A. Assistance for activities where donor is not recipient
(in thousands of dollars)

Donor	Extrabudgetary						In kind					Total
	Experts	Equip-ment	Fellow-ships	Group training	Sub-con-tracts	Sub-total	Experts	Equip-ment	Fellow-ships	Group training	Sub-total	
Countries												
Argentina	0.0	0.0	0.0	0.0	0.0	0.0	5.4	0.0	0.0	48.8	54.2	54.2
Australia	27.8	148.4	0.0	71.8	24.5	272.5	18.2	0.0	0.0	0.0	18.2	290.7
Austria	0.0	0.0	0.0	0.0	0.0	0.0	0.0	100.0	0.0	0.0	100.0	100.0
Belgium	8.5	47.9	0.0	0.0	0.0	56.4	7.7	0.0	105.6	0.0	113.3	169.7
Brazil	0.0	0.0	0.0	0.0	0.0	0.0	3.6	0.0	0.0	36.0	39.6	39.6
Bulgaria	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.3	0.0	1.3	1.3
Canada	0.0	0.0	0.0	0.0	0.0	0.0	40.8	0.0	0.0	3.9	44.7	44.7
Chile	0.0	0.0	0.0	9.6	0.0	9.6	2.5	0.0	0.0	6.8	9.3	18.9
China	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2.8	43.9	46.7	46.7
Colombia	0.0	0.0	0.0	0.0	0.0	0.0	2.2	0.0	0.0	0.9	3.1	3.1
Cuba	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	12.2	23.7	35.9	35.9
Czech & Slovak F.R.	0.0	0.0	0.0	0.0	0.0	0.0	4.8	0.0	17.2	0.5	22.5	22.5
Denmark	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	33.5	0.0	33.5	33.5
Ecuador	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.9	0.9	0.9
Finland	3.5	9.3	0.0	0.0	0.0	12.8	3.9	0.0	4.3	0.0	8.2	21.0
France	99.0	255.4	0.0	15.9	0.0	370.3	30.2	0.0	16.7	11.3	58.2	428.5
German Dem. Rep.	0.0	0.0	0.0	0.0	0.0	0.0	5.2	0.0	0.0	0.0	5.2	5.2
Germany	391.2	838.6	0.0	238.6	53.8	1,522.2	40.5	0.0	198.7	5.4	244.6	1,766.8
Guatemala	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	3.4	3.4	3.4
Hungary	0.0	0.0	0.0	0.0	0.0	0.0	7.8	0.0	106.9	6.3	121.0	121.0
India	0.0	0.0	0.0	0.0	0.0	0.0	1.2	0.0	122.4	72.5	196.1	196.1
Ireland	0.0	0.0	0.0	0.0	0.0	0.0	1.2	0.0	0.0	0.0	1.2	1.2
Israel	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	24.8	0.6	25.4	25.4
Italy	111.1	46.1	0.0	107.1	74.9	339.2	11.0	0.0	152.7	0.0	163.7	502.9
Jamaica	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2.0	2.0	2.0
Japan	114.5	0.1	31.2	68.0	0.0	213.8	11.5	0.0	0.0	32.3	43.8	257.6
Korea, Rep. of	16.0	0.0	0.0	0.0	0.0	16.0	0.0	0.0	0.0	55.8	55.8	71.8
Kuwait	0.0	9.2	0.0	0.0	0.0	9.2	0.0	0.0	0.0	0.0	9.2	9.2
Malaysia	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	4.0	4.0	4.0
Mali	0.0	0.0	0.0	0.0	0.0	0.0	1.5	0.0	0.0	0.0	1.5	1.5
Mexico	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	25.4	25.4	25.4
Netherlands	0.0	0.0	0.0	0.0	0.0	0.0	1.5	0.0	32.1	0.0	33.6	33.6
Peru	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2.0	2.0	2.0
Poland	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2.5	2.5	2.5
Romania	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.3	0.0	1.3	1.3
Spain	0.0	0.0	0.0	0.0	147.3	147.3	7.2	0.0	32.6	0.4	40.2	187.5
Sweden	143.9	159.8	28.5	0.0	0.0	333.2	17.1	0.0	0.0	0.5	17.6	350.8

Donor	Extrabudgetary						In kind					Total
	Experts	Equip-ment	Fellow-ships	Group training	Sub-con-tracts	Sub-total	Experts	Equip-ment	Fellow-ships	Group training	Sub-total	
Switzerland	0.0	0.0	0.0	0.0	0.0	0.0	1.5	0.0	0.0	0.0	1.5	1.5
Ukrainian SSR	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.5	1.5	1.5
United Kingdom	87.2	437.2	72.3	0.0	91.2	687.9	5.6	0.0	75.5	5.5	86.6	774.5
Uruguay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.7	1.7	1.7
USA	410.2	1,409.6	0.0	157.7	70.8	2,048.3	71.9	25.0	393.3	29.5	519.7	2,568.0
USSR	0.0	610.9	0.0	0.0	0.0	610.9	8.5	0.0	0.0	0.0	8.5	619.4
Organizations												
Asian Development Bank	0.0	0.0	0.0	0.9	0.0	0.9	0.0	0.0	0.0	0.0	0.0	0.9
CEC	1.3	5.2	33.4	4.4	0.0	44.3	1.2	0.0	0.0	0.0	1.2	45.5
FAO	0.0	0.0	0.0	0.0	0.0	0.0	3.6	0.0	0.0	0.0	3.6	3.6
IBRD	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2.6	2.6	2.6
WHO	0.0	0.0	0.0	0.0	0.0	0.0	0.8	0.0	0.0	6.2	7.0	7.0
Sub-total	1,414.2	3,977.7	166.4	674.0	462.5	6,694.8	318.1	125.0	1,333.9	436.8	2,213.8	8,908.6
Additional extrabudgetary disbursements included in the Agency's Accounts under TACF as Miscellaneous Income												
Colombia	0.0	0.0	0.0	10.0	0.0	10.0	0.0	0.0	0.0	0.0	0.0	10.0
TOTAL	1,414.2	3,977.7	166.4	684.0	462.5	6,704.8	318.1	125.0	1,333.9	436.8	2,213.8	8,918.6

**B. Assistance for activities where donor is recipient
(in thousands of dollars)**

Donor	Project title	Project code	Equipment	Fellowships	Total
Ecuador	Nuclear medicine services	ECU/6/009	0.3	0.0	0.3
Ghana	Training in nuclear instrumentation	GHA/4/008	28.1	0.0	28.1
Hungary	Procurement assistance for Hungary	HUN/4/008	15.5	0.0	15.5
Libyan A.J.	Eradication of Mediterranean Fruit Fly	LIB/5/003	0.0	35.2	35.2
Malaysia	Nitrogen-15 fertilizer studies	MAL/5/018	0.1	0.0	0.1
Poland	Procurement assistance	POL/4/007	13.3	0.0	13.3
Syria A.R.	Procurement assistance	SYR/0/005	38.8	0.0	38.8
Thailand	Radioisotope production facility	THA/4/008	2.0	0.0	2.0
U.A. Emirates	Radioactive environmental and food contamination	UAE/9/003	335.8	0.0	335.8
Yugoslavia	Procurement assistance	YUG/9/023	19.0	0.0	19.0
TOTAL			452.9	35.2	488.1

ANNEX II

TRAINING COURSES: 1990

Project title and code	Place(s) and dates	Source of funds	Participation ^a			Amount(s) expended ^b (\$)
			(1)	(2)	(3)	
INTERREGIONAL TRAINING COURSE ON ELECTRIC SYSTEM EXPANSION PLANNING (WASP), INT/0/050/001	ARGONNE, IL, USA 10 SEPTEMBER - 9 NOVEMBER	AGENCY	26	0	0	234,323 (CC)
INTERREGIONAL TRAINING COURSE ON PROJECT MANAGEMENT STRENGTHENING WITH EMPHASIS ON QUALITY ASSURANCE (TOOLS AND METHODS), INT/0/051/001	KALPAKKAM, INDIA 15 OCTOBER - 23 NOVEMBER	AGENCY	15	0	0	149,988 (CC)
INTERREGIONAL TRAINING COURSE ON EXPERIMENTAL NUCLEAR SPECTROSCOPY, INT/1/047/001	ATHENS, GREECE 24 SEPTEMBER - 19 OCTOBER	AGENCY GERMANY, F.R.	20	0	2	113,323 (CC) 34,408 (CC)
INTERREGIONAL TRAINING COURSE ON DETERMINATION OF RADIONUCLIDES IN FOOD AND ENVIRONMENTAL SAMPLES, INT/2/007/001	KARLSRUHE, GERMANY 23 APRIL - 25 MAY	AGENCY	21	1	0	127,288 (CC)
INTERREGIONAL TRAINING COURSE ON RESEARCH REACTOR CORE CONVERSION TO LOW ENRICHED URANIUM FUELS, INT/4/094/001	MENAI, NSW, AUSTRALIA 26 FEBRUARY - 23 MARCH	AGENCY	17	0	0	123,185 (CC)
ADVANCED INTERREGIONAL TRAINING COURSE ON NUCLEAR ELECTRONICS, INT/4/101/001	ARGONNE, IL, USA 8 JANUARY - 30 MARCH	AGENCY	20	0	0	207,361 (CC)
INTERREGIONAL TRAINING COURSE ON INTERFACING IN NUCLEAR EXPERIMENTS, INT/4/102/001	CHIANG MAI, THAILAND 23 APRIL - 15 JUNE	AGENCY USA	18	0	1	147,471 (CC) 24,326 (CC)
INTERREGIONAL TRAINING COURSE ON QUALIFICATION OF NUCLEAR POWER PLANT OPERATIONS PERSONNEL, INT/4/103/001	KARLSRUHE, GERMANY 5 MARCH - 6 APRIL	AGENCY	26	0	0	117,501 (CC)
INTERREGIONAL TRAINING COURSE ON PLANNING OF MANAGEMENT OF THE NUCLEAR FUEL CYCLE, INT/4/104/001	SAN CARLOS DE BARILOCHE, ARGENTINA 12 NOVEMBER - 30 NOVEMBER	AGENCY	26	1	7	191,930 (CC)
INTERREGIONAL TRAINING COURSE ON INDUCTION AND USE OF MUTATIONS IN PLANT BREEDING, INT/5/118/001	SEIBERSDORF, AUSTRIA 3 APRIL - 24 MAY	AGENCY	17	3	0	140,513 (CC) 32 (NCC)
INTERREGIONAL TRAINING COURSE ON THE USE OF ISOTOPE AND RADIATION TECHNIQUES IN STUDIES ON SOIL/PLANT RELATIONSHIPS, WITH EMPHASIS ON SOIL WATER MANAGEMENT, INT/5/119/001	SEIBERSDORF, AUSTRIA 28 MAY - 4 JULY	AGENCY	19	0	0	138,081 (CC) 573 (NCC)
INTERREGIONAL TRAINING COURSE ON THE USE OF RADIATION AND ISOTOPES IN INSECT CONTROL, INT/5/120/001	GAINESVILLE, FL, USA 13 MAY - 23 JUNE	AGENCY	20	0	0	112,069 (CC)
INTERREGIONAL TRAINING COURSE ON NUCLEAR MEDICINE, INT/6/039/001	MOSCOW, USSR 3 SEPTEMBER - 19 OCTOBER	AGENCY	30	0	0	76,283 (CC) 89,850 (NCC)
INTERREGIONAL TRAINING COURSE ON RADIATION CYTOGENETICS IN BIOMEDICAL, ENVIRONMENTAL HEALTH AND RADIATION PROTECTION PROBLEMS, INT/7/010/001	RIO DE JANEIRO, BRAZIL 11 JUNE - 29 JUNE	AGENCY	19	1	2	112,010 (CC)
INTERREGIONAL TRAINING COURSE ON STRATEGIES AND METHODOLOGIES FOR APPLIED MARINE RADIOACTIVITY STUDIES, INT/7/011/001	LA SPEZIA, ITALY MONACO-VILLE, MONACO 1 OCTOBER - 16 OCTOBER	AGENCY	17	0	0	107,004 (CC)
INTERREGIONAL TRAINING COURSE ON SAFETY AND REGULATION OF RADIATION SOURCES, INT/9/103/001	ARGONNE, IL, USA 9 APRIL - 11 MAY	AGENCY	28	0	0	158,980 (CC)
INTERREGIONAL TRAINING COURSE ON SAFETY IN THE OPERATION OF RESEARCH REACTORS, INT/9/104/001	ARGONNE, IL, USA 14 MAY - 15 JUNE	AGENCY	29	3	0	138,132 (CC)

