

THE  
AGENCY'S TECHNICAL  
CO-OPERATION ACTIVITIES  
IN 1988

Report by the Director General

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GC(XXXIII)/INF/268

Printed by the  
International Atomic Energy Agency  
in Austria - August 1989



INTERNATIONAL ATOMIC ENERGY AGENCY

## PREFACE

Following its usual practice, the Board of Governors has requested the communication to the General Conference of the material it used in reviewing the Agency's technical co-operation activities in 1988; this material is accordingly reproduced in the present document. The review was carried out pursuant to paragraph 19 of the *Revised Guiding Principles and General Operating Rules Governing the Provision of Technical Assistance by the Agency*.<sup>1</sup>

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<sup>1</sup> See document INFCIRC/267.

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# LIST OF ABBREVIATIONS

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<b>AAPC</b>	<b>Agency's Area of Activity/Project Codes</b>
<b>Agency</b>	<b>International Atomic Energy Agency</b>
<b>AGRIS</b>	<b>Agricultural Information System</b>
<b>ARCAL</b>	<b>Regional Co-operative Arrangements for the Promotion of Nuclear Science and Technology in Latin America</b>
<b>BWR</b>	<b>Boiling water reactor</b>
<b>CC</b>	<b>Convertible currency</b>
<b>CEC</b>	<b>Commission of the European Communities</b>
<b>EEC</b>	<b>European Economic Community</b>
<b>FAO</b>	<b>Food and Agriculture Organization of the United Nations</b>
<b>FICS</b>	<b>Financial Information Control System</b>
<b>IAEA</b>	<b>International Atomic Energy Agency</b>
<b>IBRD</b>	<b>International Bank for Reconstruction and Development (World Bank)</b>
<b>IFFIT</b>	<b>International Facility for Food Irradiation Technology</b>
<b>INIS</b>	<b>International Nuclear Information System</b>
<b>LAN</b>	<b>Local area network</b>
<b>LDC</b>	<b>Least-developed country</b>
<b>NCC</b>	<b>Non-convertible currency</b>
<b>NDT</b>	<b>Non-destructive testing</b>
<b>NE</b>	<b>Department of Nuclear Energy, IAEA</b>
<b>NENF</b>	<b>Division of Nuclear Fuel Cycle, IAEA</b>
<b>NENP</b>	<b>Division of Nuclear Power, IAEA</b>
<b>NENS</b>	<b>Division of Nuclear Safety, IAEA</b>
<b>NPP</b>	<b>Nuclear power plant</b>
<b>PHWR</b>	<b>Pressurized heavy water reactor</b>
<b>PSA</b>	<b>Probabilistic safety analysis</b>
<b>PWR</b>	<b>Pressurized water reactor</b>
<b>RAPAT</b>	<b>Radiation Protection Advisory Team</b>
<b>RCA</b>	<b>Regional Co-operative Agreement for Research, Development and Training Related to Nuclear Science and Technology</b>
<b>RI</b>	<b>Department of Research and Isotopes, IAEA</b>
<b>RIAL</b>	<b>Agency's Laboratories</b>
<b>RIFA</b>	<b>Joint FAO/IAEA Division of Isotope and Radiation Applications of Atomic Energy for Food and Agricultural Development</b>
<b>RILS</b>	<b>Division of Life Sciences, IAEA</b>

<b>RIPC</b>	<b>Division of Physics and Chemistry, IAEA</b>
<b>SIDA</b>	<b>Swedish International Development Authority</b>
<b>TACC</b>	<b>Technical Assistance and Co-operation Committee</b>
<b>TACF</b>	<b>Technical Assistance and Co-operation Fund</b>
<b>TC</b>	<b>Department of Technical Co-operation, IAEA</b>
<b>TCAC</b>	<b>Division of Technical Assistance and Co-operation, IAEA</b>
<b>TCMS</b>	<b>Technical Co-operation Management System</b>
<b>UN</b>	<b>United Nations</b>
<b>UNDP</b>	<b>United Nations Development Programme</b>
<b>UNFSTD</b>	<b>United Nations Fund for Science and Technology for Development</b>
<b>UNTC</b>	<b>Department of Technical Co-operation for Development, United Nations</b>
<b>WHO</b>	<b>World Health Organization</b>
<b>WVER</b>	<b>Pressurized water-cooled and water-moderated power reactor</b>

## **COUNTRY ABBREVIATIONS**

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

# GLOSSARY OF TERMS AND CONCEPTS

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**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.

**Approved programme** – the total value of project and non-project assistance approved by the Board of Governors in a given year, excluding UNDP and Special Programme assistance.

**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.

**Financial year** – the year in which a financial transaction takes place. In the Agency, the financial year and calendar year are identical.

**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.

**Special Programme** – projects identified jointly by donor and recipient Member States and executed by the Agency utilizing extrabudgetary funds and in-kind contributions especially provided for this purpose.

**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

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

**UNDP Programme** – projects executed by the Agency on behalf of UNDP and its associated funds, 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.

**Note:** All sums of money are expressed in US dollars and have been rounded off to the nearest hundred or thousands dollars in most instances. Percentages have also been rounded off in statistical tables and figures.

## I. EXECUTIVE SUMMARY

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- The year under review, 1988, saw the introduction and preparation of the first ever two-year programme, covering the Agency's technical co-operation activities for 1989-90. This meant an increased workload in 1988 but will, in the longer term, yield significant benefits as workloads will be spread more evenly and more time will be available for thorough project formulation and preparation.
- After extensive consultations with Member States, the mandate of the Technical Assistance and Co-operation Committee (TACC) of the Board was clarified.
- The use of preparatory assistance expanded, and the rate of returns of management plans increased. Valuable experience was gained which may help to enhance further the usefulness of these management tools.
- Data transfer between the Financial Information and Control System (FICS) and the Technical Co-operation Management System (TCMS) improved further, and linkages were established with the Agency's Research Contract Data Base. The Agency's first local area network (LAN) was established in the Department of Technical Co-operation.
- Close contacts were maintained at headquarters levels with UNDP and UN organizations in respect of operational activities of the UN system. Contacts with UNDP Resident Representatives were intensified as much as possible.
- Evaluation activities continued to provide indispensable insights into the Agency's technical co-operation activities. In addition to project evaluations, the Agency's project reporting system to Member States was reviewed, and a comparative study was made of existing regional co-operative arrangements. A second country programme evaluation was completed.
- During 1988, a total of 1009 projects were operational, and 88 regional and interregional courses were held. A total of 2023 expert assignments were carried out, and 1947 persons received training abroad.

- Overall resources for technical co-operation grew by 10% over the previous year. The Technical Assistance and Co-operation Fund (TACF) accounted for 75.7% of all resources; 12.5% was derived from extrabudgetary funds, 6.7% from UNDP and 5.1% from assistance in kind.
- The total adjusted programme for 1988, valued at \$60.2 million, was 7.4% higher than that for 1987. The implementation rate attained was 64.1%. The improvement of the overall implementation rate, which stood at 61.3% in 1987, was due in large part to a significant increase in implementation of projects funded from extrabudgetary resources.
- Slightly less than half of the 1988 programme was earmarked for equipment; the remaining provisions were nearly evenly split between training and expert services.
- Whereas the percentage of the target for voluntary contributions actually pledged declined further, to 86.1%, in 1988, additional income, especially in the form of payments of assessed programme costs, ensured that 90.7% of the target amount was received.
- The combination of higher miscellaneous income and stringent monitoring throughout the year of commitments, particularly in convertible currency, led to the intended reduction in overprogramming. By the end of 1988, overprogramming had been reduced from \$8 million to \$4.8 million.

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

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### A. Overview

#### 1. Introduction

1. The report at hand continues to provide detailed data as to where, on what and to what extent the various funds made available for technical co-operation activities in a particular year were used. Quantitative data, easily comparable with prior years, are not only given in financial terms, but also in terms of man-months, number of assignments and the like.
2. Whereas qualitative aspects of the programme are addressed in depth through evaluation activities, a new chapter (Chapter IV) has been introduced which summarizes the accomplishments of the projects concluded during the year under review.
3. The spotlighting of a particular region each year, which began with Latin America in the report for 1987, continues in this report with profiles of the Agency's activities in African Member States.
4. To make the report as comprehensive as possible, a new sub-section, "Review by Region", has been introduced. In addition to providing programmatic information, it covers other points relevant to technical co-operation in each region.
5. The section "Review by Division" has been expanded to include information on fields of activity, utilizing the existing technical co-operation classification scheme. As, during 1988, some changes were made in the composition of the Agency's area of activity/project codes (AAPCs), reporting by AAPC has been deferred.

#### 2. General Issues

6. It is appropriate for a report which purports to review technical co-operation activities during a given year and which has to contain data covering programme delivery during that year to emphasize the implementation work carried out by the Secretariat. It is also true that an equal amount of staff time is devoted to planning and programming, as the two are closely interlinked. The continuing efforts to achieve, together with Member States, a programme that is optimally responsive to the development needs of those Member States, represent important aspects of technical co-operation in which staff time has to be invested.
7. Thorough preparation and intensive consultations with Member States led, in 1988, to two major new features relating to the manner in which the Agency's technical co-operation activities are administered: the introduction of the two-year programme cycle and the clarification of the mandate of the TACC.
8. The preparation of the first two-year programme proved to be particularly demanding, as it had to be carried out within the time constraints hitherto prevailing for a one-year programme. A larger volume of requests had to be evaluated technically, costed and appraised, and the programme had to be accommodated within resource projections made over a longer period. The hoped for positive impact which

a longer preparatory period may have on project formulation will, in all likelihood, only find its reflection in the second two-year programme, provided Member States fully avail themselves of the opportunity to submit their project proposals in good time.

9. The clarification of the mandate of TACC required certain adjustments in technical co-operation monitoring systems to ensure that, without delaying preparatory work, no commitments against new projects would be made prior to their approval by the Board. These adjustments were accomplished in time.

10. A definite improvement was observed in the rate of returns of project management plans signed by Governments for large-scale multi-year projects.

11. During the first year that such management plans were used (1987), only 20 of 42 programme management plans had been returned by the end of the year. In 1988, an equal number went out and 36 had been returned. Nevertheless, as it still takes from three to six months to receive signed copies, an appeal is made to Member States to ensure the timely return of signed management plans as these should serve as a basis for project implementation.