Project title and code	Place(s) and dates	Source of funds	Participation ^a			Amount(s) expended ^b (\$)	
			(1)	(2)	(3)		
INTERREGIONAL TRAINING COURSE ON PHYSICAL PROTECTION OF NUCLEAR FACILITIES AND MATERIALS, INT/9/107/001	ALBUQUERQUE, NM, USA 23 APRIL - 17 MAY	AGENCY USA	16	10	0	1,077 112,045	(NCC) (CC)
INTERREGIONAL TRAINING COURSE ON RADIATION PROTECTION AND NUCLEAR SAFETY, INT/9/108/001	BUENOS AIRES, ARGENTINA 2 APRIL - 30 NOVEMBER	AGENCY	21	0	15	182,893	(CC)
INTERREGIONAL TRAINING COURSE ON THE MANAGEMENT OF RADIOACTIVE WASTES, INT/9/110/001	GIF-SUR-YVETTE, FRANCE 5 JUNE - 22 JUNE	AGENCY	25	0	0	79,113	(CC)
INTERNATIONAL TRAINING COURSE ON OPERATIONAL SAFETY ASSESSMENT TECHNIQUES FOR NUCLEAR POWER PLANTS USING PRESSURIZED WATER REACTORS, INT/9/111/001	GIF-SUR-YVETTE, FRANCE 26 NOVEMBER - 14 DECEMBER	AGENCY	10	0	0	71,027	(CC)
REGIONAL SEMINAR ON NUCLEAR SCIENCE FOR PEACE AND DEVELOPMENT, RAF/0/005/001	KAMPALA, UGANDA 12 MARCH - 18 MARCH	RESERVE (CC)	16	0	0	45,623	(CC)
REGIONAL TRAINING COURSE ON NUCLEAR INSTRUMENTATION MAINTENANCE, RAF/4/007/001	RABAT, MOROCCO 4 JUNE - 13 JULY	AGENCY	12	2	5	84,374	(CC)
REGIONAL GROUP TRAINING OF NATIONAL AGRO-ECONOMISTS, RAF/5/013/002	MEKNES, MOROCCO 24 SEPTEMBER - 28 SEPTEMBER	AGENCY	3	0	1	3,350	(CC)
REGIONAL WORKSHOP ON MEDFLY TRAPPING, RAF/5/013/003	AGADIR, MOROCCO 12 NOVEMBER - 23 NOVEMBER	AGENCY	3	0	8	7,845	(CC)
REGIONAL WORKSHOP ON MEDFLY TRAPPING, RAF/5/013/004	TUNIS, TUNISIA 26 NOVEMBER - 7 DECEMBER	AGENCY	7	0	10	8,951	(CC)
REGIONAL TRAINING COURSE ON INDUCTION AND USE OF MUTATIONS IN PLANT BREEDING, RAF/5/015/001	KWABENYA, GHANA 20 AUGUST - 28 SEPTEMBER	AGENCY ITALY	16	0	3	46,068 61,400	(CC) (CC)
REGIONAL TRAINING COURSE ON TSETSE CONTROL WITH THE STERILE INSECT TECHNIQUE, RAF/5/017/001	PONG-TAMALE, GHANA 7 MAY - 1 JUNE	AGENCY	14	0	4	42,540	(CC)
REGIONAL TRAINING COURSE ON THE USE OF IMMUNOASSAY TECHNIQUES IN THE DIAGNOSIS AND CONTROL OF ANIMAL DISEASES, RAF/5/019/001	BINGERVILLE, COTE D'IVOIRE 29 OCTOBER - 23 NOVEMBER	AGENCY	17	1	2	139,586	(CC)
REGIONAL TRAINING COURSE ON RADIOIMMUNOASSAY, RAF/6/004/001	ADDIS ABABA, ETHIOPIA 1 OCTOBER - 19 OCTOBER	AGENCY	11	0	2	81,370	(CC)
REGIONAL WORKSHOP ON HYDROSEDIMENTOLOGY, RAF/8/012/003	BAMAKO, MALI 10 DECEMBER - 18 DECEMBER	AGENCY	6	0	4	54,930	(CC)
REGIONAL TRAINING COURSE FOR RADIATION PROTECTION OFFICERS, RAF/9/005/003	TUNIS, TUNISIA 7 MAY - 1 JUNE	AGENCY	16	0	7	62,468	(CC)
REGIONAL WORKSHOP ON BASIC RADIATION AND DEVELOPMENT OF NATIONAL INFRASTRUCTURE FOR RADIATION SAFETY, RAF/9/005/004	IBADAN, NIGERIA 3 DECEMBER - 14 DECEMBER	AGENCY	18	0	0	25,765	(CC)
FOURTH REGIONAL WORKSHOP ON ENERGY, ELECTRICITY AND NUCLEAR POWER PLANNING, RAS/0/013/005	TAEJEON, CHUNG-NAM, KOREA, R. 27 AUGUST - 31 AUGUST	AGENCY	10	1	4	25,351	(CC)
REGIONAL TRAINING COURSE ON ISOTOPE TECHNIQUES IN HYDROLOGY, RAS/0/015/002	BOMBAY, INDIA 17 SEPTEMBER - 5 OCTOBER	AGENCY	9	0	3	11,406	(CC)
REGIONAL TRAINING COURSE ON RESEARCH REACTOR SAFETY PRINCIPLES, RAS/0/015/003	BOMBAY, INDIA 9 APRIL - 20 APRIL	AGENCY	9	17	2	9,261	(CC)
REGIONAL TRAINING COURSE ON NUCLEAR POWER PROJECT PLANNING AND IMPLEMENTATION, RAS/0/015/004	TAEJEON, CHUNG-NAM, KOREA, R. 22 OCTOBER - 9 NOVEMBER	AGENCY	13	0	3	19,544	(CC)
REGIONAL WORKSHOP ON TECHNOLOGY AND UTILIZATION OF LOW POWER RESEARCH REACTORS, RAS/0/015/005	BEIJING, CHINA 19 NOVEMBER - 23 NOVEMBER	AGENCY	10	0	4	3,045	(CC)