12. Experience with programme management plans, albeit short, seems to indicate that the work plans they contain tend to be overly optimistic. In many cases, the absence of a project manager in the field, who could ensure day-to-day follow-up, makes strict adherence to the proposed time-table very difficult. As is standard practice in large-scale UNDP projects – which have project managers on site – these work plans would have to be revised regularly. Incorporation in such revisions of the information provided in implementation reports submitted by national counterparts would strengthen the usefulness of the programme management plans as a management tool. With increased computerization in future, this might be more easily accomplished than is the case at present.

13. Preparatory assistance has become an important modality not merely for assisting in the preparation of specific project requests or work plans but often for assisting governments or institutes in focusing on a longer term framework for activities in which nuclear techniques can play a useful role. During 1988, a total of 48 preparatory assistance missions to 35 countries were undertaken.

14. TCMS was enhanced by the introduction of a number of on-line programs; these modules have immediate error checking routines built in, obviating the need for printed error lists. Data transfer between FICS and TCMS was further improved, allowing for the closer monitoring of implementation by component, fund, area and technical Division.

15. Links were also established between TCMS and the Agency's Research Contract Data Base. Immediate information is now available on those research contracts which are related to technical co-operation projects and the institutes in Member States at which both activities are taking place. This linkage allows for better co-ordination and serves as a good example of a departmental database whose information can be shared by all.

16. The Agency collaborated actively with the UN Advisory Committee for the Co-ordination of Information Systems (ACCIS) in Geneva. Comprehensive data was provided from TCMS for the "Register of Development Activities of the United Nations System", which gives a listing, by country and subject area, of all projects being carried out by all UN organizations.



17. In September 1988, the Department acquired 26 personal computers, four laser printers, two file servers and various accessories as part of an in-kind contribution of the United States of America aimed at enhancing the productivity of staff engaged in managing the technical co-operation programme. The receipt of this equipment, as well as of cost-free expert services, enabled the Department to establish the Agency's first large-scale LAN and to expand the use of office automation facilities. Several LAN-based applications relating to project planning and monitoring were developed, and a system was designed to expedite administrative work in connection with expert recruitment.

18. With generous assistance of the United Kingdom, a second development workshop took place from 14 to 18 November 1988. Thirteen staff members from the Department of Technical Co-operation and three technical officers participated, bringing the total number of people who have received such training to 30.

19. Close contacts were maintained with other international organizations, both within and outside the UN system, some being intensified. Co-ordination with such organizations engaged in technical co-operation is in itself an important modality through which the Agency can work towards enhancing the overall development impact of its technical assistance inputs.

20. Ideally, UNDP's country programmes should serve as a frame of reference for all technical co-operation programmes, irrespective of the source of funding. While the UN system and some bilateral donors are, in principle, willing to focus on projects reflecting priorities outlined in country programmes, various impediments — such as different financial cycles — still stand in the way of completely cohesive technical co-operation programming encompassing all sources of external assistance at the country level.

21. A review undertaken by UNDP pursuant to General Assembly Resolution 42/196 identified the major constraints and concluded that, whereas individual agencies would continue to programme their resources as separate entities, they should do so within a common holistic socio-economic framework at the country level. This means that, in many cases, recipient government capacities to develop such a holistic framework should be strengthened.

22. The Agency's role in ensuring that its technical co-operation focus corresponds to the overall development priorities of a country is, in some ways, easier and, in other ways, more complex than that of other agencies. It is easier because nuclear techniques are not specific to one sector and can be applied to most sectors that would be identified as a priority area by a Government — be it health, agriculture, or industry, for example. It then becomes a question of ascertaining whether such techniques can, in a cost-effective manner, contribute to the development goals set for such priority sectors. However, since the Agency, in contrast to most other organizations of the UN system, is not sector-specific, it cannot so easily assist Governments with advice on sectoral plans as an input to the overall developmental plan of the country. For the same reason, the participation of the Agency's national counterparts in the establishment of national priorities is, at times, less intensive than that of the substantive, sectoral ministries would be.

23. The Agency, to the extent its staff resources permit it to do so, takes part in the wide array of discussions on these matters within the UN system through its participation in UNDP Inter-Agency Meetings and in the Consultative Committee on Substantive Questions dealing with operational activities (CCSQ/OPS).

24. At the same time, every effort is made to strengthen further the close contacts which are maintained with UNDP resident representatives at the country level. UNDP resident representatives receive descriptions of the Agency's programmes for their countries, and, in turn, provide the Agency with country programmes and country programme management plans. These are perused by the Secretariat, so that areas where the Agency might usefully associate itself with a particular activity can be identified. As this could more effectively be done at an earlier planning stage, a continuing dialogue with resident representatives is necessary. Staff and travel resources are, in this connection, a limiting factor. In both 1987 and 1988, a total of 33 countries were visited by Area Office staff. When one considers the fact that there are some 75 Member States in receipt of Agency assistance, visits average around every 2.3 years per country. UNDP resident representatives visit the IAEA during their briefing trips to the European Agencies. During 1988, 19 such visits took place, offering opportunities for discussing Agency programmes in the countries concerned.

### **3. Evaluation**

25. The Agency's project implementation reporting system, which covers all technical co-operation projects, continues to be the major means by which national project counterparts report regularly on the progress of their projects, on difficulties being encountered and on achievements. The reports emanating from the system, some 500 during 1988, continue to provide Agency support staff, both in the Department of Technical Co-operation and in other Departments, with up-to-date information on implementation, so that early corrective action can be taken to overcome reported delays and difficulties.

26. Overall, the reports completed this year indicate a satisfactory implementation record. The performance of Agency-supplied equipment, which was found to be particularly worrisome three years ago, is now markedly better, especially in Asia and Latin America. Clearly, more attention is being paid by Agency staff and national project counterparts to ensuring that requested equipment is properly specified. Recent Agency efforts further to enhance national equipment maintenance capabilities also seem to be helping, judging by the increasing number of cases where equipment malfunctions are reported but Agency assistance is not requested because local maintenance capabilities are adequate for carrying out needed repairs. However, fairly widespread difficulty in obtaining necessary spare and replacement parts continues to be reported. The two most common problems identified in 1988 relate to the lack of adequate numbers of trained national counterpart staff and to the lack of adequate national funds to achieve the full utilization of the capabilities and resources made available through Agency-assisted projects. Effective steps to address these two problems require the co-ordinated action of both the Agency and Member States. Considerable efforts were made in the transition to a two-year programming cycle to strengthen project design and planning procedures so as to ensure that national project commitments and Agency-supplied resources are effectively matched.

27. The efficiency and effectiveness with which the Agency reports to Member States were the subject of an in-depth evaluation. The reports of Agency experts play a vital role, providing a comprehensive record of their missions, an assessment of the status of work, staffing, equipment and facilities at the project site, a description of the activities and accomplishments of the expert, and a record of the expert's conclusions and recommendations to the Government, the counterpart institution and the Agency. Such reports are an indispensable, visible output from expert missions, providing the continuity and information essential for the successful management of technical

co-operation projects and for decisions on their future direction. Earlier evaluations, in 1983 and 1984, had found serious delays — of more than 10 months on average and of two years in some cases — in providing project counterparts and governments with expert reports. New procedures were introduced in 1984 in an attempt to overcome this problem. The evaluation carried out in 1987 confirmed that the new procedures had made considerable progress in reducing delays, which thereafter averaged six months. This was considered to be still too long. The latest evaluation identified a number of points where divergent practices in Area Offices were resulting in considerable variations in the time being taken for reports to be forwarded to national counterparts and to governments. The most effective practices were identified, with a view to their generalization throughout the Department. Steps were also recommended that would allow a simple, low-cost monitoring system to be incorporated into TCMS, and the relevant procedures for achieving this have been developed.

28. Interest has grown during the past few years in establishing, through the Agency, regional co-operative arrangements for Africa and for the Middle East similar to those existing in Asia (RCA) and Latin America (ARCAL). With this in mind, a comparative evaluation was undertaken in 1988 of the structure and operation of RCA and ARCAL. Both of the existing arrangements had elicited strong support among their participants, effectively identified and supported regional activities and marshalled additional resources for the application of nuclear techniques at the regional level. The primary purpose of the evaluation was to present a clear, factual picture of this experience in the light of which proposals concerning new regional co-operative arrangements could be assessed. Where differences and difficulties were found, an effort was made to identify their operational consequences. As regards the possible establishment of new regional co-operation arrangements, the evaluation emphasized the importance of making substantial allowances for regional conditions rather than simply replicating existing arrangements.

29. The second country evaluation aimed at assessing the impact of the Agency's total programme of co-operation with a Member State was undertaken in 1988. Such evaluations provide guidance for the future programming of Agency assistance and give an opportunity for an in-depth examination of the link between the Agency's assistance and the wider national development programme. The 1988 country evaluation was undertaken in Thailand, which, during the period 1958-87, was the third largest recipient of Agency's assistance.

30. Mid-project and end-of-project evaluations in 1988 continued to be selected with a view to representing the range of approaches and areas of activity of the Agency's technical co-operation programme as a whole. It is hoped that, in this way, the relatively small number of in-depth evaluations that can be conducted (57 in 1988) will have a wider impact.

#### **4. Programme Delivery**

<b>Total operational projects .....</b>	<b>1009</b>
<b>New projects in 1988 .....</b>	<b>182</b>
<b>Completed projects .....</b>	<b>161</b>
<b>Reports produced .....</b>	<b>369</b>

31. At the beginning of 1988, 827 projects were operational. In addition to authorizing new provisions for on-going projects, the Board also approved 102 new projects, so that there were 929 projects financed from all sources and in various stages of implementation on the books on 1 January 1988.

32. During the year, 35 Training Courses were approved, 29 footnote-a/ projects were upgraded, ten Reserve Fund projects were created, three new UNDP projects got under way, and two funds-in-trust projects and one special programme project became operational. These 80 additional projects brought the total number of operational projects in 1988 to 1009 (1987: 962).

33. In the course of the year, 161 projects were completed, of which 35 were training courses. Two country projects and two training courses were cancelled. At the end of the year, therefore, 844 projects were still operational.

34. A total of 322 reports were produced for submission to the respective national authorities in Member States. As listed in Annex III, 20 of these reports were published.

35. Whereas the value of the average project was roughly \$60,000, projects varied in size from 1 month of expert services valued at \$7,200 to large-scale multi-year activities comprising all technical co-operation modalities (experts, equipment and training). The largest on-going project in 1988 had a budget for that year of \$2.2 million. Many projects were funded from multiple sources as a result of the combination and co-ordination of inputs from the TACF, from extrabudgetary resources and from in-kind contributions.

36. In addition to the assistance mentioned above, the Board also approved the use of \$3.5 million for individual fellowships, to which considerable in-kind resources were added. A total of 838 persons studied abroad as fellows or as visiting scientists, and a further 1109 participated in training courses.

## **5. Resources and Implementation**

Total new resources .....	\$45.6 million
Adjusted current year programme .....	\$60.2 million
New obligations .....	\$38.6 million
Implementation rate .....	64.1%
Disbursements and assistance in kind .....	\$37.0 million

37. The total new resources available for carrying out Agency technical co-operation activities in 1988 were more than \$4 million, or nearly 10%, higher than those for the previous year. This growth was due mainly to a 14.4% increase in TACF resources, since the TACF accounted for 75.7% of all resources in 1988. Whereas extrabudgetary resources grew only very slightly in 1988, they represented, at 12.5%, the second largest source of funds. UNDP funds, which grew by 18.8%, represented 6.7% of all 1988 resources. The remaining 5.1% was derived from assistance in kind, the only resource category in which a decline was recorded as compared with the previous year. More information on resources is given in Figure 1A.

38. 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 cancel-

lations, rephasings and additions) constitute the "adjusted programme". In 1988, the value of the adjusted programme grew by \$4.1 million, or 7.4%, over that of the previous year.

39. During 1988, implementation actions resulting in new obligations kept pace with the growing programme. A total of \$38.6 million dollars was obligated – over 12%, or \$4.2 million more than in 1987 – so that an overall implementation rate of 64.1% was attained in 1988 (1987: 61.3%).

40. As the following table, summarizing financial performance during the past five years, shows, the overall improvement noted in the implementation rate was due, in large part, to a significant increase in the rate for extrabudgetary funds.

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

Year	TACF	Funds in trust	Extrabudgetary funds	UNDP	Total
	(%)	(%)	(%)	(%)	(%)
1984	65.0	22.7	44.4	81.6	59.3
1985	66.3	24.3	35.4	76.3	57.9
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

41. The performance of each of the funds is discussed in Section E of this chapter, and a detailed and comprehensive overview of the status of the total programme at the end of 1988 is given in Implementation Summaries I and II.

42. Figures for "new obligations" provide a precise indicator of the value of technical assistance inputs set in motion by the Agency in a given year. They indicate that, for the assistance involved, all actions that can be taken at headquarters to recruit the experts, to order the equipment, to place the fellows, to hold the training courses and to start sub-contracts have been completed. A part of these obligated amounts may actually be disbursed at a later date, sometimes well after delivery has taken place and after projects have been operationally completed.

43. Since, in 1988, major equipment orders, particularly in non-convertible currencies, were placed towards the end of the year, the resulting increase in new obligations has, of course, not yet had an impact on disbursements. Disbursements declined sharply from \$46.3 million in 1987 to \$37.0 million in 1988. Owing to the time lag between the obligation of funds and the actual payment of bills, the high disbursements in 1987 reflect the peak implementation rate achieved in 1986; similarly, the low disbursements in 1988 reflect lower obligations in 1987.

## **B. Review by Field of Activity and Division**

### **1. Field of activity**

44. The Agency has traditionally classified its technical co-operation activities into ten broad fields, as shown in Figure 5C. Over three quarters of all technical co-operation disbursements from all sources of funds over the past five years were made in five of these fields. Until 1988, these five fields were (i) the application of isotopes and

radiation in agriculture, (ii) nuclear engineering, (iii) safety in nuclear energy, (iv) the application of isotopes in industry and hydrology, and (v) nuclear physics. In 1988, for the first time, nuclear medicine moved into the top five, replacing nuclear physics.

45. Consistently throughout the past few years, agriculture, nuclear engineering, nuclear safety and industry/hydrology have occupied the top four places. With the exception of 1987, agriculture has been in first place, accounting for 21% of all technical co-operation disbursements during the past five years; it is followed by nuclear engineering (16%), nuclear safety (16%), industry and hydrology (13%) and nuclear physics (10%).

46. While agriculture retained its top ranking in 1988 with 19% of all disbursements, significant shifts took place in the ranks of the other fields of activity. Nuclear safety moved to second place (18%), followed by radioisotope applications in industry and hydrology (16%), nuclear engineering (15%) and nuclear medicine (nearly 8%).

47. The largest share of the assistance provided in the field of agriculture over the past five years, namely 40%, has gone to Africa. Of the assistance provided in nuclear safety, the highest regional share has been received by Asia and the Pacific, which accounted for 23% of all disbursements in this field. Owing to the large training programme in nuclear safety, an equal share of this assistance (23%) was delivered through interregional rather than through country projects.

## **2. Division**

48. A total of 158 technical officers handled 1009 projects in 1988 — as compared with 142 technical officers and 962 projects in 1987 — so that the overall ratio of projects to technical officers improved somewhat, from 7 in 1987 to 6.4 in 1988.

49. The number of fellowship nominations evaluated by technical officers remained more or less stable at 1200 (1987: 1213). The number of project requests received from Member States which required appraisal by technical officers declined from 724 in 1987 to 675 in 1988. As these requests covered the first biennial programme, the appraisal workload for technical officers will be appreciably smaller in 1989 and more evenly distributed in the years to come.

50. In 1988, the Department of Research and Isotopes provided technical backstopping for 72% of all technical co-operation activities in terms of monetary value (adjusted programme), its staff carrying out 66% of all fellowship evaluations and handling 71% of all projects. It accounted for 49% of the technical officers supporting technical co-operation activities. The average number of projects handled by the technical officers in that Department was 9.1, well above the overall average.

51. The Department of Nuclear Energy and Safety, accounting for 44% of all technical officers, handled 26% of the adjusted programme, dealt with 27% of all projects and evaluated 31% of all fellowship nominations. The average number of projects handled by the technical officers in that Department was 4.

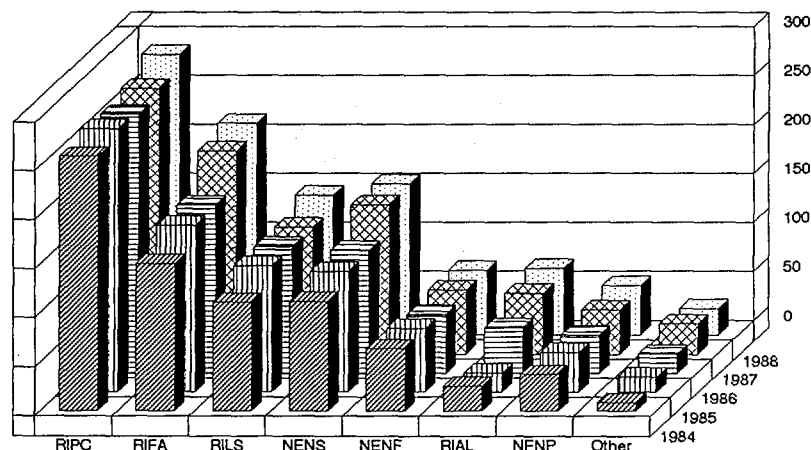
52. Although such figures indicate the general workload situation, they hide some significant movements that have taken place over the past five years at the Division level. Consistently during this period, over 80% of the total technical co-operation programme has been handled by four Divisions: RIPC, RIFA, NENS and RILS. In 1984, RIFA had technical responsibility for 33% of the programme and NENS for only 9%. In the 1988 programme, however, RIFA's share was only 20% and that of NENS had increased to 15%. As mentioned in paragraph 48 above, the number of projects per

technical officer for the Agency as a whole improved somewhat. Also, the range in the number of projects dealt with by individual technical officers declined slightly (from 1-67 in 1987 to 1-65 projects in 1988). Apart from the technical backstopping they provide for projects, technical officers continue to be called upon to furnish expert services. Again, as in 1987, technical officers undertook 106 lecturer assignments. The number of expert assignments carried out by technical officers rose from 301 to 324. A total of 135 man-months of expert services were contributed by technical officers, as against 117 in 1987.

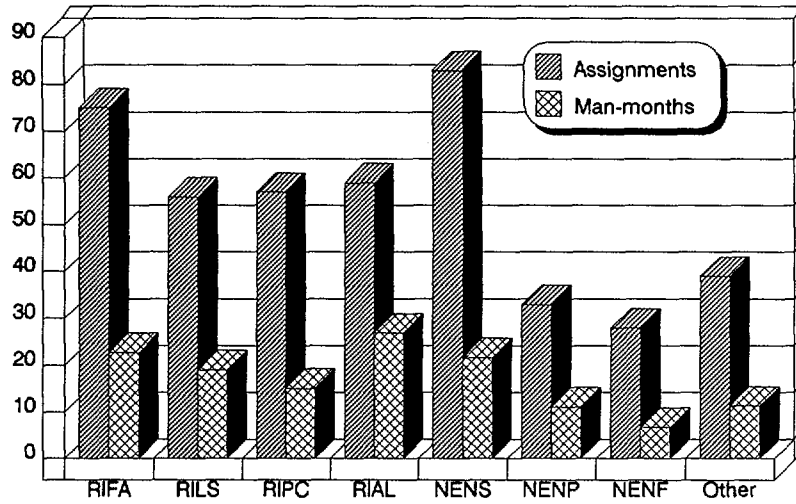
53. The table below and the bar charts that follow provide detailed information on the contribution of various divisions to technical co-operation activities.