Project title and code	Place(s) and dates	Source of funds	Participation ^A			Amount(s) expended ^B (\$)
			(1)	(2)	(3)	
REGIONAL WORKSHOP ON PROJECT MANAGEMENT AND EVALUATION TECHNIQUES FOR TC PROJECTS, RAS/0/017/001	JAKARTA, INDONESIA 18 JUNE - 29 JUNE	AGENCY	19	0	5	82,350 (CC)
REGIONAL TRAINING COURSE ON PREPARATION AND CONTROL OF RADIOPHARMACEUTICALS, RAS/2/003/001	BEIJING, CHINA 8 OCTOBER - 2 NOVEMBER	AGENCY	15	0	2	82,656 (CC) 16,390 (NCC)
REGIONAL WORKSHOP ON MAINTENANCE OF NUCLEAR MEDICAL INSTRUMENTS, RAS/4/008/001	BOMBAY, INDIA 15 JANUARY - 2 FEBRUARY	INDIA	9	2	8	GIFT IN KIND
REGIONAL TRAINING COURSE ON IMMUNOASSAY TECHNIQUES IN ANIMAL PRODUCTION AND DISEASE CONTROL, RAS/5/018/001	JAKARTA, INDONESIA 24 SEPTEMBER - 19 OCTOBER	AGENCY	15	0	5	134,262 (CC)
RESEARCH CO-ORDINATION MEETING ON FOOD IRRADIATION WITH EMPHASIS ON PROCESS CONTROL AND ACCEPTANCE, RAS/5/020/001	BOMBAY, INDIA 16 APRIL - 20 APRIL	UNDP	12	0	0	13,996 (CC)
REGIONAL WORKSHOP ON TECHNOECONOMIC FEASIBILITY OF USING ELECTRON BEAM VS. ISOTOPIC SOURCES OF RADIATION FOR FOOD PROCESSING, RAS/5/020/002	TAKASAKI, GUNMA, JAPAN 22 OCTOBER - 2 NOVEMBER	UNDP	7	1	0	28,385 (CC)
RESEARCH CO-ORDINATION MEETING ON THE USE OF ISOTOPES IN STUDIES TO IMPROVE YIELDS AND NITROGEN FIXATION OF GRAIN LEGUMES THE TROPICS AND SUB-TROPICS OF ASIA, RAS/5/021/002	FAISALABAD, PAKISTAN 2 MAY - 11 MAY	UNDP	5	0	1	28,322 (CC)
REGIONAL TRAINING COURSE ON THE USE OF COMPUTERS IN TECHNETIUM - 99M IMAGING, RAS/6/016/002	CAMPERDOWN, AUSTRALIA 26 FEBRUARY - 12 APRIL	AUSTRALIA	12	6	0	42,587 (CC)
REGIONAL TRAINING COURSE ON RADIATION STERILIZATION OF TISSUE GRAFTS FOR CLINICAL USE IN HEALTH CARE, RAS/7/003/003	CHEONAN, SEOUL, KOREA, REP. 3 DECEMBER - 14 DECEMBER	AGENCY	16	0	1	67,348 (CC)
REGIONAL TRAINING COURSE ON APPLICATION OF RADIATION AND RADIOISOTOPE TECHNIQUES IN BIOLOGICAL SCIENCES SIGNIFICANT FOR HUMAN HEALTH PROBLEMS, RAS/7/004/001	TOKYO, JAPAN 13 NOVEMBER - 14 DECEMBER	AGENCY	16	0	0	120,331 (CC)
REGIONAL TRAINING COURSE ON NON-DESTRUCTIVE TESTING OF EDDY CURRENTS (LEVEL II), RAS/8/061/051	ISLAMABAD, PAKISTAN 16 SEPTEMBER - 4 OCTOBER	UNDP	11	0	2	35,492 (CC)
REGIONAL EXECUTIVE MANAGEMENT SEMINAR ON THE USE OF NUCLEONIC CONTROL SYSTEM FOR MINERLA PROCESSING, RAS/8/061/071	DILIMAN, QUEZON CITY, PHILIPPINES 21 FEBRUARY - 23 FEBRUARY	UNDP	7	0	2	20,896 (CC)
REGIONAL TRAINING COURSE ON NON-DESTRUCTIVE TESTING OF ULTRASONICS (LEVEL III), RAS/8/061/072	BANDUNG, INDONESIA 9 JULY - 27 JULY	UNDP	13	2	6	36,067 (CC)
REGIONAL TRAINING COURSE ON INDUSTRIAL RADIATION STERILIZATION, QUALITY CONTROL AND STERILITY ASSURANCE, RAS/8/061/073	BANGKOK, THAILAND 14 MAY - 25 MAY	UNDP	15	1	3	50,890 (CC)
REGIONAL WORKSHOP ON INDUSTRIAL STERILIZATION OF MEDICAL PRODUCTS - REGULATORY ASPECTS, RAS/8/061/074	KUALA LUMPUR, MALAYSIA 28 MAY - 30 MAY	UNDP	10	7	3	25,072 (CC)
REGIONAL TRAINING COURSE ON RADIATION CURING OF SURFACE COATINGS ON WOOD PRODUCTS, RAS/8/061/075	JAKARTA, INDONESIA 4 JUNE - 22 JUNE	UNDP	13	0	2	46,104 (CC)
REGIONAL TRAINING COURSE ON NON-DESTRUCTIVE TESTING OF RADIOGRAPHY (LEVEL III), RAS/8/061/076	DILIMAN, QUEZON CITY, PHILIPPINES 4 JUNE - 22 JUNE	UNDP	10	0	2	24,366 (CC)
REGIONAL TRAINING COURSE ON INDUSTRIAL RADIATION STERILIZATION- QUALITY CONTROL AND COMPATIBILITY OF MATERIALS, RAS/8/061/077	BOMBAY, INDIA 17 SEPTEMBER - 28 SEPTEMBER	UNDP	10	0	2	13,299 (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 TRACER APPLICATIONS IN INDUSTRY, RAS/8/061/079	LAHORE, PAKISTAN 25 NOVEMBER - 13 DECEMBER	UNDP	10	0	3	51,435 (CC)
REGIONAL TRAINING COURSE ON NON-DESTRUCTIVE TESTING OF SURFACE METHODS (LEVEL II), RAS/8/061/080	KUALA LUMPUR, MALAYSIA 5 NOVEMBER - 23 NOVEMBER	UNDP	13	0	4	35,361 (CC)
REGIONAL WORKSHOP ON CHARACTERIZATION METHODS FOR NEW MATERIALS, RAS/8/061/089	BEIJING, CHINA 30 JULY - 3 AUGUST	UNDP	8	0	1	42,345 (CC)
REGIONAL TRAINING COURSE ON RADIATION CROSSLINKING TECHNOLOGY, RAS/8/061/102	CHANGCHUN, JL, CHINA 3 SEPTEMBER - 11 SEPTEMBER	UNDP	11	0	4	2,992 (CC)
REGIONAL EXECUTIVE MANAGEMENT SEMINAR ON INDUSTRIAL RADIATION CURING TECHNOLOGY, RAS/8/062/018	JAKARTA, INDONESIA 19 MARCH - 21 MARCH	JAPAN	10	0	4	13,202 (CC)
REGIONAL WORKSHOP ON FABRICATION OF NDT TEST PIECES, RAS/8/062/022	TOKYO, JAPAN 10 SEPTEMBER - 22 SEPTEMBER	JAPAN	12	0	0	58,796 (CC)
REGIONAL TRAINING COURSE ON DEVELOPMENT OF INFRASTRUCTURES FOR ENSURING RADIATION PROTECTION, RAS/9/006/003	LUCAS HEIGHTS, AUSTRALIA 10 SEPTEMBER - 5 OCTOBER	AGENCY JAPAN AUSTRALIA	13	1	0	16,304 (CC) 4,361 (CC) 62,475 (CC)
REGIONAL WORKSHOP ON INTERCOMPARISON FOR PERSONAL DOSIMETERS, RAS/9/006/004	IBARAKI, JAPAN 22 OCTOBER - 26 OCTOBER	AGENCY JAPAN	13	1	0	4,437 (CC) 28,254 (CC)
REGIONAL WORKSHOP ON WWER 440/1000 STEAM-GENERATOR IN SERVICE INSPECTION, RER/4/002/006	ZAGREB, YUGOSLAVIA 12 JUNE - 14 JUNE	AGENCY	11	0	0	22,218 (CC)
REGIONAL WORKSHOP AND ON-THE-JOB TRAINING ON NDT, AUDITS AND EROSION-CORROSION OF RPV AND PIPING OF WWER-TYPE REACTORS, RER/4/002/007	MADRID, SPAIN 17 SEPTEMBER - 28 SEPTEMBER	AGENCY	12	0	0	23,900 (CC)
REGIONAL ON-THE-JOB TRAINING COURSE ON IN-SERVICE INSPECTION OF KRSKO NUCLEAR POWER PLANT, RER/4/002/008	ZAGREB, YUGOSLAVIA 26 NOVEMBER - 5 DECEMBER	AGENCY	6	0	0	8,470 (CC)
REGIONAL TRAINING COURSE ON NUCLEAR ELECTRONICS (MAINTENANCE ORIENTED), RER/4/004/001	ANKARA, TURKEY 10 SEPTEMBER - 19 OCTOBER	AGENCY	16	0	0	78,549 (CC)
REGIONAL WORKSHOP ON GENERATOR-PRODUCED RADIOPHARMACEUTICALS, RER/6/002/004	BAGHDAD, IRAQ 11 FEBRUARY - 25 FEBRUARY	AGENCY	5	0	0	10,450 (CC)
REGIONAL TRAINING COURSE ON RADIOIMMUNOASSAY, RER/6/002/005	DAMASCUS, SYRIAN ARAB REP. 17 JUNE - 28 JUNE	AGENCY	10	0	0	30,481 (CC)
REGIONAL WORKSHOP ON SAPOS NETWORK-OPERATORS, RER/9/003/004	DAMASCUS, SYRIAN ARAB REP. 25 MARCH - 29 MARCH	AGENCY	3	0	0	c
REGIONAL WORKSHOP ON SAPOS NETWORK-MAINTENANCE TECHNICIANS AND ENGINEERS, RER/9/003/005	DAMASCUS, SYRIAN ARAB REP. 25 MARCH - 12 APRIL	AGENCY	6	0	0	20,330 (CC)
REGIONAL CO-ORDINATION MEETING ON INTERCOMPARISON MEASUREMENTS, RER/9/003/006	AMMAN, JORDAN 15 APRIL - 19 APRIL	AGENCY	8	0	0	7,990 (CC)
REGIONAL WORKSHOP ON RADIOCHEMICAL MEASUREMENTS IN FOOD AND ENVIRONMENTAL SAMPLES, RER/9/003/007	ZAGREB, YUGOSLAVIA 10 DECEMBER - 21 DECEMBER	AGENCY	8	0	0	30,075 (CC)
REGIONAL WORKSHOP ON RADIATION PROTECTION IN MEDICAL APPLICATIONS OF IONIZING RADIATION, RER/9/007/003	KUWAIT CITY, KUWAIT 3 MARCH - 15 MARCH	AGENCY	7	0	0	27,037 (CC)
THIRD REGIONAL TRAINING COURSE FOR LIBRARIANS AND INFORMATION SPECIALISTS IN NUCLEAR SCIENCE AND TECHNOLOGY, RLA/0/009/005	GUATEMALA CITY, GUATEMALA 2 JULY - 20 JULY	AGENCY	9	0	2	36,526 (CC)

Project title and code	Place(s) and dates	Source of funds	Participation ^a			Amount(s) expended ^b (\$)
			(1)	(2)	(3)	
REGIONAL TRAINING COURSE ON DESIGN, MANAGEMENT AND EVALUATION TECHNIQUES OF IAEA TC PROJECTS, RLA/0/012/001	MEXICO CITY, MEXICO 5 NOVEMBER - 16 NOVEMBER	AGENCY	23	0	9	100,174 (CC)
REGIONAL WORKSHOP ON APPLICATIONS OF NEUTRON ACTIVATION ANALYSIS IN ENVIRONMENTAL STUDIES, RLA/2/003/003	BOGOTA, COLOMBIA 12 FEBRUARY - 9 MARCH	AGENCY	10	0	2	38,621 (CC)
REGIONAL TRAINING COURSE ON APPLICATION OF NUCLEAR ANALYTICAL TECHNIQUES IN FOSSIL ENERGY RESOURCES, RLA/2/003/005	MEXICO CITY, MEXICO 5 NOVEMBER - 30 NOVEMBER	AGENCY	11	0	0	34,643 (CC)
REGIONAL TRAINING COURSE ON THE APPLICATION OF X-RAY FLUORESCENCE TO ENVIRONMENTAL PROBLEMS, RLA/2/003/006	ASUNCION, PARAGUAY 12 NOVEMBER - 30 NOVEMBER	AGENCY	8	0	0	37,629 (CC)
SECOND REGIONAL WORKSHOP ON NUCLEAR ANALYTICAL TECHNIQUES, RLA/2/003/007	BUENOS AIRES, ARGENTINA 1 OCTOBER - 3 OCTOBER	AGENCY	13	0	1	21,417 (CC)
REGIONAL WORKSHOP ON ATOMIC ABSORPTION SPECTROMETRY AND ICP (INDUCED COUPLED PLASMA SPECTROMETRY) FOR ANALYSIS OF AGROINDUSTRIAL PRODUCTS AND FOOD, RLA/2/003/008	PIRACICABA, BRAZIL 1 OCTOBER - 23 NOVEMBER	AGENCY	5	0	0	26,113 (CC)
REGIONAL WORKSHOP ON ACTIVATION ANALYSIS OF AGROINDUSTRIAL PRODUCTS AND FOOD, RLA/2/003/009	SAO PAULO, BRAZIL 1 OCTOBER - 23 NOVEMBER	AGENCY	2	1	0	10,493 (CC)
REGIONAL WORKSHOP ON NUCLEAR ANALYTICAL TECHNIQUES AND QUALITY ASSURANCE, RLA/2/003/010	BUENOS AIRES, ARGENTINA 4 OCTOBER - 12 OCTOBER	AGENCY	11	0	5	36,854 (CC)
REGIONAL TRAINING COURSE ON MAINTENANCE OF INDUSTRIAL NUCLEAR EQUIPMENT, RLA/4/006/019	MEXICO CITY, MEXICO 19 NOVEMBER - 7 DECEMBER	AGENCY	9	0	0	15,978 (CC)
REGIONAL WORKSHOP ON APPLICATION OF PROGRAMMABLE LOGIC CONTROLLERS (PLCS) AND PERSONAL COMPUTER, RLA/4/006/020	BUENOS AIRES, ARGENTINA 12 NOVEMBER - 23 NOVEMBER	AGENCY	6	0	6	47,368 (CC)
REGIONAL WORKSHOP ON MAINTENANCE OF GAMMA CAMERAS, RLA/4/006/021	BOGOTA, COLOMBIA 2 JULY - 27 JULY	AGENCY	10	0	1	31,037 (CC)
REGIONAL TRAINING COURSE ON MAINTENANCE OF POWER SUPPLIES IN NUCLEAR INSTRUMENTS, RLA/4/006/022	GUATEMALA CITY, GUATEMALA 11 JUNE - 29 JUNE	AGENCY	10	0	2	27,993 (CC)
REGIONAL TRAINING COURSE ON BURNUP DETERMINATION OF RESEARCH REACTORS FUELS, RLA/4/007/010	MEXICO CITY, MEXICO 1 OCTOBER - 12 OCTOBER	GERMANY, F.R.	8	0	4	18,239 (CC)
REGIONAL TRAINING COURSE FOR RESEARCH REACTORS OPERATORS, RLA/4/007/011	SAO PAULO, BRAZIL 15 OCTOBER - 2 NOVEMBER	GERMANY, F.R.	11	0	2	30,451 (CC)
REGIONAL WORKSHOP ON SAFETY ANALYSIS REPORT AND ASSOCIATED COMPUTER CALCULATIONS FOR RESEARCH REACTORS, RLA/4/007/012	SAN CARLOS DE BARILOCHE, ARGENTINA 19 NOVEMBER - 7 DECEMBER	GERMANY, F.R.	9	0	0	17,376 (CC)
REGIONAL TRAINING COURSE ON RADIOIMMUNOASSAY AND ENZYME ASSAY FOR THE DETERMINATION OF HORMONES, METABOLITES AND ANTIBODIES IN ANIMAL PRODUCTION AND HEALTH, RLA/5/019/002	HAVANA, CUBA 7 NOVEMBER - 21 NOVEMBER	AGENCY	15	0	0	29,856 (CC)
SECOND REGIONAL WORKSHOP ON IMPROVEMENT OF RICE AND OTHER CEREALS IN LATIN AMERICA THROUGH MUTATION BREEDING, RLA/5/021/005	CAMPINAS, BRAZIL 19 NOVEMBER - 23 NOVEMBER	AGENCY	9	1	4	34,122 (CC)
REGIONAL ADVANCE TRAINING COURSE ON DOUBLED HAPLOID TECHNIQUES IN MUTATION BREEDING, RLA/5/021/006	GUATEMALA CITY, GUATEMALA 3 SEPTEMBER - 21 SEPTEMBER	AGENCY USA	7	0	5	7,212 (CC) 8,930 (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 OPTIMIZATION OF THE PRODUCTION AND PREPARATION OF BULK REAGENT WITH PRESENT METHODOLOGY, RLA/6/011/028	HAVANA, CUBA 12 NOVEMBER - 23 NOVEMBER	AGENCY	14	1	5	26,061 (CC) 29,734 (NCC)
REGIONAL TRAINING COURSE ON MEDICAL SCINTIGRAPHY, RLA/8/015/001	HAVANA, CUBA 13 MAY - 9 JUNE	AGENCY	14	0	10	64,262 (CC) 80,789 (NCC)
REGIONAL WORKSHOP ON QUALITY ASSESSMENT, RLA/8/013/056	SAO PAULO, BRAZIL 28 MAY - 1 JUNE	AGENCY ITALY	16	0	0	643 (CC) 31,478 (CC)
REGIONAL WORKSHOP ON RADIATION PROTECTION FOR RADIOGRAPHERS, RLA/8/013/058	BUENOS AIRES, ARGENTINA 11 JUNE - 15 JUNE	AGENCY GERMANY, F.R. ITALY	17	0	0	1,285 (CC) 29,034 (CC) 650 (CC)
REGIONAL TRAINING COURSE ON INSPECTION OF LPG CYLINDERS, RLA/8/013/061	LIMA, PERU 2 JULY - 6 JULY	ITALY	13	0	0	21,402 (CC)
REGIONAL WORKSHOP ON UNDERWATER INSPECTION, RLA/8/013/072	SAO PAULO, BRAZIL 6 AUGUST - 10 AUGUST	GERMANY, F.R.	14	0	0	24,199 (CC)
REGIONAL TRAINING COURSE ON UT AND RT IN CASTING INSPECTION, RLA/8/013/078	COAHUILA, MEXICO 27 AUGUST - 31 AUGUST	AGENCY GERMANY, F.R.	15	0	0	72 (CC) 26,923 (CC)
REGIONAL TRAINING COURSE ON EDDY CURRENTS (LEVEL III - TUBES), RLA/8/013/079	LIMA, PERU 3 SEPTEMBER - 14 SEPTEMBER	GERMANY, F.R. ITALY	14	0	0	25,309 (CC) 626 (CC)
REGIONAL TRAINING COURSE ON DIAGNOSIS OF ROTATING EQUIPMENT, RLA/8/013/080	KINGSTON, JAMAICA 3 SEPTEMBER - 14 SEPTEMBER	GERMANY, F.R.	14	0	0	30,628 (CC)
REGIONAL TRAINING COURSE ON COMPUTERS IN RT INSPECTION, RLA/8/013/088	CUERNAVACA, MEXICO 24 SEPTEMBER - 28 SEPTEMBER	ITALY	14	0	0	19,281 (CC)
REGIONAL SEMINAR ON HYDROELECTRIC PLANT MAINTENANCE, RLA/8/013/095	ASUNCION, PARAGUAY 15 OCTOBER - 19 OCTOBER	ITALY	10	0	0	11,878 (CC)
REGIONAL TRAINING COURSE ON THE USE OF ENVIRONMENTAL ISOTOPES IN HYDROLOGY, RLA/8/014/005	SANTIAGO, CHILE 23 APRIL - 11 MAY	AGENCY GERMANY, F.R. CHILE	18	0	6	62,180 (CC) 2,958 (CC) 6,000 (CC)
REGIONAL TRAINING COURSE ON RADIATION PROTECTION IN RADIODIAGNOSIS, RLA/9/009/045	QUITO, ECUADOR 6 AUGUST - 31 AUGUST	AGENCY	9	1	12	20,346 (CC)
REGIONAL TRAINING COURSE ON RADIATION PROTECTION IN MEDICAL APPLICATIONS OF IONIZING RADIATION, RLA/9/009/047	HAVANA, CUBA 5 NOVEMBER - 23 NOVEMBER	AGENCY FRANCE	13	0	6	7,305 (CC) 27,527 (NCC) 14,286 (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 or 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 in respect of local lecturers, or expenditures for laboratory, lecture room and other facilities. They are also not representative of the final cost of the training course, since unobligated amounts may be disbursed in the following year.

^c In connection with RER/9/003/005.

ANNEX III

PUBLISHED REPORTS: 1990

Recipient	Subject of report	Project code	Author(s)	Reference no.
ARGENTINA	NUCLEAR REACTOR THERMOHYDRAULICS AND SAFETY TECHNOLOGY	ARG/4/078	LAHEY, RICHARD THOMAS JR.	IAEA/UNDP-ARG/89/012-01
	BURN-UP DETERMINATION OF SPENT FUEL ELEMENTS	ARG/4/078	PHILLIPS, JOHN R.	IAEA/UNDP-ARG/89/012-02
CUBA	RADIO CHEMISTRY	CUB/0/004	BUCHTELA, KARL	IAEA/UNDP-CUB/86/018-TR
INDONESIA	NUTRITION, REPRODUCTION AND DISEASE DIAGNOSTICS IN INDONESIAN RUMINANTS	INS/5/021	PERERA, BUTHGAMU M.A.	IAEA/UNDP-INS/88/013-07
	METHODS FOR INCREASING RUMINANT PRODUCTIVITY FROM AVAILABLE FEED RESOURCES.	INS/5/021	LENG, RONALD ALFRED	IAEA/UNDP-INS/88/013-08
	NATIONAL TRAINING COURSE ON ELISA FOR THE SERADIAGNOSIS OF ANIMAL DISEASES - IV	INS/5/021	MCCLURE, LAWRENCE HOWARD	IAEA/UNDP-INS/88/013-09
	FIELD APPLICATION OF ISOTOPES IN INSECT ECOLOGICAL STUDIES	INS/5/021	SHELTON, ANTHONY MINOT	IAEA/UNDP-INS/88/013-10
INTERREGIONAL	WAMAP MISSION TO ZAMBIA	INT/9/081	BERGMAN, C. PLUMB, GEOFFREY R. THOMAS, KARYANIL THOMAS	IAEA-TA-2442
	RAPAT MISSION TO ZIMBABWE	INT/9/055	COLLINS, DOUGLAS M. STROHAL, PETAR TATTERSALL, PHILIP	IAEA-TA-2445
	WAMAP MISSION TO POLAND	INT/9/081	KRAUSE, HELMUT MOLINAŠ, E. THOMAS, KARYANIL THOMAS	IAEA-TA-2446
	WAMAP MISSION TO CHILE	INT/9/081	THOMAS, KARYANIL THOMAS CORBET, ALAN D.W.	IAEA-TA-2447
	WAMAP MISSION TO LIBYA	INT/9/081	THOMAS, KARYANIL THOMAS PETTERSSON, BENGT G. TSYPLENKOV, VLADIMIR	IAEA-TA-2449
	RAPAT MISSION TO THE LIBYAN ARAB JAMAHIRIYA	INT/9/055	STROHAL, PETAR MRABIT, KHAMMAR BENGTSSON, LARS GUNNAR	IAEA-TA-2450
	RAPAT MISSION TO THE DEM. PEOPLE'S REP. OF KOREA	INT/9/055	STROHAL, PETAR ASLAM, JAVED MOISEEV, ALEXEJ RABIEJ, STANISLAW	IAEA-TA-2451
	RAPAT MISSION TO GHANA	INT/9/055	STROHAL, PETAR COLLINS, DOUGLAS M. TATTERSALL, PHILIP	IAEA-TA-2452
	WAMAP MISSION TO THE PHILIPPINES	INT/9/081	MCCOMBIE, CHARLES DLOUHY, ZDENEK THOMAS, KARYANIL THOMAS	IAEA-TA-2453
	RAPAT MISSION TO MONGOLIA	INT/9/055	STROHAL, PETAR MOISEEV, ALEXEJ ASLAM, JAVED RABIEJ, STANISLAW	IAEA-TA-2454
	RAPAT MISSION TO SRI LANKA	INT/9/055	STROHAL, PETAR BUTTON, JAMES CHARLES E. JAVED, MOHAMMAD	IAEA-TA-2455
KOREA, REP. OF	MUTATION BREEDING - FRUIT TREES	ROK/5/025	DONINI, BASILIO	IAEA/UNDP-ROK/84/003-29
	HORTICULTURAL CROPS: MUTATION BREEDING AND TISSUE CULTURE OF GARLIC	ROK/5/025	NOVAK, FRANTISEK J.	IAEA/UNDP-ROK/84/003-30
	ROOT GROWTH AND NUTRIENT UPTAKE STUDIES	ROK/5/025	ROEMHELD, VOLKER	IAEA/UNDP-ROK/84/003-31
	GENETIC IMPROVEMENT ON RESISTIBILITY OF SESAME	ROK/5/025	LI, LILI	IAEA/UNDP-ROK/84/003-32
THAILAND	BREEDING FOR RESISTANCE TO DISEASE IN LEGUMES	THA/5/031	BACKMAN, PAUL ANTHONY	IAEA/UNDP-THA/85/004-14
	STORAGE, ANALYSIS AND INTERPRETATION OF DATA ON BUFFALO AND DAIRY COW REPRODUCTION	THA/5/031	MACKINNON, MARGARET JANE	IAEA/UNDP-THA/85/004-15
	MUTATION BREEDING OF FOOD LEGUMES - A REVIEW OF PROJECT ACHIEVEMENTS	THA/5/031	ASHRI, AMRAM	IAEA/UNDP-THA/85/004-16

ANNEX IV
VOLUNTARY CONTRIBUTIONS PLEDGED AND PAID TO THE
TECHNICAL ASSISTANCE AND CO-OPERATION FUND FOR 1990
(as at 31 December 1990)