Department/ Division	Number of technical officers	Number of projects supported	Number of fellowship applications evaluated	Number of experts/lecturers	
				assignments	man-months
<b>Research and Isotopes</b>					
RIFA	26	216	263	75	22/21
RILS	16	142	162	56	19/04
RIPC	22	286	290	57	15/04
RIAL	14	68	78	59	26/26
Sub-total	78	712	793	247	83/25
<b>Nuclear Energy</b>					
NENS	34	154	193	83	21/19
NENP	13	50	90	33	11/04
NENF	16	66	82	28	6/20
Sub-total	63	270	365	144	39/13
Other	17	27	42	39	11/11
<b>TOTAL</b>	<b>158</b>	<b>1009</b>	<b>1200</b>	<b>430</b>	<b>134/19</b>

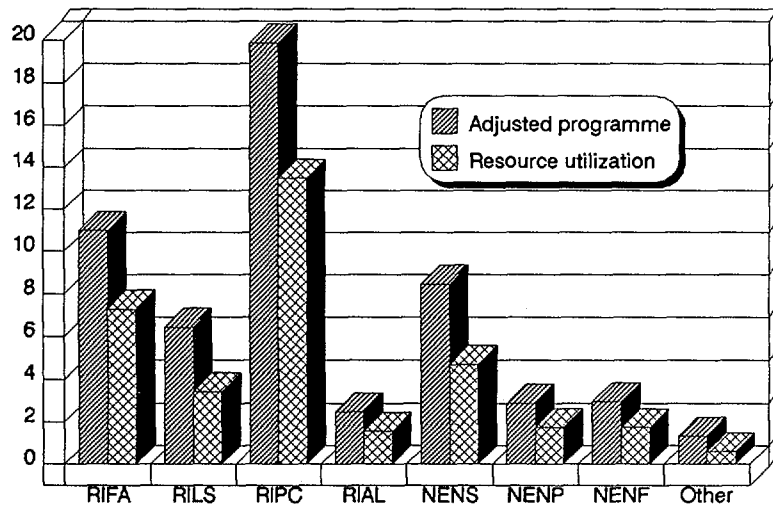
**PROJECT WORKLOADS BY DIVISION: 1984 - 1988**



**TECHNICAL SUPPORT FOR PROJECTS: 1988  
EXPERT AND LECTURER ASSIGNMENTS**



**IMPLEMENTATION BY DIVISION: 1988  
(IN MILLIONS OF DOLLARS)**





## **C. Review by Area**

### **1. Africa**

54. Over the past five years, a fifth of all the assistance approved from the Technical Assistance and Co-operation Fund was allocated to African countries. When disbursements from all funds, including extrabudgetary, UNDP and assistance in kind are considered, Africa received 21% of all technical assistance delivered through the Agency during this period.

55. Activities in the Africa region have consistently focused on agriculture, 40% of all disbursements being made in this field. In second place came nuclear safety, accounting for 20% of all disbursements.

56. During 1988, the Agency expanded the assistance and services it provides to Member States in Africa in developing and strengthening radiation protection. RAPAT missions were undertaken to Côte d'Ivoire, Ethiopia, Madagascar, Nigeria and Senegal. A pre-project mission visited Cameroon to assist in reviewing a project request for assistance on radiation protection, and an advisory mission visited Zimbabwe to assist in the assessment of radiation protection aspects relating to the operation of a newly installed linear accelerator. Also, a regional training course for radiation protection officers was held in Nairobi, Kenya, with 14 participants from Kenya, Uganda, Tanzania and Zimbabwe. Temporary dosimetry services were provided to technical co-operation projects in Nigeria and Sierra Leone, and calibration services to Kenya, Tanzania and Zimbabwe. Expendable items such as thermoluminescence badges were provided to Ethiopia, Ghana, Madagascar, Mali, Uganda, Tanzania and Zambia.

57. Following a request by TACC that special attention be paid to the needs of the least-developed countries (LDCs), the Secretariat analysed the programmes already being carried out in these countries and took steps to organize programming missions to some of them. Other measures that would allow the Agency to approach the introduction of nuclear applications in an integrated fashion and which would meet the special requirements of LDCs are under consideration.

58. During the year, the Agency supported activities of African Member States which are considering the possibility of establishing a regional arrangement along the lines of existing ones for Asia and Latin America. A preliminary informal meeting of African Member States requested the Agency to prepare a questionnaire so that the capabilities of the countries in the region and priority areas for regional co-operation could be ascertained. The questionnaire was prepared and dispatched to all Member States in the region.

### **2. Asia and the Pacific**

59. Viewed financially, Asia and the Pacific constitutes the largest region in the Agency's technical co-operation programme. Its share of approvals from the TACF during the period 1984-88 was 21%, the total adjusted programme from all sources was 24% and disbursements from all sources were 28%. Whereas the 1988 programme for Asia and the Pacific accounted for 22.9% of TACF resources, large UNDP-financed projects brought the region's share of the total programme to 25.5%.

60. Radioisotope applications in industry and hydrology represented the most important field of activity in this region, accounting, during the past five years, for 19.6% of all the technical assistance received through the Agency. Nuclear science and technology and radioisotope applications have proven to be major vectors of science development in countries such as Bangladesh, Malaysia, Mongolia, Pakistan and Viet Nam. The work undertaken at atomic energy centres serves as a technological vehicle for co-operative work among research institutes, the academic world and industry. A gradual spinning off of developmental research initiated in atomic research establishments can be evidenced by the transfer of technology in industrial projects. In Thailand, the successful establishment of a radioisotope production facility has contributed to a reduction in imports of radioisotopes for medical purposes.

61. In countries such as China and the Republic of Korea, high priority has been assigned to nuclear power, with a particular focus on manpower training. This emphasis was also apparent in Indonesia where, during 1988, a 30 MW research reactor that became operational late in 1987, became the central focus for Agency technical co-operation projects.

62. The pattern of networking provided through the RCA has led to a strengthening of national co-ordinators and has facilitated a greater co-ordination of the work undertaken by each of the participating institutes.

### **3. Latin America**

63. With an 18% share of all TACF assistance approved during the period of 1984-88, the Latin America region ranks third in terms of approvals, but second in assistance actually received from all sources of funding. During the past five years, 23% of all technical co-operation disbursements were made on behalf of Latin America. During each year of this period, applications of radioisotopes in agriculture and in industry/hydrology were either in first or second place among the various fields of activity. In line with this pattern, most of the assistance provided in 1988 went for industrial and technical applications of nuclear energy – particularly for non-destructive testing – hydrology and agriculture. Considerable assistance was also provided in nuclear engineering and technology relating to the upgrading of existing research centres.

64. Whereas a deteriorating economic situation and attendant problems in most Latin American countries have often hampered full implementation of technical co-operation efforts, there have been a number of noteworthy achievements. Significant amongst these is the licensing of the 10 MW research reactor in Peru. The reactor was constructed by Argentina and constitutes a good example of south-south co-operation and technology transfer. The Agency has assisted in this undertaking since 1976. Significant also was the start-up of the 650 MW(e) Laguna Verde nuclear power plant in Mexico. In this case, the Agency provided substantial assistance in terms of training and in nuclear-safety-related aspects of plant operation. Support to an existing research centre in Chile has led to the start of core conversion in the La Reina reactor. In Colombia, assistance was provided for the modernization of research reactor control instrumentation so that the system could be brought up to international safety standards.

65. Aquifer studies were undertaken in Peru as part of a larger effort to slow desertification. New nuclear medicine centres were established in Panama. Studies of the hydrology, the carbon cycle, soil fertility and the impact of agrochemicals were carried out in the Brazilian Amazon region. In Ecuador, steps were taken towards the installation of a 6 MeV linear accelerator.

66. As for future directions, the Secretariat has recognized the need to improve programming activities so that the number of projects which have to be rejected can be reduced. Efforts will also be made to secure greater Government commitment to Agency-financed activities and to support projects with a clear technology transfer component.

67. Regional activities continued to flourish in 1988. Mexico became the fourteenth country to participate in the ARCAL programme. A total of 143 activities, for the most part training events, were undertaken during the year. Intensified co-operation among the participating countries was noticeable. In 1988, the total value of all regional activities in Latin America was estimated at nearly \$3.9 million. Through the TACF and co-ordinated research programmes, the Agency contributed about 30% of this amount. Donor countries and institutions (the USA, the Federal Republic of Germany, Italy and the European Economic Community) provided around 15%. The remaining 55% was contributed by the participating countries themselves through the provision of local services and experts.

68. Future efforts within ARCAL will focus on (i) consolidation of the programme, (ii) identification of sources of funding outside the TACF and (iii) encouraging the participation of "non-nuclear" institutions which have a need for or already use nuclear techniques. As regards the NDT project, the objectives will be to establish a NDT federation in Latin America and to adopt regional standards and qualifications.

#### **4. The Middle East and Europe**

69. TACF approvals for the region of the Middle East and Europe during the period 1984-88 amounted to 16% of total TACF approvals, and the region's share of disbursements from all funds was also 16%. It had the highest average implementation rate during this five-year period and a particular high one, 70.6%, in 1988.

70. In contrast to other regions, agriculture was not a major field of activity in the Middle East and Europe during this period, the programme being characterized by a focus on nuclear engineering (31.2%), nuclear safety (19.4%) and industrial applications of radioisotopes (14.0%). This was again the pattern in 1988.

71. During the year, a joint effort began in Eastern European countries which operate WWER type reactors to define common criteria in a number of areas pertaining to the safety analysis of WWERs. The implementation of safety codes using the Agency's computer has enabled safety engineers from Bulgaria, Czechoslovakia, Hungary and Poland to benefit from expertise gained by the USSR and the German Democratic Republic in the analysis of a reference plant. As a result, new techniques for the safety analysis of nuclear power plants have been adapted to WWER-type reactors for use by the owners of these plants.

72. In the Arab Middle East, a regional project has contributed to the establishment of a network to determine environmental radioactivity in the region. Training was provided in the measurement of radionuclides in food, permitting local authorities to institute intervention levels relating to imported foodstuffs.

73. Several countries, including Greece and Portugal, are improving further their installations for the production of radiopharmaceuticals. Others, such as Turkey, the Islamic Republic of Iran and the Syrian Arab Republic, are modernizing or completing such installations. A regional project on the quality control of radiopharmaceuticals was initiated, mainly in co-operation with the Faculty of Medicine in Kuwait.

74. Co-ordinated efforts were undertaken to strengthen radiation protection, including regulatory aspects, in the Middle East. Essential collaboration has been fostered between health authorities and atomic energy commissions in the Syrian Arab Republic, Jordan, Iraq and Kuwait for this purpose.