Member State	Base rate %	Share of \$45.5 million target for voluntary contributions for 1990 using base rate ^a	Pledged	Paid
Afghanistan	0.01	4,550	0	0
Albania	0.01	4,550	4,550	0
Algeria	0.15	68,250	0	0
Argentina	0.65	295,750	50,000	0
Australia	1.55	705,250	760,000	760,000
Austria	0.73	332,150	332,150	332,150
Bangladesh	0.01	4,550	4,550	4,550
Belgium	1.16	527,800	128,205	128,205
Bolivia	0.01	4,550	0	0
Brazil	1.43	650,650	265,000	0
Bulgaria	0.15	68,250	68,250	68,250
Byelorussian SSR	0.33	150,150	150,150	147,043
Cameroon	0.01	4,550	0	0
Canada	3.06	1,392,300	1,102,823	1,102,823
Chile	0.08	36,400	36,400	0
China	0.78	354,900	354,900	354,900
Colombia	0.14	63,700	50,000	50,000
Costa Rica	0.02	9,100	0	0
Côte d'Ivoire	0.02	9,100	0	0
Cuba	0.09	40,950	40,950	40,950
Cyprus	0.02	9,100	9,100	9,100
Czech & Slovak F.R.	0.65	295,750	295,750	295,750
Dem. Kampuchea	0.01	4,550	0	0
Dem. P.R. Korea	0.05	22,750	22,750	0
Denmark	0.68	309,400	309,400	309,400
Dominican Republic	0.03	13,650	0	0
Ecuador	0.03	13,650	0	0
Egypt	0.07	31,850	31,850	31,850
El Salvador	0.01	4,550	0	0
Ethiopia	0.01	4,550	0	0
Finland	0.50	227,500	227,500	227,500
France	6.19	2,816,450	2,816,450	2,816,450
Gabon	0.03	13,650	0	0
Germany ^b	9.27	4,217,850	4,217,850	4,217,850
Ghana	0.01	4,550	6,000	0
Greece	0.39	177,450	177,450	0
Guatemala	0.02	9,100	9,100	0
Haiti	0.01	4,550	0	0
Holy See	0.01	4,550	2,000	2,000
Hungary	0.21	95,550	106,452	106,452
Iceland	0.03	13,650	13,650	13,650
India	0.37	168,350	163,800	163,800
Indonesia	0.15	68,250	39,000	39,000
Iran, Islamic Rep.	0.68	309,400	390,400	390,400
Iraq	0.12	54,600	54,600	0
Ireland	0.18	81,900	0	0
Israel	0.21	95,550	0	0
Italy	3.95	1,797,250	0	0
Jamaica	0.01	4,550	0	0
Japan	11.27	5,127,850	5,127,850	5,127,850
Jordan	0.01	4,550	4,550	0
Kenya	0.01	4,550	0	0
Korea, R.	0.22	100,100	100,100	100,100
Kuwait	0.29	131,950	0	0
Lebanon	0.01	4,550	0	0

Member State	Base rate %	Share of \$45.5 million target for voluntary contributions for 1990 using base rate ^a	Pledged	Paid
Liberia	0.01	4,550	0	0
Libyan A.J.	0.28	127,400	15,000	0
Liechtenstein	0.01	4,550	4,600	3,805
Luxembourg	0.06	27,300	0	0
Madagascar	0.01	4,550	1,600	0
Malaysia	0.11	50,050	50,050	50,050
Mali	0.01	4,550	0	0
Mauritius	0.01	4,550	0	0
Mexico	0.93	423,150	423,150	423,150
Monaco	0.01	4,550	0	0
Mongolia	0.01	4,550	4,550	0
Morocco	0.04	18,200	18,200	18,200
Myanmar	0.01	4,550	0	0
Namibia	0.00	0	0	0
Netherlands	1.63	741,650	741,650	741,650
New Zealand	0.24	109,200	0	0
Nicaragua	0.01	4,550	0	0
Niger	0.01	4,550	0	0
Nigeria	0.20	91,000	91,000	91,000
Norway	0.54	245,700	245,700	245,700
Pakistan	0.06	27,300	27,300	27,300
Panama	0.02	9,100	0	0
Paraguay	0.03	13,650	0	0
Peru	0.06	27,300	0	0
Philippines	0.09	40,950	0	0
Poland	0.55	250,250	250,250	250,250
Portugal	0.18	81,900	0	0
Qatar	0.05	22,750	0	0
Romania	0.19	86,450	0	0
Saudi Arabia	1.01	459,550	0	0
Senegal	0.01	4,550	0	0
Sierra Leone	0.01	4,550	0	0
Singapore	0.11	50,050	0	0
South Africa	0.44	200,200	0	0
Spain	1.93	878,150	90,000	41,393
Sri Lanka	0.01	4,550	0	0
Sudan	0.01	4,550	0	0
Sweden	1.20	546,000	546,000	546,000
Switzerland	1.07	486,850	486,850	486,850
Syrian A.R.	0.04	18,200	0	0
Thailand	0.10	45,500	45,500	45,500
Tunisia	0.03	13,650	0	0
Turkey	0.32	145,600	145,600	145,600
Uganda	0.01	4,550	0	0
Ukrainian SSR	1.24	564,200	564,000	779
USSR	9.89	4,499,950	4,495,400	4,495,400
U.A. Emirates	0.19	86,450	0	0
United Kingdom	4.81	2,188,550	2,188,550	2,188,550
U.R. Tanzania	0.01	4,550	0	0
USA	25.00	11,375,000	10,654,000	10,200,000
Uruguay	0.04	18,200	15,000	0
Venezuela	0.56	254,800	0	0
Viet Nam	0.01	4,550	513	513
Yugoslavia	0.45	204,750	204,750	0
Zaire	0.01	4,550	1,000	0
Zambia	0.01	4,550	4,550	4,550
Zimbabwe	0.02	9,100	8,962	8,962
TOTAL	100.00	45,500,000	38,797,255	36,855,225

^a As recommended in GC(V)/RES/100 and amended in GC(XV)/RES/286. ^b Through accession of the German Democratic Republic to the Federal Republic of Germany with effect from 3 October 1990, the two German States have united to form one sovereign State. As from the date of unification, the Federal Republic of Germany acts in the United Nations under the Designation "Germany".

ANNEX V

COST-FREE FELLOWSHIPS OFFERED AND AWARDED: 1990

Donor	Number of fellowships offered	Number of months offered	Number of fellowships awarded ^a	Number of months awarded ^a
Argentina	6	72	-	-
Austria	1	12	1	2
Belgium	5	-	2	7
Brazil	10	-	-	-
Bulgaria	-	-	3	2
China	-	-	2	2
Cuba	-	-	24	6
Czech & Slovak F.R.	9	-	1	3
Denmark	5	60	1	2
Finland	-	-	2	2
France	-	50	12	48
Germany	-	105	22	94
Hungary	4	48	1	12
India	10	-	1	6
Israel	-	45	12	43
Italy	25	200	2	10
Japan	5	45	-	-
Netherlands	8	-	1	3
Poland	10	-	-	-
Romania	-	-	1	1
Spain	5	60	5	12
Sweden	-	-	1	1
United Kingdom	^b	-	7	55
United States of America	^b	-	23	102

^a Awards less rejections and withdrawals as at 31 December 1990. ^b A specific amount of money was made available rather than a given number of fellowships.

ANNEX VI
APPROVED AND ON-GOING UNDP PROJECTS
AS AT 31 DECEMBER 1990
(in thousands of dollars)

Recipient	Short title	Project code	Tot. approval	Prior to 1990	Approved budgets				
					1990	1991	1992	1993	1994
A. Projects executed by the IAEA									
ALBANIA	STRENGTHENING OF NUCL. TECH. APPLIC. USING RESEARCH REACTOR	ALB87001	2,000	52	42	1,278	338	215	75
ARGENTINA	NUCLEAR ENGINEERING, PHASE II	ARG89012	274	120	115	39	0	0	0
CHINA	MANPOWER DEVELOPMENT FOR NUCLEAR POWER PROGRAMME	CPR85085	1,708	1,375	264	69	0	0	0
CHINA	USE OF RADIATION AND ISOTOPES IN FOOD AND AGRICULTURE	CPR86022	415	318	97	0	0	0	0
CUBA	EXTENSION OF THE APPLICATION OF NUCLEAR TECHNIQUES	CUB86018	600	570	30	0	0	0	0
EGYPT	NATIONAL CENTRE FOR RADIATION TECHNOLOGY, PHASE III	EGY89015	331	0	213	118	0	0	0
HUNGARY	STRENGTHENING OF AN ADVANCED AUTOMATED RADIATION LABORATORY	HUN86004	32	22	10	0	0	0	0
INDONESIA	AGRICULTURAL PRODUCTION, PHASE II	INS88013	470	222	124	124	0	0	0
KENYA	FATE OF TRYPANOCIDAL DRUGS IN CATTLE	KEN90023	89	0	89	0	0	0	0
KOREA, R.	ISOTOPES AND RADIATION IN AGRICULTURAL RESEARCH	ROK84003	633	645	-12	0	0	0	0
ROMANIA	NUCLEAR SAFETY	ROM87002	587	217	93	149	128	0	0
SYRIAN A.R.	URANIUM EXPLORATION	SYR86005	464	452	12	0	0	0	0
THAILAND	IMPROVING FOOD AND AGRICULTURAL PRODUCTION	THA85004	1,515	1,264	192	59	0	0	0
TURKEY	DEVELOPMENT OF NDT AT NUCLEAR RESEARCH AND TRAINING CENTRE	TUR87016	239	165	74	0	0	0	0
TURKEY	INDUSTRIAL STERILIZATION OF MEDICAL SUPPLIES	TUR88040	700	230	386	74	10	0	0
VENEZUELA	CENTRE FOR NUCLEAR AGRICULTURE	VEN86007	269	216	53	0	0	0	0

Recipient	Short title	Project code	Tot. approval	Prior to 1990	Approved budgets				
					1990	1991	1992	1993	1994
REGIONAL ASIA	FOOD IRRADIATION PROCESS CONTROL AND ACCEPTANCE	RAS89044	650	0	117	185	173	175	0
REGIONAL ASIA	INDUSTRIAL APPL. OF ISOTOPES AND RADIATION TECHNOLOGY (RCA)	RAS86073	3,270	1,789	843	638	0	0	0
REGIONAL ASIA	INCREASING THE CAPABILITIES OF COMMON GRAIN LEGUMES	RAS89045	970	30	243	225	246	196	30
REGIONAL LATIN AMERICA	NON-DESTRUCTIVE TESTING NETWORK	RLA84T01	1,611	1,588	23	0	0	0	0
SUB-TOTAL			16,827	9,275	3,008	2,958	895	586	105
B. Projects for which IAEA is associated agency									
CHINA	NUCLEAR SAFETY ADMINISTRATION	CPR85067	612	417	195	0	0	0	0
IRAN, I.R.	STRENGTHENING THE WATER RESOURCES RESEARCH INSTITUTE	IRA85015	106	108	-2	0	0	0	0
REGIONAL ARAB STATES	TRAINING OF TECHNICIANS IN WATER RESOURCES USE IN LDAC	RAB86008	22	0	22	0	0	0	0
SUB-TOTAL			740	525	215	0	0	0	0
TOTAL			17,567	9,800	3,223	2,958	895	586	105