75. Projects on the use of nuclear techniques in mining were being carried out in Romania and Poland, and gamma irradiation plants for the sterilization of medical products were being installed in Portugal and Bulgaria.

76. The use of environmental isotopes in hydrology has been expanding and the laboratories concerned in Portugal, Greece, Albania and Jordan are being upgraded.

77. Towards the end of 1988, a mission visited Albania to assist in the formulation of a project document for a UNDP project under which a small research reactor is to be constructed. The reactor will permit production of some short-lived isotopes for use in medicine, industry and hydrology. (This project, with a budget of \$2 million, was approved by UNDP early in 1989.) A framework for future Agency assistance to Albania was elaborated during the same mission, ensuring this will be closely linked to the UNDP project so as to enhance its development impact.

## **5. Interregional**

78. In reviewing the technical co-operation programme by region, one should not overlook the fact that, over the past five years, a quarter of the total TACF resources was allocated for interregional activities. The largest share of these resources (25.6%) went for activities relating to nuclear safety, particularly training courses. Nuclear engineering, at 22%, ranked second.

79. Most of the funds allocated to the interregional programme were used for fellowships and training courses, but the remaining provisions went to support activities which are also of considerable importance to Member States. All preparatory assistance missions, for instance, have been financed from interregional projects. Interregional projects also provide an effective vehicle for strengthening south-south co-operation through the networking of laboratories and for promoting the standardization of techniques and services.

## **D. Review by Component**

### **1. Experts**

80. While the share of the expert component had stabilized at roughly one quarter of the total adjusted programme in 1987, the declining trend noted earlier continued in 1988; during that year, provisions for expert services accounted for 23.7% of the total.

81. The following tables provides a five year-perspective of the delivery of expert services.

Year	Adjusted programme	New obligations	Implementation rate	Earmarkings
	\$ millions	\$ millions	%	\$ millions
1984	14.0	6.1	43.5	7.9
1985	15.1	7.7	51.0	7.4
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

Year	Number of persons	Number of assignments	Number of man-months	Man-months per assignment
1984	1017	1530	1550	1.01
1985	1188	1846	1585	0.86
1986	1168	1930	1516	0.79
1987	1100	1808	1356	0.75
1988	1263	2023	1239	0.61
Increase over five years (%)	24.2	32.2	(20.1)	

82. A significant increase in the number of persons recruited and, in particular, in the number of assignments carried out occurred in 1988. As the average duration of assignments decreased considerably (from 0.75 m/m per assignment in 1987 to 0.61 m/m in 1988), the total number of man-months of expert services delivered also declined from 1356 to 1239.

83. The Agency expert programme has thus been following the trend observed in nearly all UN organizations: it has been taking more and more assignments to deliver the same amount of man-months. This development has had a significant impact on the workload of the section involved. Notwithstanding existing staffing constraints, 14.8% more experts were recruited in 1988 than in 1987. As there were only six recruiters in the Experts Section and four in-service clerks during the year, it meant that each recruiter averaged 210 recruitments and each in-service clerk handled 315 cases.

84. The shorter average length of assignment contributed to an increase in the average man-month cost in 1988. Whereas, for budgetary purposes, a standard man-month cost figure of \$7200 had been assumed, the average actual cost during 1988 was \$7568 per man-month. The expert component of the programme demonstrates how close implementation measurements made in financial terms are to implementation measurements in terms of other indicators, if the latter are available. Expressed in man-months, implementation was 53.2%; expressed in cost, the rate was 54.1%.

85. The general increase in the number of assignments from 1808 in 1987 to 2023 in 1988 represents an increase in international expert assignments (from 1339 to 1517) and in national expert assignments (from 87 to 143). The total number of assignments also includes 341 lecturers and 22 other project personnel. Nearly 40% of all assignments were carried out by experts originating from Member States which themselves are recipients of Agency technical assistance.

86. The Agency has relied, to a large extent, on the recruitment of experts from government organizations in various Member States. Until recently, costs for such experts were usually restricted to actual salary, travel and the daily subsistence allowance. However, government organizations in several Member States have now

been instructed to recover full costs, including overheads, and, in some cases, to show a profit when making manpower available to other organizations, including the Agency.

87. These measures entail a considerable increase in the cost of experts seconded by such organizations. As a result, their services will either become too expensive to be accommodated within the prevailing pro-forma cost range or drive up the average cost considerably. Efforts have been made by the Secretariat to gain exemption for the Agency from such policies, but these have been only partially successful.

88. More information on the expert component is given in Figures 2A and 2B, as well as in tables 3A and 6A, which show, inter alia, where the experts provided in 1988 came from, where they went and in which fields they provided assistance.

## 2. Equipment

89. Equipment still represents the major component through which technical assistance is furnished, although its share of the total adjusted programme dropped from 50.3% in 1987 to 49.5% in 1988.

90. A significant increase was achieved in the volume of equipment for which orders were placed during 1988. As compared with 1987, a total of \$3.7 million more was obligated, which brought up the implementation rate for this component from 57.5% to 66.9%. In addition, nearly \$2 million in new obligations were raised against future years.

91. The following table shows the various performance indicators relating to the work of the Field Procurement Section.

Year	Adjusted programme	New obligations	Implementa- tion rate	Earmarkings	Disburse- ments	Number of purchase or- ders
	\$ millions	\$ millions	%	\$ millions	\$ millions	
1984	23.0	15.3	66.8	7.6	17.3	2,970
1985	24.9	15.9	63.8	9.0	16.0	3,391
1986	26.7	18.1	67.9	8.6	19.5	3,738
1987	28.2	16.2	57.5	12.0	23.1 <sup>a</sup>	3,701 <sup>b</sup>
1988	29.8	19.9	66.9	9.9	16.3 <sup>a</sup>	3,386 <sup>b</sup>

<sup>a</sup> Excluding training course equipment. <sup>b</sup> Including all purchase orders processed by the Field Procurement Section (i.e. for projects, training courses and research contracts).

92. In accordance with existing financial regulations, all procurement orders exceeding \$20,000 have to be submitted to the Procurement Authorization Committee for approval. Any upward revision of this amount would reduce workload and contribute to the speedier processing of equipment orders. As the ceiling amount has meanwhile been raised to \$40,000 in other organizations of the United Nations system, a review of this aspect of the regulations was initiated.

93. Utilization of non-convertible currencies continued satisfactorily. The implementation rate for that part of the programme funded in non-convertible currencies was, during 1988, nearly equal to that achieved in the convertible currency part of the programme.

94. Further information on equipment delivery is given in Figures 3A and 3B, which show where the equipment came from and to which countries it went.

### 3. Fellowships

95. An overextension of the fellowship programme during 1986 and 1987, with the resulting deferment of new awards during 1988, led to a sharp decline in all indicators for this programme component. The number of fellows who underwent training in 1988 was below that recorded for the previous two years; the figure for man-months of training provided (3056) was lower than that for each of the preceding four years. The figures for visiting scientists declined much less steeply.

Year	Adjusted programme	New obligations	Implementation rate	Earmarkings	Number of fellows	Number of fellowship m/m	Number of visiting scientists	Number of visiting scientist m/m
	\$ millions	\$ millions	%	\$ millions				
1984	4.3	3.8	90.0	0.4	702	3423	123	67
1985	4.5	3.2	72.0	1.2	615	3323	188	108
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
Increase over five years (%)					(3)	(11)	27	31

96. With the introduction of the 1989-90 programme, the global allotment for fellowships was replaced by individual allotments for regional manpower development projects. This change is expected not only to facilitate monitoring and budgetary control but also to ensure greater integration of fellowship training into the overall programme within a region. This is a first step since, ideally, most fellowships should be awarded within the framework and as an integral part of a particular project, but this would require that corresponding nominations be forwarded promptly to avoid the fellowship component of a project lagging unduly behind in overall implementation, as had often occurred in the past. The Secretariat intends to renew its efforts to persuade the authorities of the Member States involved of the need to receive early nominations for project-related fellowships.

97. Additional information on fellowship training is given in Figures 4A and 4B and Tables 3B and 6B, which show the fellows' country of origin and place of study.

### 4. Training Courses

98. A total of 88 regional and interregional training courses were organized and implemented by the Training Course Section in 1988. Twenty-three of these courses were interregional, and 65 were of a regional nature. In addition, the Section was involved in the implementation of 67 group training activities at the national level through the arrangement of lecturer assignments for such events.

99. The increase in regional and national courses continued. Annex II lists the courses held in 1988 in detail. It is particularly noteworthy that, whereas in 1987 about two thirds of all non-national courses were held in developing countries, nearly three quarters (73.9%) of all such courses took place in developing Member States in 1988.

100. The following table presents an overview of the training courses programme during the last five years. Additional information on training activities – dealing with the number of trainees, where they came from, where they went and in which fields they received training – is given in Figures 4A and 4B, Tables 3B and 6B and, as mentioned, in Annex II.

Year	Adjusted programme	New obligations	Implementation rate	Earmarkings	Number of courses	Number of participants	Number of man-months
	\$ millions	\$ millions	%	\$ millions			
1984	4.2	3.7	87.1	0.5	51	850	1220
1985	4.0	3.4	85.2	0.6	60	926	1098
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

101. The lower implementation rates in 1987 and 1988 as compared with prior years reflect changes in accounting procedures since advances made to course directors and institutes for training courses held during the year are no longer reflected as obligations. In effect, all 88 courses in 1988 were implemented as planned.

102. The Training Courses Section has, of course, a twofold function: the formulation of the Agency's interregional training course programme and the implementation of the entire training course programme, which comprises interregional, regional and national events.

103. The programming exercise takes place every year between March and May for the following programme year. It is undertaken by the Division of Technical Assistance and Co-operation in close consultation with Divisions in the technical Departments (NE and RI). In the case of the nuclear power and safety courses, advice is also sought from course directors of nuclear power training centres and from representatives of a number of major recipient countries; these meet every two years with the Agency staff involved within the framework of the Advisory Committee on Nuclear Power Training.

104. Regional and national training courses are, to a great extent, complementary to technical co-operation projects. This part of the programme has, in the past three years, experienced dynamic expansion, owing mainly to an intensification of activities under the two regional co-operative agreements (RCA and ARCAL).

## **5. Sub-contracts**

105. Provisions for sub-contracts continue to represent only a small fraction of the total adjusted programme: 1.5%, or \$0.9 million. The implementation rate for this component reached a high 81.1% during the year under review, as is shown in the following table.