ANNEX VII
FOOTNOTE-a/ PROJECTS MADE OPERATIONAL
OR EXTENDED DURING 1990

Recipient	Project title and code	Expert services (months)	Equipment (\$)	Fellowships (\$)	Group training (\$)	Sub-contracts (\$)	Source a)
BANGLADESH	REPAIR AND MAINTENANCE OF NUCLEAR INSTRUMENTS, DHAKA, BGD/4/013	1	0	0	0	0	USA
	AGROCHEMICAL RESIDUES, BGD/5/014	2	30,000	15,300	0	0	UK
BOLIVIA	IMPROVEMENT OF NUCLEAR MEDICINE, BOL/8/015	2	110,000	0	0	0	FRA
BRAZIL	RADIATION PROTECTION IN MEDICAL PRACTICE, BRA/9/035	14	110,000	0	0	0	GFR
COLOMBIA	UPGRADING OF RESEARCH REACTOR INSTRUMENTATION, COL/4/009	0	25,000	0	0	0	USA
COTE D'IVOIRE	FUEL-WOOD PRODUCTION, IVC/5/018	1	20,000	0	0	0	USA
CYPRUS	RADIOISOTOPES IN AGRICULTURE, CYP/5/014	1	35,000	10,200	0	0	UK
	POLLUTION DISPERSION, CYP/8/004	2	10,000	0	0	0	UK
ECUADOR	NUCLEAR ANALYTICAL TECHNIQUES (PHASE II), ECU/2/008	1	120,000	0	0	0	USA
	ISOTOPE APPLICATIONS IN HYDROLOGY, ECU/8/012	4	41,000	0	0	0	GFR
EGYPT	FEASIBILITY STUDY FOR SMALL AND MEDIUM NUCLEAR POWER PLANTS, EGY/4/029	10	0	0	0	0	USA
	RADIOIMMUNOASSAY IN ANIMAL SCIENCE, EGY/5/018	1	7,500	0	0	0	USA
EL SALVADOR	NUCLEAR INSTRUMENTATION, ELS/4/003	2	10,000	0	0	0	USA
	MUTATION BREEDING TECHNIQUES, ELS/5/003	7	85,000	27,900	0	0	UK
	CONTAMINATION OF THE AGRICULTURAL ENVIRONMENT, ELS/5/004	2	65,000	27,900	0	0	UK
GHANA	NON-DESTRUCTIVE TESTING (NDT), GHA/8/005	2	0	0	0	0	USA
GREECE	ION IMPLANTATION USING A TANDEM ACCELERATOR, GRE/1/034	1	100,000	0	0	0	USA
GUATEMALA	DOSIMETRY LABORATORY (PHASE II), GUA/1/005	1	150,000	7,700	0	0	UK
HUNGARY	RADIOACTIVE CONTAMINATION AND FOOD CONTROL, HUN/5/012	0	20,000	0	0	0	FRA
INDONESIA	UNIVERSITY RESEARCH AND TEACHING, INS/0/011	6	75,000	0	0	0	USA
	URANIUM EXPLORATION AND DEVELOPMENT, INS/3/009	5	40,000	0	0	0	FRA
	RESEARCH REACTOR SAFETY, INS/9/014	2	0	0	0	0	GFR
KOREA, REPUBLIC OF	PROCESSING OF AGRICULTURAL WASTES FOR ANIMAL FEED, ROK/5/027	3	20,000	0	0	0	USA
MALAYSIA	NUCLEAR INSTRUMENTATION CENTRE, MAL/4/008	2	0	0	0	0	USA
	RADIATION AND ISOTOPE APPLICATIONS IN INDUSTRY, MAL/8/010	2	35,000	0	0	0	USA
MEXICO	CHARACTERIZATION OF GEOTHERMAL RESOURCES, MEX/8/017	2	60,000	0	0	0	USA
MOROCCO	ISOTOPES IN HYDROLOGY, MOR/8/004	2	60,000	0	0	0	FRA
NIGERIA	PREVENTING TSETSE FLY RE-INVASION (PHASE II), NIR/5/021	0	58,100	0	0	0	BEL
		8	75,000	15,300	0	55,000	UK
	NUCLEAR MEDICINE, NIR/6/005	4	0	0	0	0	USA
POLAND	WHOLE-BODY COUNTING, POL/9/009	0	40,000	0	0	0	USA

Recipient	Project title and code	Expert services (months)	Equipment (\$)	Fellowships (\$)	Group training (\$)	Sub-contracts (\$)	Source a)
PORTUGAL	URANIUM EXPLORATION, POR/3/009	1	0	0	0	0	FRA
	NITROGEN FIXATION, POR/5/003	2	30,000	0	0	0	USA
THAILAND	ANIMAL DISEASES, THA/5/036	1	15,000	0	0	0	USA
TUNISIA	ADVANCED NON-DESTRUCTIVE TESTING TECHNIQUES IN INDUSTRY, TUN/8/010	3	45,000	0	0	0	FRA
VIET NAM	NUCLEAR INFORMATION CENTRE, VIE/0/005	0	8,000	0	0	0	TACF
YUGOSLAVIA	NUCLEAR POWER PLANT ANALYSIS, YUG/4/026	7	90,100	0	0	0	USA
REGIONAL ASIA AND PACIFIC	NUCLEAR INSTRUMENT MAINTENANCE, RAS/4/012	5	65,000	0	25,000	0	GFR
	USE OF COMPUTERS IN TECHNETIUM-99M IMAGING, RAS/8/016	0	0	0	116,200	0	AUL
	RADIOISOTOPES IN INDUSTRY (RCA), RAS/8/062	15	0	23,000	134,300	0	JPN
	RADIATION AND ISOTOPE APPLICATIONS IN INDUSTRY (RCA), RAS/8/064	4	65,000	48,500	146,400	0	AUL
	MARINE CONTAMINANT AND SEDIMENT TRANSPORT, RAS/8/065	5	20,000	0	0	0	USA
	STRENGTHENING OF RADIATION PROTECTION INFRASTRUCTURES (RCA), RAS/9/006	0	0	0	136,200	0	AUL
REGIONAL MIDDLE EAST AND EUROPE	IN-SERVICE INSPECTION DESIGN, RER/4/003	0	0	0	0	200,000	SPA
REGIONAL LATIN AMERICA	NUCLEAR INSTRUMENTATION (ARCAL II), RLA/4/006	2	70,000	0	0	0	GFR
	RESEARCH REACTOR UTILIZATION (ARCAL V), RLA/4/007	2	20,000	0	55,000	0	GFR
	RADIOIMMUNOASSAY IN ANIMAL REPRODUCTION, RLA/5/019	6	0	0	0	0	TACF
		6	0	0	0	0	SWE
	IMPROVEMENT OF CEREALS THROUGH MUTATION BREEDING (ARCAL VII), RLA/5/021	3	50,000	0	0	0	USA
	NON-DESTRUCTIVE TESTING TECHNIQUES, RLA/8/013	0	73,000	0	150,000	55,000	GFR
		11	220,000	0	32,700	130,000	ITA
	APPLICATION OF ISOTOPE TECHNIQUES IN HYDROLOGY (ARCAL XIII), RLA/8/014	17	120,000	0	55,000	0	GFR
		0	0	0	6,000	0	CHI
RADIATION PROTECTION (ARCAL I), RLA/9/009	0	0	0	42,400	0	TACF	
	0	30,000	0	10,000	0	FRA	

a) Explanation of abbreviations: AUL = Australia; BEL = Belgium; CHI = Chile; FRA = France; GFR = Federal Republic of Germany; ITA = Italy; JPN = Japan; SPA = Spain; 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 1990

Recipient	Project title and number	Expert mm.dd	Expert \$	Equipment \$	Other \$	Total \$
A. New projects						
Bulgaria	Seismic safety review mission — BUL/9/009	5.06	33,600	0	0	33,600
	Pre-OSART and OSART missions to Kozloduy & Belene NPPs — BUL/9/010	5.22	37,800	0	0	37,800
Byelorussian SSR	Radiation protection — BYE/9/002	0.00	0	50,000	0	50,000
China	Pre-OSART mission to Guangdong nuclear power plant — CPR/9/011	8.00	45,000	0	0	45,000
Czech & Slovak F.R.	Pre-OSART & OSART mission to Temelin NPP, Unit 1 & 2 — CZE/9/003	8.15	25,200	0	0	25,200
	Site safety review missions in Temelin NPP — CZE/9/004	3.00	25,200	0	0	25,200
Iran, I.R.	Review of bids for a variable energy cyclotron — IRA/4/018	1.00	8,400	0	0	8,400
Jamaica	Nuclear agriculture development — JAM/5/003	2.00	16,800	0	0	16,800
Pakistan	Site safety review mission to Chasma nuclear power plant — PAK/9/011	2.17	40,000	0	0	40,000
Poland	Evaluation of safety requirements for Zarnowiec NPP — POL/9/012	3.00	25,200	0	0	25,200
Romania	Pre-OSART mission to Cernavoda NPP — ROM/9/005	5.16	16,800	0	0	16,800
Ukrainian SSR	Radiation protection — UKR/9/002	0.00	0	50,000	0	50,000
USSR	Radiation protection — SSR/9/002	0.00	0	50,000	0	50,000
Yugoslavia	OSART mission to Krsko NPP — YUG/9/027	1.00	8,400	0	0	8,400
Regional Africa	TC on peaceful uses of atomic energy in Africa — RAF/0/005	0.00	0	0	50,000 a	50,000
	Water desalination using nuclear heat reactors — RAF/4/010	0.00	0	0	50,000 b	50,000
Sub-total		45.16	282,400	150,000	100,000	532,400
B. Supplementary assistance to existing projects						
Bangladesh	Food irradiation — BGD/5/010	0.00	0	25,000	0	25,000
Czech & Slovak F.R.	OSART mission to Dukovany nuclear power plant — CZE/9/002	1.00	0	0	0	0
Indonesia	Radiation therapy — INS/6/006	0.00	0	50,000	0	50,000
Libyan A.J.	Eradication of the screwworm — LIB/5/007	3.00	25,200	24,800	0	50,000
Poland	Modernization of Maria reactor — POL/4/009	0.00	0	25,000	0	25,000
Viet Nam	Underwater inspection of Dalat nuclear research reactor — VIE/9/005	0.00	0	3,000	0	3,000
Sub-total		4.00	25,200	127,800	0	153,000
TOTAL		49.16	307,600	277,800	100,000	685,400

^a Approval for training course. ^b Approval for sub-contract.

ANNEX IX
NET PROGRAMME CHANGES BY RECIPIENT: 1990

Recipient	Component	Existing approval	Net change
ALBANIA	Experts (months)	8,00	-0,24
	Equipment (CC)	328,140	8,133
	Equipment (NCC)	98,000	-5,000
	Fellowships (CC)	55,400	-20,113
	Fellowships (NCC)	0	5,000
ALGERIA	Experts (months)	23/27	-6/11
	Equipment (CC)	644,203	121,661
	Equipment (NCC)	315,000	-70,000
	Fellowships (CC)	156,000	-82,420
BANGLADESH	Experts (months)	36/20	-8/13
	Equipment (CC)	1,483,520	45,194
	Equipment (NCC)	1,564,500	-133,035
	Fellowships (CC)	175,900	-54,196
BOLIVIA	Experts (months)	26/14	-4/00
	Equipment (CC)	739,563	31,775
	Equipment (NCC)	248,000	-78,404
BRAZIL	Experts (months)	235,08	0/10
	Equipment (CC)	2,631,092	4,786
	Equipment (NCC)	45,500	-2,862
	Fellowships (CC)	372,054	-48,955
	Training courses (CC)	35,150	-35,150
	Sub-contracts (CC)	40,000	-40,000
BULGARIA	Experts (months) (CC)	19,05	10/18
	(months) (NCC)	1,00	-0/12
	Equipment (CC)	1,006,200	3,762
	Equipment (NCC)	2,490,503	-810,449
	Fellowships (CC)	33,250	24,450
	Fellowships (NCC)	0	2,620
CAMEROON	Experts (months)	3,08	1,05
	Equipment (CC)	164,700	-16,000
	Equipment (NCC)	10,000	-6,080
	Fellowships (CC)	50,500	3,606
CHILE	Experts (months)	26/19	-2/12
	Equipment (CC)	1,217,391	21,078
	Equipment (NCC)	59,000	-10,000
	Fellowships (CC)	123,274	-85
CHINA	Experts (months)	51,04	-12/10
	Equipment (CC)	1,192,909	40,937
	Equipment (NCC)	76,000	-1,000
	Fellowships (CC)	334,265	60,352
	Fellowships (NCC)	28,800	-11,700
COLOMBIA	Experts (months)	34/16	-4/14
	Equipment (CC)	784,185	151,443
	Equipment (NCC)	71,800	-35,000
	Fellowships (CC)	107,030	4,213
COSTA RICA	Experts (months)	7/16	1,09
	Equipment (CC)	166,235	6,880
	Equipment (NCC)	14,000	-1,195
	Fellowships (CC)	55,991	-19,687

Recipient	Component	Existing approval	Net change
COTE D'IVOIRE	Experts (months)	40,01	-5,04
	Equipment (CC)	558,147	-27,771
	Equipment (NCC)	126,000	-11,169
	Fellowships (CC)	59,505	-19,305
CUBA	Experts (months)	30/15	-2,09
	Equipment (CC)	791,838	88,904
	Equipment (NCC)	1,609,000	-214,247
	Fellowships (CC)	152,066	-32,350
	Fellowships (NCC)	0	1,000
CYPRUS	Experts (months)	2,00	-0,04
	Equipment (CC)	169,150	20,000
	Fellowships (CC)	13,950	-6,000
	Sub-contracts (CC)	25,000	-20,000
CZECH AND SLOVAK F.R.	Experts (months)	13,00	5/11
	Equipment (CC)	47,257	-2,100
	Fellowships (CC)	2,197	300
DEM. P.R. KOREA	Experts (months)	26,00	-5/14
	Equipment (CC)	678,710	16,500
	Equipment (NCC)	2,729,102	-267,201
	Fellowships (CC)	22,050	-21,600
	Fellowships (NCC)	35,250	-6,752
DOMINICAN REPUBLIC	Experts (months)	8/23	-1,02
	Equipment (CC)	650,200	8,386
	Equipment (NCC)	118,100	-26,024
	Fellowships (CC)	0	7,300
ECUADOR	Experts (months)	34/14	-3/11
	Equipment (CC)	1,123,036	36,158
	Equipment (NCC)	1,843,342	-210,346
	Fellowships (CC)	157,776	-938
	Fellowships (NCC)	0	613
EGYPT	Experts (months)	88/21	-18/13
	Equipment (CC)	972,450	24,700
	Equipment (NCC)	3,165,200	-115,555
	Fellowships (CC)	67,200	80,200
	Fellowships (NCC)	42,750	-25,984
	Training courses (CC)	148,500	-13,500
	Sub-contracts (CC)	3,200	109,860
EL SALVADOR	Experts (months)	23,00	-3/29
	Equipment (CC)	277,000	55,078
	Equipment (NCC)	63,930	-1,987
	Fellowships (CC)	43,350	-26,900
ETHIOPIA	Experts (months)	47/26	-3,08
	Equipment (CC)	624,870	86,255
	Equipment (NCC)	58,200	-7,520
	Fellowships (CC)	141,900	-63,235
GHANA	Experts (months)	28,00	-2,01
	Equipment (CC)	960,565	56,660
	Equipment (NCC)	27,583	-21,547
	Fellowships (CC)	62,434	64,199

Recipient	Component	Existing approval	Net change
GREECE	Experts (months)	7/15	-1/29
	Equipment (CC)	435,326	8,320
	Equipment (NCC)	620,000	-332,090
	Fellowships (CC)	15,450	19,600
	Fellowships (NCC)	0	3,000
GUATEMALA	Experts (months)	26,04	-8,00
	Equipment (CC)	504,600	179,625
	Equipment (NCC)	346,000	-331,000
	Fellowships (CC)	97,100	-16,675
HAITI	Equipment (CC)	89,000	17,224
	Equipment (NCC)	3,230	3,939
	Fellowships (CC)	11,623	3,800
HUNGARY	Experts (months)	5,00	-2/20
	Equipment (CC)	634,444	32,925
	Equipment (NCC)	3,585,444	-107,992
	Fellowships (CC)	1,500	6,420
INDONESIA	Experts (months)	94/21	-8/20
	Equipment (CC)	1,102,564	16,175
	Equipment (NCC)	450,000	-251,665
	Fellowships (CC)	362,250	-21,836
	Sub-contracts (CC)	0	8,000
INTERREGIONAL	Experts (months) (CC)	118,05	-1,00
	(months) (NCC)	1,08	-1,08
	Equipment (CC)	50,700	7,700
	Equipment (NCC)	136,646	-37,740
IRAN, ISLAMIC REPUBLIC OF	Experts (months)	80/17	-22/11
	Equipment (CC)	798,880	106,880
	Equipment (NCC)	397,500	0
	Fellowships (CC)	84,716	22,320
	Fellowships (NCC)	9,126	4,300
	Sub-contracts (CC)	0	80,150
IRAQ	Experts (months)	75/15	-9/09
	Equipment (NCC)	500,000	-131,636
	Fellowships (CC)	16,245	78,120
JAMAICA	Experts (months)	17/11	-2/02
	Equipment (CC)	50,000	5,400
	Equipment (NCC)	15,000	1,200
JORDAN	Experts (months)	31/27	-3/19
	Equipment (CC)	382,880	34,020
	Equipment (NCC)	50,000	-5,723
	Fellowships (CC)	34,350	-7,900
KENYA	Experts (months)	81/09	-4/29
	Equipment (CC)	797,600	23,946
	Fellowships (CC)	35,865	-27,747
KOREA, REPUBLIC OF	Experts (months)	99/14	-5/27
	Equipment (CC)	236,200	-89
	Fellowships (CC)	334,050	-39,222
LIBYAN ARAB JAMAHIRIYA	Experts (months)	13,00	11,03
	Equipment (CC)	111,800	88,270
	Fellowships (CC)	33,950	-15,900
	Fellowships (NCC)	18,800	-3,700

Recipient	Component	Existing approval	Net change
MADAGASCAR	Experts (months)	4,00	-0/15
	Equipment (CC)	187,230	8,700
	Equipment (NCC)	7,000	1,600
	Fellowships (CC)	21,450	-8,483
MALAYSIA	Experts (months)	93,00	-10/13
	Equipment (CC)	986,418	58,846
	Equipment (NCC)	401,900	-47,900
	Fellowships (CC)	302,260	-32,862
	Fellowships (NCC)	9,600	-2,426
MALI	Experts (months)	10,03	-2,00
	Equipment (CC)	675,477	-22,750
	Equipment (NCC)	90,000	-21,940
	Fellowships (CC)	43,500	-1,549
MAURITIUS	Equipment (CC)	157,096	19,000
	Fellowships (CC)	59,493	-6,530
MEXICO	Experts (months)	63,04	-17,03
	Equipment (CC)	648,484	207,116
	Equipment (NCC)	867,000	-418,239
	Fellowships (CC)	136,330	70,495
	Sub-contracts (CC)	444,019	-17,176
MONGOLIA	Experts (months)	46/14	-3,00
	Equipment (CC)	395,230	39,300
	Equipment (NCC)	603,377	-270,009
	Fellowships (CC)	118,600	-14,440
	Fellowships (NCC)	12,000	58,023
MOROCCO	Experts (months)	54,09	-8,03
	Equipment (CC)	865,865	55,123
	Equipment (NCC)	95,000	-12,800
	Fellowships (CC)	125,200	-50,098
MYANMAR	Experts (months)	16/20	-5/20
	Equipment (CC)	197,750	14,000
	Equipment (NCC)	35,000	-9,067
	Fellowships (CC)	88,200	-28,800
NICARAGUA	Experts (months)	13,00	-7/28
	Equipment (CC)	226,699	33,240
	Equipment (NCC)	126,000	-24,955
	Fellowships (CC)	61,650	3,600
NIGER	Sub-contracts (CC)	10,000	-10,000
	Experts (months)	4,00	-0/15
	Equipment (CC)	396,469	18,200
	Equipment (NCC)	30,000	12,426
NIGERIA	Fellowships (CC)	14,400	1,900
	Experts (months)	75/25	-9/10
	Equipment (CC)	1,058,652	61,570
	Equipment (NCC)	305,500	-190,928
PAKISTAN	Fellowships (CC)	118,750	-71,706
	Experts (months)	61/14	-1/20
	Equipment (CC)	1,326,186	88,395
	Equipment (NCC)	348,500	-175,468
PANAMA	Fellowships (CC)	183,854	-65,019
	Fellowships (NCC)	12,000	-9,920
	Equipment (CC)	472,587	17,100

Recipient	Component	Existing approval	Net change
PARAGUAY	Experts (months)	10,03	-2,22
	Equipment (CC)	397,726	20,430
	Equipment (NCC)	27,000	-1,100
	Fellowships (CC)	41,100	7,360
PERU	Experts (months)	44,19	-10,10
	Equipment (CC)	2,146,291	136,248
	Equipment (NCC)	1,182,817	-223,195
	Fellowships (CC)	39,120	-19,200
PHILIPPINES	Experts (months)	27,03	-4,21
	Equipment (CC)	1,257,811	95,480
	Equipment (NCC)	20,000	-20,000
	Fellowships (CC)	118,549	-20,434
	Fellowships (NCC)	5,000	-3,304
POLAND	Experts (months) (CC)	21,26	-9,20
	(months) (NCC)	0,00	2,13
	Equipment (CC)	774,511	13,795
	Equipment (NCC)	3,282,130	-1,313,754
	Fellowships (CC)	28,200	15,048
PORTUGAL	Experts (months)	22,07	-8,02
	Equipment (CC)	844,198	112,264
	Equipment (NCC)	2,684,037	-1,003,096
	Fellowships (CC)	62,550	-1,756
REGIONAL AFRICA	Experts (months)	231,22	-10,03
	Equipment (CC)	871,203	146,984
	Equipment (NCC)	80,000	-19,935
	Fellowships (CC)	1,801,542	533,959
	Fellowships (NCC)	401,719	-245,857
	Training courses (CC)	222,125	84,041
REGIONAL ASIA AND PACIFIC	Experts (months)	93,04	-13,00
	Equipment (CC)	257,500	5,200
	Fellowships (CC)	1,505,798	563,717
	Fellowships (NCC)	803,300	-360,270
	Training courses (CC)	34,200	11,440
REGIONAL EUROPE	Experts (months) (CC)	85,22	0,03
	(months) (NCC)	0,00	2,16
	Equipment (CC)	397,648	122,432
	Equipment (NCC)	10,000	-10,000
	Fellowships (CC)	1,418,069	-21,960
	Fellowships (NCC)	351,953	-219,272
	Training courses (CC)	295,900	18,400
	Training courses (NCC)	29,000	8,345
	Sub-contracts (CC)	480,805	-98,272
Sub-contracts (NCC)	110,000	-80,000	
REGIONAL LATIN AMERICA	Experts (months)	641,10	18,07
	Equipment (CC)	3,051,202	13,640
	Fellowships (CC)	1,157,068	-479,586
	Fellowships (NCC)	296,850	-206,478
	Training courses (CC)	2,982,773	86,980
	Training courses (NCC)	30,000	23,300
	Sub-contracts (CC)	497,000	-20,000

Recipient	Component	Existing approval	Net change
ROMANIA	Experts (months)	8/12	2/16
	Equipment (CC)	1,005,920	21,195
	Equipment (NCC)	469,258	-81,018
	Fellowships (CC)	36,430	19,065
	Training courses (CC)	60,000	-2,000
SENEGAL	Experts (months)	2/03	-0/25
	Equipment (CC)	231,369	-15,450
	Equipment (NCC)	60,000	-13,604
	Fellowships (CC)	15,300	-15,300
SIERRA LEONE	Experts (months)	4/00	-1/00
	Equipment (CC)	34,000	8,400
	Fellowships (CC)	7,650	-7,650
SINGAPORE	Experts (months)	2/07	-0/14
	Equipment (CC)	272,621	1,827
	Fellowships (CC)	50,940	-3,180
SPAIN	Equipment (CC)	85,000	-6,000
	Fellowships (CC)	0	6,000
SRI LANKA	Experts (months)	22/15	-5/18
	Equipment (CC)	1,678,321	27,140
	Equipment (NCC)	0	17,500
	Fellowships (CC)	81,988	-45,338
SUDAN	Experts (months)	46/25	-7/10
	Equipment (CC)	1,270,295	32,234
	Equipment (NCC)	71,600	2,300
	Fellowships (CC)	45,025	368
SYRIAN ARAB REPUBLIC	Experts (months)	16/22	6/07
	Equipment (CC)	987,421	9,923
	Equipment (NCC)	1,400,000	-828,936
	Fellowships (CC)	21,600	-1,186
	Training courses (CC)	32,000	12,000
	Sub-contracts (CC)	0	39,200
THAILAND	Experts (months)	76/29	-2/24
	Equipment (CC)	2,485,685	74,476
	Equipment (NCC)	256,383	-5,000
	Fellowships (CC)	330,740	-19,362
	Fellowships (NCC)	0	5,250
TUNISIA	Experts (months)	18/25	-3/12
	Equipment (CC)	376,943	37,812
	Fellowships (CC)	49,894	-20,553
TURKEY	Experts (months)	75/15	-1/19
	Equipment (CC)	1,121,930	40,369
	Equipment (NCC)	99,600	-7,900
	Fellowships (CC)	72,728	-21,140
UGANDA	Experts (months)	28/11	-6/16
	Equipment (CC)	203,100	31,180
	Equipment (NCC)	20,000	-20,000
UK (HONG KONG)	Experts (months)	5/01	0/00
	Equipment (CC)	18,000	2,200
	Fellowships (CC)	31,864	-6,916
UNITED ARAB EMIRATES	Experts (months)	15/24	-2/00
	Equipment (CC)	64,250	8,400
	Fellowships (CC)	0	8,400