Year	Adjusted programme	New obligations	Implementation rate	Earmarkings
	\$	\$	%	\$
1984	6 763 730	1 774 654	26.2	4 989 076
1985	5 107 505	831 622	16.3	4 275 883
1986	1 229 604	506 740	41.2	722 864
1987	904 314	549 535	60.8	354 780
1988	933 023	756 598	81.1	176 425

106. While sub-contracting would appear to be a practical, efficient way of furnishing technical assistance, in practice, various problems, apart from the high cost, stand in the way of a more significant utilization of this modality of project execution. Many firms and organizations on the open market are able to deliver and install equipment and to provide consultants; it is, however, difficult to ensure that real transfer of technology – the aim of the Agency's technical co-operation programme – takes place through adequate follow-up visits and training. In addition, most of the Agency's technical co-operation activities represent inputs into larger on-going national activities rather than ones for totally new undertakings. Although the Agency's inputs are of a crucial nature, they are usually rather modest in size. Moreover, the scheduling of the various components (experts, equipment and training) has to correspond to government plans and possibilities, and due attention must be paid to changing local conditions, which often require a greater flexibility than can be offered through sub-contracted services.

107. Nevertheless, the sub-contract modality is attractive when authorities in donor countries are able to identify institutions which are prepared to deliver the total inputs required for a project activity in which they have a particular interest. As a result 66% of all subcontracts obligated in 1988 were in respect of extrabudgetary projects.

## **E. Review by Fund**

### **1. Technical Assistance and Co-operation Fund**

Resources.....	\$34.5 million (75.7% of total)
Adjusted programme.....	\$43.7 million (72.5% of total)
Implementation .....	\$28.4 million (73.5% of total)
Implementation rate .....	65.0%
Disbursements.....	\$26.8 million (72.4% of total)

108. The TACF continues to be the mainstay of the Agency technical co-operation programme, accounting for 75.7% of all resources made available in 1988. TACF resources grew by 14.4% in 1988 (8.2% in 1987) to \$34.5 million. This amount represented 90.7% of the target for voluntary contributions in 1988, whereas only 88.7% of the target was attained in 1987. It must be borne in mind, however, that this amount also includes other sources of income to the TACF such as assessed programme costs – payments of which rose significantly in 1988 – interest income and exchange adjustments.

109. From 1982 onwards, pledges against the target have been declining consistently: from 93.1% in 1982 to 87.6% in 1987 and 86.1% in 1988. Tables 1 and 2 show these developments and the growth of the TACF over the past ten years.

110. As discussed in the report for 1987, the amount of overprogramming at the start of 1988 (\$8 million) had given reason for concern as it exceeded the permissible level of 10%, particularly in the convertible currency part of the programme. The stringent steps taken during the year to ensure that no increase would occur, particularly not in respect of projects earmarked in convertible currency, were entirely successful.

111. Higher than anticipated payments of assessed programme costs and higher interest and other income further alleviated the pressure on convertible-currency resources. As the following table shows, overprogramming at the end of 1988 was down considerably.

**Resources available and programme commitments by year-end**

Year	Available financial resources			Programme			Balance		
	CC	NCC	Total	CC	NCC	Total	CC	NCC	Total
1979	6,418	3,579	9,997	7,672	2,117	9,789	(1,254)	1,462	208
1980	8,267	4,467	12,734	9,470	3,925	13,395	(1,203)	542	(661)
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)

112. In view of resource uncertainties, a conservative approach, intended to virtually eliminate overprogramming as such, was adopted for the 1989-90 programme. Nevertheless, it should be recalled that, throughout the UN system, "overprogramming" is used deliberately as a tool to ensure a higher rate of resource utilization. Knowing that it is unlikely that implementation rates higher than 75-80% of the available budgets will be achieved, UNDP, for instance, aims at approving a peak budget level for its programme which, in any given year, is about 20% higher than the anticipated resources for that year.

113. The heavy workload connected with the preparation, in 1988, of a two-year programme within the same time-frame normally available for a one-year programme, as well as the increased emphasis placed on improving the very low implementation rate for extrabudgetary funds, had some impact on the performance of the TACF. The implementation rate declined from 67.0% in 1987 to 65.0% in 1988.

114. This does not, of course, mean that any decline occurred in the volume of technical assistance actually put in motion in 1988 — which exceeded the 1987 amount by \$1.3 million. The 65% implementation rate represents \$28.4 million in new obligations. In 1984, when exactly the same rate prevailed, only \$21.6 million was involved. The following table provides a five-year comparison in this respect.

Year	Adjusted programme	New obligations	Implementation rate	Earmarkings
	\$	\$	%	\$
1984	33,344,604	21,670,547	65.0	11,674,057
1985	34,810,179	23,064,817	66.3	11,745,362
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

115. The Board approved a Reserve Fund of \$500,000 for 1988, of which \$400,000 was foreseen for convertible and \$100,000 for non-convertible currency. Of this amount, only \$272,314 was allotted (\$242,314 in convertible and \$30,000 in non-convertible currencies). The projects approved against the Reserve Fund in 1988 are detailed in Annex VIII.

116. It should perhaps be reiterated that, since the Reserve Fund is part of overall technical co-operation resources, any unallocated balance at year-end is carried over and augments the resources available for programming in the next year. It is in no way lost to the technical co-operation programme.

## 2. Extrabudgetary Resources

Resources.....	\$5.7 million (12.5% of total)
Adjusted programme.....	\$12.9 million (21.4% of total)
New obligations .....	\$7.2 million (18.6% of total)
Implementation rate .....	55.7%
Disbursements.....	\$5.4 million (14.6% of total)

117. Until 1988, the low implementation rate for that part of the programme financed from extrabudgetary resources tended to depress the implementation rate for the programme as a whole.

118. In 1988, however, a major effort was made to increase the utilization of extrabudgetary resources. Restoration of computerized monitoring tools made prompt identification possible of any area, component, field or project where obligations were lagging so that early remedial action could be initiated. Very close collaboration was established with donors so that appropriate solutions could be found when difficulties were foreseen or impediments to implementation arose. These efforts bore fruit, the implementation rate rising sharply from 38.2% in 1987 to 55.7% in 1988. It is now much closer to that prevailing for the TACF.

119. The bulk of new extrabudgetary resources, namely \$4.14 million, was received for footnote-a/ projects made operational or extended during 1988. A considerable portion of this amount (91.3%) was contributed in support of 42 footnote-a/ projects included in the 1988 programme. Of these projects, 28 were made operational for the first time. The remainder was made available for projects approved in earlier years.

120. Although the value of footnote-a/ projects approved as part of the 1988 programme was 29% higher than that for 1987, the extrabudgetary resources made available for these projects increased by 25.8% so that the share of footnote-a/ projects made operational during 1988 was only slightly below that for 1987, as illustrated in the following table.

Year	Approved footnote-a/ projects	Footnote-a/ projects & components made operational	Share of footnote-a/ projects made opera- tional
	\$	\$	%
1984	5,187,000	3,222,260	62.1
1985	7,779,500	4,187,000	53.8
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

121. The USA remained the largest single contributor of extrabudgetary funds for technical co-operation in 1988, followed by the USSR, the Federal Republic of Germany and the United Kingdom. Cash contributions were also made by Australia and Japan in 1988 for training and co-ordinated research within the framework of the RCA and by Sweden in support of the hydrological cycle component of the Brazilian Amazon project. For the first time a footnote-a/ project could be upgraded with an extrabudgetary contribution from the Republic of Korea. Chile supported a regional project in Latin America.

122. As in prior years, a very minor part of the extrabudgetary programme was financed from funds in trust, which, in 1988, accounted for only 0.6% of the adjusted programme. Details on extrabudgetary funds for technical co-operation activities by donor are given in Table 5.

### 3. UNDP

Resources.....	\$3.1 million (6.7% of total)
Adjusted programme.....	\$3.7 million (6.1% of total)
New obligations .....	\$3.1 million (7.9% of total)
Implementation rate .....	82.8%
Disbursements.....	\$2.5 million (6.7% of total)

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

124. UNDP resources increased by \$482,000 and the adjusted programme by \$375,000 as compared with 1987, whereas the disbursements made during 1988 were lower than in the previous year. The implementation rate improved from 77.7% in 1987 to 82.8% in 1988.

125. The peak budgets for 1988 approved during the year — in other words, the amount of resources that would have been available had the implementation rate reached 100% — amounted to \$5.6 million, as compared with \$5.4million during 1987. In accordance with UNDP procedures, budgets are rephased during the year to keep them aligned as closely as possible with the expected delivery in that year. Therefore, as happens every year during the budget revision exercise in the autumn, these peak budgets were revised downwards in the light of expected delivery, resulting in a 82.8% implementation rate. This is shown in the table below.

Year	Adjusted programme	New obligations	Implementation rate	Earmarkings
	\$	\$	%	\$
1984	3,112,964	2,541,287	81.6	571,677
1985	3,475,903	2,653,512	76.3	822,391
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	3,080,530	82.8	631,591

126. During 1988, seven UNDP-financed projects were completed and three new ones approved, so that 21 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 the Government of China.

127. Work continued on the preparation of a number of project proposals of potential interest to UNDP. A UNDP-financed preparatory mission to Albania formulated the project document for a large-scale project in that country which was approved early in 1989.

#### 4. Assistance in kind

Resources.....	\$2.3 million (5.1% of total)
Disbursements.....	\$2.3 million (6.3% of total)

128. Assistance in kind is recorded at the end of the year, after it has been delivered. Disbursements therefore equal resources made available, and the concepts of "adjusted programme", "new obligations" and "implementation rate" do not apply. In 1988, assistance in kind declined from its relatively high 1987 level of over \$3 million to \$2.3 million.

129. As shown in Annex IA, the USA remained the largest donor of this type of contribution, followed by the Federal Republic of Germany. Over 22% of all assistance in kind was provided by countries which themselves were recipients of Agency's technical assistance.

130. Assistance in kind was again of great importance for the Agency's training programmes. A total of 641 man-months of fellowships valued at \$1.5 million, or about 24% of the total in 1988, was provided through assistance in kind, and 136 individual lecturers were made available to Agency's training courses, either totally or partially cost-free. Expert services accounted for 12% of the in-kind assistance received, and 2% was donated in the form of equipment and supplies.