Recipient	Component	Existing approval	Net change
UNITED REPUBLIC OF TANZANIA	Experts (months)	8,00	-1,00
	Equipment (CC)	560,194	17,425
	Equipment (NCC)	108,500	-17,010
	Fellowships (CC)	107,388	29,555
URUGUAY	Experts (months)	5/25	-0/25
	Equipment (CC)	363,077	5,857
	Equipment (NCC)	45,400	-23,659
	Fellowships (CC)	62,656	6,563
VENEZUELA	Experts (months)	49/25	-4/15
	Equipment (CC)	749,880	133,971
	Equipment (NCC)	315,000	-182,921
	Fellowships (CC)	100,100	36,050
VIET NAM	Experts (months)	34/06	-8/26
	Equipment (CC)	1,451,183	49,040
	Equipment (NCC)	2,829,600	-796,185
	Fellowships (CC)	129,969	45,390
	Fellowships (NCC)	122,400	-71,914
YUGOSLAVIA	Experts (months)	20/02	-2/08
	Equipment (CC)	381,600	32,138
	Equipment (NCC)	3,315,071	-1,272,421
	Fellowships (CC)	14,850	-2,650
ZAIRE	Experts (months)	10/07	-4/15
	Equipment (CC)	688,943	59,631
	Equipment (NCC)	44,000	-5,382
	Fellowships (CC)	168,530	-55,144
ZAMBIA	Experts (months)	55/09	-8/27
	Equipment (CC)	1,053,705	-22,879
	Equipment (NCC)	352,800	-128,353
	Fellowships (CC)	129,561	-48,316
	Fellowships (NCC)	0	3,520
ZIMBABWE	Experts (months)	8/03	-0/05
	Equipment (CC)	148,240	4,200
	Equipment (NCC)	24,000	-18,978
TOTALS	Experts (months)	3,602/14	-281/21
	Experts (\$)	24,930,522	-2,328,985
	Experts (\$) (NCC)	55,460	113,047
	Equipment (CC)	55,229,280	3,120,226
	Equipment (NCC)	40,443,056	-10,351,275
	Fellowships (CC)	12,116,091	128,119
	Fellowships (NCC)	2,149,548	-1,084,254
	Training courses (CC)	3,810,649	162,211
	Training courses (NCC)	59,000	31,645
	Sub-contracts (CC)	1,500,024	31,761
	Sub-contracts (NCC)	110,000	-80,000
	TOTAL ALLOTTED	140,403,632	-10,257,502

ANNEX X
NET REPHASINGS UNDERTAKEN DURING 1990

Recipient	Project component	Net allotted/ Net rephased	Current year	1991	1992
CHILE	FELLOWSHIPS	ALLOTTED	7,650	0	0
	(CC)	REPHASED	-6,000	6,000	0
CHINA	EXPERTS	ALLOTTED	2,00	0,00	0,00
	MONTHS	REPHASED	-1,00	1,00	0,00
	EQUIPMENT	ALLOTTED	100,000	25,000	0
	(CC)	REPHASED	-10,000	10,000	0
ECUADOR	EXPERTS	ALLOTTED	3/19	0,00	0,00
	MONTHS	REPHASED	-2,00	2,00	0,00
	EQUIPMENT	ALLOTTED	75,000	0	0
	(CC)	REPHASED	-10,000	10,000	0
EGYPT	EXPERTS	ALLOTTED	12,00	0,00	0,00
	MONTHS	REPHASED	-11,00	8,00	3,00
ETHIOPIA	EQUIPMENT	ALLOTTED	240,000	80,000	0
	(NCC)	REPHASED	-240,000	240,000	0
INDONESIA	EXPERTS	ALLOTTED	7,00	0,00	0,00
	MONTHS	REPHASED	-4,00	4,00	0,00
	EQUIPMENT	ALLOTTED	45,000	0	0
	(CC)	REPHASED	-14,000	14,000	0
	(NCC)	ALLOTTED	300,000	0	0
	(NCC)	REPHASED	-10,400	10,400	0
KOREA, REPUBLIC OF	EXPERTS	ALLOTTED	18/22	0,00	0,00
	MONTHS	REPHASED	-9,00	9,00	0,00

Recipient	Project component	Net allotted/ Net rephased	Current year	1991	1992
LIBYAN ARAB JAMAHIRIYA	EXPERTS	ALLOTTED	3,00	0,00	0,00
	MONTHS	REPHASED	-2,00	2,00	0,00
	EQUIPMENT	ALLOTTED	266,700	0	0
	(CC)	REPHASED	-142,000	142,000	0
MADAGASCAR	EXPERTS	ALLOTTED	6/20	0,00	0,00
	MONTHS	REPHASED	-4,00	4,00	0,00
MONGOLIA	EXPERTS	ALLOTTED	3,00	0,00	0,00
	MONTHS	REPHASED	-1,00	1,00	0,00
	FELLOWSHIPS	ALLOTTED	35,000	0	0
	(CC)	REPHASED	-15,000	15,000	0
PAKISTAN	EXPERTS	ALLOTTED	12/10	0,00	0,00
	MONTHS	REPHASED	-6,00	6,00	0,00
PHILIPPINES	EXPERTS	ALLOTTED	5/17	0,00	0,00
	MONTHS	REPHASED	-4,00	4,00	0,00
PORTUGAL	EQUIPMENT	ALLOTTED	1,091,000	150,000	0
	(NCC)	REPHASED	-435,000	0	435,000
SRI LANKA	EXPERTS	ALLOTTED	22,00	0,00	0,00
	MONTHS	REPHASED	-11,00	11,00	0,00
THAILAND	EXPERTS	ALLOTTED	6,00	0,00	0,00
	MONTHS	REPHASED	-2,00	2,00	0,00
UNITED REPUBLIC OF TANZANIA	EQUIPMENT	ALLOTTED	30,000	10,000	0
	(CC)	REPHASED	1,180	-1,180	0
VENEZUELA	EQUIPMENT	ALLOTTED	105,300	50,000	0
	(CC)	REPHASED	0	-50,000	0

Recipient	Project component	Net allotted/ Net rephased	Current year	1991	1992	
VIET NAM	EXPERTS	ALLOTTED	4,00	0,00	0,00	
	MONTHS	REPHASED	-1,00	1,00	0,00	
YUGOSLAVIA	EQUIPMENT	ALLOTTED	420,000	0	0	
	(NCC)	REPHASED	-420,000	0	100,000	
TOTALS	EXPERTS	ALLOTTED	105,28	0,00	0,00	
	MONTHS	REPHASED	-58,00	55,00	3,00	
	EXPERTS (\$)	ALLOTTED	874,830	0	0	
	(\$)	REPHASED	-479,400	486,750	27,900	
	EQUIPMENT	ALLOTTED	622,000	85,000	0	
	(CC)	REPHASED	-174,820	124,820	0	
	EQUIPMENT	ALLOTTED	2,051,000	230,000	0	
	(NCC)	REPHASED	-1,105,400	250,400	535,000	
	FELLOWSHIPS	ALLOTTED	42,650	0	0	
	(CC)	REPHASED	-21,000	21,000	0	
	TOTAL ALLOTTED			3,590,480	315,000	0
	TOTAL REPHASED			-1,780,620	882,970	562,900

ANNEX XI

EXTRABUDGETARY CONTRIBUTIONS FOR ACTIVITIES RELATING TO TECHNICAL CO-OPERATION WHICH ARE NOT INCLUDED IN THE TECHNICAL CO-OPERATION PROGRAMME: 1990 (in US dollars)

Donor	Activity	Funds received
BRAZIL	INTERNATIONAL CENTRE FOR THEORETICAL PHYSICS, TRIESTE	16,000
CANADA	THIRD WORLD ACADEMY OF SCIENCES	507,100
	INTERNATIONAL CENTRE FOR THEORETICAL PHYSICS, TRIESTE	1,700
IRAN, I.R.	INTERNATIONAL CENTRE FOR THEORETICAL PHYSICS, TRIESTE	35,100
	THIRD WORLD ACADEMY OF SCIENCES	20,000
ITALY	INTERNATIONAL CENTRE FOR THEORETICAL PHYSICS, TRIESTE	14,761,200
	DEVELOPMENT AND FIELD APPLICATION OF NUCLEAR TECHNIQUES FOR MALARIA RESEARCH AND CONTROL	159,000
JAPAN	STRENGTHENING OF RADIATION PROTECTION	72,000
	RADIATION THERAPY	58,900
	NUCLEAR MEDICINE	48,000
	INTERNATIONAL CENTRE FOR THEORETICAL PHYSICS, TRIESTE	39,100
KUWAIT	THIRD WORLD ACADEMY OF SCIENCES	50,000
	INTERNATIONAL CENTRE FOR THEORETICAL PHYSICS, TRIESTE	41,600
NETHERLANDS	IMMUNOASSAY TECHNIQUES TO IMPROVE THE REPRODUCTIVE EFFICIENCY AND HEALTH STATUS OF INDIGENOUS AFRICAN LIVESTOCK	260,200
SPAIN	INTERNATIONAL CENTRE FOR THEORETICAL PHYSICS, TRIESTE	14,900
SWEDEN	ADVERSE SIDE EFFECTS ON FLORA AND FAUNA FROM THE USE OF ORGANOCHLORINE PESTICIDES ON THE AFRICAN CONTINENT	345,800
	INTERNATIONAL CENTRE FOR THEORETICAL PHYSICS, TRIESTE	344,500
	INCREASING AND STABILIZING PLANT PRODUCTIVITY IN LOW PHOSPHATE AND SEMI-ARID AND SUB-HUMID SOILS OF THE TROPICS AND SUB-TROPICS	193,900
	RESEARCH AND DEVELOPMENT IN SUPPORT OF NEW WORLD SCREWORM ERADICATION FROM NORTH AFRICA	96,000
	IMMUNOASSAY AND DNA PROBE METHODS FOR SEROSURVEILLANCE OF RINDERPEST IN AFRICA AND FOR THE DIAGNOSIS AND CONTROL OF ANIMAL DISEASES IN LATIN AMERICA	71,100
UNITED KINGDOM	INTERNATIONAL CENTRE FOR THEORETICAL PHYSICS, TRIESTE	76,800
OTHER DONORS ^a	INTERNATIONAL CENTRE FOR THEORETICAL PHYSICS, TRIESTE	1,068,800
	MANAGEMENT OF NITROGEN FIXATION BY TREES FOR RESTORING AND MAINTAINING SOIL FERTILITY	20,000
	THIRD WORLD ACADEMY OF SCIENCES	13,000
TOTAL		18,314,700

^a Includes contributions from various international organizations and national institutes.