# III. A PROFILE OF TECHNICAL CO-OPERATION ACTIVITIES IN AFRICA

## INTRODUCTION

131. With a profile of technical co-operation activities in Latin America in the report for 1987, a new feature was introduced, highlighting the programme activities in a particular region. In the following pages, the spotlight is on Africa, which has the second largest programme of the four regions.

132. The 25 Member States in this region count amongst them 8 of the 11 Member States of the Agency which have been designated as LDCs by the United Nations. Although nuclear activities have barely started in some countries in Africa, others have well-functioning nuclear establishments of many years' standing.

133. The Agency's programme therefore differs vastly from country to country. In all countries, however, growing attention is being paid to radiation protection. Also, increased emphasis is being placed on the utilization of programming and pre-project assistance to ensure that the assistance provided through the Agency is best suited to meeting the particular development needs of each country.

134. The following country narratives are intended to give an impression of the types of activity carried out with Agency assistance in a given country. They do not purport to be comprehensive or evaluative reports; the most important fields of activity in the on-going programme are described, together with some of the successes achieved — as well as some of the difficulties encountered. With an eye to the future, the direction a given programme is moving — or, perhaps, in the Agency's view, should be moving — is also indicated whenever this appears relevant.

135. All monetary figures given in the tables preceding the individual narratives are in thousands of United States dollars.

## ALGERIA

### 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
	\$	\$	\$	\$		
1984	29.3	29.3	0.0	0.0	5	0
1985	33.8	0.0	0.0	0.7	2	0
1986	39.0	39.0	0.0	0.0	1	0
1987	47.6	37.6	0.0	0.0	0	0
1988	53.2	0.0	0.0	0.8	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 \$	\$	\$	\$	\$
1984	217.8	0.0	217.8	4.9	175.3	0.0	0.0	0.0	0.0	175.3
1985	342.5	0.0	342.5	6.7	223.7	0.0	0.0	0.0	0.0	223.7
1986	322.9	95.0	417.9	7.2	423.4	31.1	0.0	0.0	0.0	454.5
1987	399.7	45.0	444.7	7.1	376.5	25.7	0.0	0.0	1.7	403.9
1988	196.7	20.0	216.7	3.7	436.0	23.1	0.0	0.0	36.1	495.2

136. All Agency assistance to Algeria is provided to the High Commissariat of Research in Algiers, which carries out in its own laboratories atomic energy programmes relating to research, training and applications. The Government accords high priority to these programmes, as manifested by the position of the High Commissariat in the national administrative structure and by the Government funds made available for the construction of buildings, the purchase of major items of equipment and financial support to projects. The Agency has assisted in the organization of the various laboratories, and in equipping and upgrading them. A total of thirteen laboratories have received Agency assistance and, as a result, laboratories in activation analysis, analytical chemistry and nuclear track detection have been developed and are being used for training and for practical application of the techniques. Major items of equipment that were provided include a neutron generator, and systems to support several analytical techniques, such as Moessbauer and X-ray fluorescence spectrometry, and neutron and fast-neutron activation analysis. In addition to the equipment and expert services provided in respect of the different projects, substantial fellowship training was approved, both project-funded and project-related.

137. In the area of uranium prospecting and analysis, assistance has been provided to strengthen two existing laboratories with the aim of enabling the country to undertake a systematic car-borne radiometric reconnaissance of the uranium potential in the Hoggar region and to establish computer processing of geological and mining data.

138. Two large-scale projects received Agency assistance. One dealt with the establishment of a quality-control laboratory to be used for systematic analysis of imported radiopharmaceuticals. Extension of activities is foreseen in 1989 to allow production of technetium-99m kits used in medical investigations. The second project provided for research into and development of food irradiation. A pilot plant for irradiation of typical produce was established, the aim being to increase shelf-life by inhibiting sprouting (potatoes and onions) and infestation and spoilage (dates and cereals). The technical and economic information gathered has led the authorities to plan a semi-industrial scale irradiator for the south-east of the country; negotiations are under way, following expert advice from the Agency on selection criteria.

139. A non-destructive testing laboratory and mobile field unit were established with Agency support to enable welds and castings as well as components used in connection with the storage and transport of petroleum products to be inspected, with a view to reducing the risk of equipment failures and fire risks. Eighteen inspectors and operators were trained to various levels of certification. Support was also provided for studies of the translocation, mobility and degradation of pesticide residues in the food chain. In this respect, a biochemistry laboratory is being set up to serve as a central facility.

140. In view of the equipment provided in support of the various projects, a repair and maintenance unit was set up with Agency assistance, and a national training course on maintenance was attended by 30 engineers and technicians from different institutions in the country.

141. The Agency also assisted in the establishment of a radiation protection service for personnel and environmental monitoring. This included assistance in the elaboration of the legislation which was promulgated in 1986. As a result, the High Commissariat is now providing personnel dosimetry services to more than 5000 radiation workers and performing inspections of the different facilities where radioactive sources are being used. The Agency also supported the establishment of a secondary standards dosimetry laboratory to undertake radiation calibrations and of a facility for radioactive waste management.

142. Agency assistance has proved to be effective, and the links between the High Commissariat for Research and other governmental services, both technical and educational, have enhanced this effectiveness. The existing infrastructure in Algeria ensures that nuclear techniques will continue to find appropriate application.

## CAMEROON

### 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
	\$	\$	\$	\$		
1984	2.3	2.1	0.0	0.0	0	0
1985	2.6	0.0	0.0	0.0	0	0
1986	3.0	0.0	0.0	0.0	0	0
1987	3.4	0.0	0.0	0.0	2	0
1988	3.8	4.1	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 \$	\$	\$	\$	\$
1984	0.0	0.0	0.0	0.0	19.1	0.0	0.0	0.0	0.0	19.1
1985	0.0	0.0	0.0	0.0	22.2	0.0	0.0	0.0	0.0	22.2
1986	23.8	0.0	23.8	0.4	6.9	0.0	0.0	0.0	0.0	6.9
1987	126.9	65.0	191.9	3.1	52.7	36.2	0.0	0.0	0.0	88.9
1988	90.2	0.0	90.2	1.5	57.6	0.0	29.8	0.0	0.0	87.4

143. Cameroon has, during the past five years, made a start on a small atomic energy programme. There are many areas in which nuclear applications can bring practical benefit to national economic development. Initially, a proper infrastructure has to be established, and this includes setting up a central co-ordinating authority to ensure that activities in the various fields match national developmental priorities, as well as establishment of appropriate radiation protection services. The main emphasis has, however, at this stage to be placed on developing appropriate manpower for the programme, both scientists and technicians, so that the advantages of nuclear methods as a support for various activities can be properly appreciated and applied.



144. The Agency is assisting two institutes that are concerned with applications of nuclear techniques in agricultural research. An Agricultural Research Laboratory has been established at Nkolbisson, near Yaounde, it having been conceived as a central research facility to serve various interested parties. Indeed, a number of collaborative research programmes with other institutions have already been elaborated. It also provides teaching facilities for students. In addition, the Agency is assisting the Research Institute for Agronomy in its investigations into the possibility of using nuclear techniques to improve rubber tree productivity. For the moment, emphasis is being placed on training plant physiologists and on designing a sound research programme.

145. Cameroon has some uranium ore deposits, and the Energy Research Laboratory of the Institute of Geological and Mining Research has received Agency support to strengthen its existing facilities and to train staff in the analysis of geological samples deriving from the uranium prospecting programme. The Laboratory, which is a national facility charged by the Government with various tasks in many different fields in which nuclear methods are of interest, is also setting up a radioactive waste management programme appropriate to the needs of the country. The Agency is at present assisting with staff training and the provision of expert services, in particular advising on regulatory aspects.

146. As part of manpower development in general, the Faculty of Science of the University of Yaounde is establishing a nuclear physics laboratory as an educational and training facility for students, and to undertake research. In the longer term, the aim is to equip the laboratory to provide analytical services for other institutions in Cameroon. This programme is receiving Agency support, as is a related project using extrabudgetary funds to establish a unit for the maintenance and repair of nuclear and associated electronic instrumentation.

## COTE D'IVOIRE

### 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
	\$	\$	\$	\$		
1984	6.8	0.0	0.0	0.0	0	0
1985	7.8	0.0	0.0	0.0	0	0
1986	9.0	0.0	0.0	0.0	0	1
1987	6.8	0.0	0.0	0.0	1	1
1988	7.8	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 \$	\$	\$	\$	\$
1984	194.2	23.0	217.2	4.9	131.8	5.0	5.3	0.0	0.0	142.1
1985	39.5	0.0	39.5	0.8	119.7	0.0	0.0	0.0	6.8	126.5
1986	246.0	0.0	246.0	4.2	146.3	5.0	0.0	0.0	20.0	171.3
1987	169.3	0.0	169.3	2.7	219.4	2.8	3.8	0.0	0.0	226.0
1988	245.8	0.0	245.8	4.1	107.2	17.0	23.1	0.0	0.0	147.3

147. Côte d'Ivoire has, since the early 1970s, been receiving Agency support for various development programmes. The principal stress has been on the use of isotope techniques in support of agriculture; furthermore, since 1982, nuclear science laboratory facilities have been set up at the Research Institute for New Energy Sources, University of Abidjan, with the aim of providing a focus for teaching and research. Indeed, manpower development is of considerable importance, since a major constraint in developing applied nuclear techniques has been the severe shortage of trained personnel. This factor also has a bearing on radiation protection activities, and the country has lacked appropriate legislation and effective radiation protection services. At the request of the Government, the Agency sent a Radiation Protection Advisory Team (RAPAT mission) to review the situation and to make recommendations regarding the establishment of a radiation protection infrastructure. The Agency programme for 1989-90 includes a project for equipping such a service and training its staff.

148. Côte d'Ivoire has a number of established agricultural research institutes each concerned with applied research on one particular crop. Agency assistance requested during the past five years was aimed at introducing radioisotope techniques, to be used in combination with other methods, to improve agricultural output. Support has included provision of equipment and training, and advice to ensure optimum use is made of the facilities that are being built up.

149. The Savannah Institute at Bouaké received Agency assistance to introduce isotope techniques in its studies of soil/plant/water relationships. Special emphasis was accorded initially to developing cultivation methods that improve productivity, and the results have been disseminated to farmers for practical application. The selection of new varieties of rice, especially with regard to drought tolerance, is reaching an encouraging phase, and work on plant nutrition as a function of the water/mineral balance is now under way.

150. The Rubber Research Institute established, with Agency support, a physiology laboratory for applied research into rubber tree (*Hevea*) breeding and rubber production. The new research methods introduced and developed under the project, completed in 1988, have led to a substantial decrease in the number of "dry cuts" and to an increase of rubber production per tapper.

151. The Marc Delorme Coconut Research Station set up a project to introduce multiple cropping with legume trees and coconut palms. The object was to identify legume trees adapted to poor, sandy soils and that have a high capacity for biological fixation of nitrogen. This improves coconut palm development, and the legume trees also serve as a source of firewood, of which there is a shortage. So far three varieties of legume trees have been selected and are being tested in association with young

coconut palms in a soil-regeneration experiment. In order to increase pineapple production, the Institute of Research on Citrus and Other Fruits is receiving expert advice on research into the effects on nitrogen and carbon uptake of damage to roots by nematodes.

152. In an attempt to reduce post-harvest losses, the National Research Institute of Tropical Technology of the Ministries of Agriculture and Research sought Agency assistance in planning and establishing a pilot-scale food irradiator. This was to train staff and provide technical and economic data, a prerequisite for assessing the feasibility of introducing commercial-scale food irradiation. Recently, a second institution has acquired from its own resources a semi-industrial food irradiator, and it is hoped that a collaborative programme can be set up.

153. In animal science, substantial Agency support is being provided to two laboratories to enable them to assess the nutritive value of various forms of ruminant feeds, to improve disease control practices and to produce more efficient vaccines locally. Feed evaluation is being undertaken by the Central Laboratory for Animal Nutrition not only in terms of simple chemical parameters but also in relation to physiological responses such as digestibility and degradability in the rumen. The laboratory has recently been given the responsibility of serving as a regional centre for West Africa and is providing services to some neighbouring countries in relation to evaluation of both conventional and non-conventional feedstuffs. The Animal Pathology Laboratory is making good use of nuclear and related techniques to diagnose major diseases prevalent in the country and to monitor, using these techniques, the rinderpest vaccination campaign in the country. Additional assistance is being provided to determine the cyclical ovarian activity in the various breeds of cattle through the use of radioimmunoassay kits that are prepared and provided by the Agency.

## EGYPT

### 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
	\$	\$	\$	\$		
1984	15.8	15.8	0.0	0.0	21	0
1985	18.2	18.2	0.0	0.0	27	0
1986	21.0	21.0	0.0	12.5	16	16
1987	23.8	23.8	0.0	2.0	10	13
1988	26.6	23.8	0.0	0.0	10	15

### 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 \$	\$	\$	\$	\$
1984	481.4	530.0	991.4	22.2	264.3	932.9	2212.7	35.7	180.3	3625.9
1985	308.1	645.0	953.1	18.7	345.0	134.1	1804.0	6.1	205.6	2494.8
1986	529.0	770.0	1299.0	22.3	465.9	81.0	1506.4	15.0	248.7	2317.0
1987	261.9	445.0	706.9	11.3	716.1	162.8	413.7	127.9	354.9	1775.4
1988	403.3	55.0	458.3	7.7	436.9	331.7	471.5	51.1	195.7	1486.9

154. Egypt was one of the first countries to engage in technical co-operation with the Agency, and there have been projects in all fields of activity in the past twenty years. The Government places high priority on manpower development, and attempts to build up manpower in these various fields have been successful, even if to some extent hampered by "brain drain". Egypt has consistently availed itself of the training activities and facilities provided through the Agency's programme of technical co-operation — among which national and other courses, workshops, fellowships and scientific visits are worthy of mention.

155. At the beginning of the 1980s, Egypt started to draw benefit from the Agency programmes designed to assist developing Member States in introducing nuclear power for electricity generation. Egypt had developed a plan for the introduction of nuclear power that envisaged having a generating capacity of 8400 MW(e) by the year 2000, comprising four units of 900 MW(e) and four of 1200 MW(e) each. The site for the first two units has been selected and the programme has reached the acquisition stage for the first plant; however, no decision to this effect has as yet been taken. The Agency provided assistance in identifying the manpower and the training requirements of the plan and in the form of site review missions. Support was also given to building up and strengthening the infrastructure and staffing of a newly established Nuclear Regulatory and Safety Centre that was charged with responsibility for all safety aspects of the proposed nuclear power plants.

156. At the present time, Agency assistance is primarily being provided to the four organizations directly engaged in the Egyptian atomic energy programme, namely the Inshass Nuclear Research Centre, the National Centre for Radiation Technology and Research, the Nuclear Power Plants Authority and the Nuclear Raw Materials Corporation. In addition, support is also being given to the Oncology and Nuclear Medicine Department of Cairo University and to the Animal Research Institute of the Ministry of Agriculture. The large-scale, multi-year projects are funded primarily by UNDP and from extrabudgetary contributions from the Federal Republic of Germany, Italy, the United Kingdom and the United States of America.

157. High priority is attached by the Government to assistance in nuclear safety, radiation protection and waste management. In 1982, an Agency preparatory mission visited Egypt and discussed the manpower development required for the national nuclear power programme with officials of the Nuclear Power Plants Authority, assisting in the formulation of a training programme. Projects that were approved and implemented comprised training in topics such as nuclear safety and siting, project management, quality assurance and quality control, and in operation and maintenance. In addition, Egypt has made extensive use of the Agency's interregional training courses in nuclear power, being one of five developing countries which sent more than 100 participants to these courses.

158. The Inshass Nuclear Research Centre is the focal point of nuclear activities in the country. The major facility at the Centre is a 2 MW research reactor. Agency assistance is at present being provided under three projects aimed at improving the safe operation of this reactor, following the recommendations of a RAPAT mission report of 1986. Under one project, equipment has been provided to upgrade the measuring and safety systems of the reactor, another centres on provision of a new radiation monitoring system, and a third involves expert assistance to carry out an inspection of the reactor's structures and components.

159. As noted above, a Nuclear Regulatory and Safety Centre was created at the Inshass Centre in the 1980s, specifically for the purpose of assuring the safety of nuclear power plants. Assistance to this programme has included provision of essential equipment for radiation monitoring, calibration and dosimeter processing, as well as computer-based safety codes. Extensive training was given, inter alia, by means of national training courses. As one outcome, regulations and guides, specifically directed to the needs of Egypt, have been developed. This has resulted in Egypt having staff well qualified in radiation protection and nuclear safety, capable of developing and implementing an effective regulatory programme. Since plans for installing nuclear power have been delayed, the Centre is now concentrating on developing an effective regulatory programme in radiation protection relating to all uses of ionizing radiations.

160. Two projects deal with environmental matters. One provides assistance in the form of expert services and equipment to improve the environmental monitoring around the Inshass Research Reactor, and another in evaluating the probable impact of nuclear power generation on the environment around the site selected for the first nuclear power plant. The project includes tracer dispersion studies, the results of which will be used to develop regulations to control future radioactive releases into the environment.

161. In support of radioactive waste management programmes, the Agency is providing assistance through a large-scale project with the design, construction and commissioning of a facility for the storage and treatment of liquid low- and medium-level radioactive wastes. Most of the equipment has already been provided and installed, and the preparation of the safety analysis report and operating manuals is under way.

162. The Agency is also co-operating with the Nuclear Regulatory and Safety Centre in a large-scale project to establish a NDT laboratory in order to enable the Centre to discharge its responsibilities for quality control and quality assurance. Following the recommendations of an expert mission, radiographic, ultrasonic and eddy-current testing equipment were provided, and a manpower development programme based on two training courses has been set up. The Government is constructing a special building for this activity, and it is expected that the project will result in a continuing programme of training and certification of personnel in NDT. Related to this work is the research and development programme of the Reactor and Neutron Physics Department on the applications of neutron physics in industrial radiography, also being given Agency support.

163. Agency collaboration with the Inshass Centre extends over several other fields. Staff of the Department of Electronics and Scientific Instrumentation have been instructed in the use of microprocessor technology as applied to nuclear measurements, and the department will be supported in improving its facilities so that staff can design and assemble electronic instruments on a small scale so as to meet local needs. The Department of Plasma Physics and Accelerators had its equipment

upgraded, this including provision of an additional data acquisition system, while the Radioisotope Production Laboratory is receiving assistance under a large-scale, multi-year project to enable it to improve its production and quality control services relating to radioisotopes, radiopharmaceuticals and radioimmunoassay (RIA) kits being used by the nuclear medicine sector.

164. The National Centre for Radiation Technology and Research uses an industrial gamma-irradiation facility, acquired from its own resources, for food preservation studies and for the sterilization of medical products. Agency assistance to the Centre is being provided under a large-scale, UNDP-financed project and includes the acquisition of an electron beam accelerator to be used for industrial applications. The accelerator has been delivered and arrangements for its installation and commissioning are under way.

165. Egypt has uranium deposits, and the Nuclear Materials Corporation is receiving Agency assistance under three projects. One project provides for the establishment of a data bank to support local activities in uranium exploration, the second provides for the construction and use of calibration pads for survey equipment, and the third provides training on radiation protection related to mining and milling.

166. In the field of public health, the Radiation Oncology and Nuclear Medicine Department of the Faculty of Medicine of Cairo University is being provided with assistance under a large-scale, multi-year project that is promoting the use of intracavitary radiotherapy in district hospitals as a simple, low-cost treatment for cancer of the cervix. The assistance provided takes the form of annual training courses and the provision of equipment to the district hospitals. Thirteen hospitals have equipment installed and a large number of staff have been trained under the training course programme. Participants from other African countries have also benefited from these training courses.

167. Egypt has a considerable agricultural production, and export crops such as cotton and potatoes are important sources of foreign currency. Animal husbandry is also practised extensively, primarily on small farms or smallholdings, to provide meat for home consumption, while milk and milk products are receiving increasing attention. In this context, the Animal Health Research Institute of the Ministry of Agriculture is receiving under a multi-year project assistance for the establishment of radioimmunoassay and enzyme-linked immunosorbent assay techniques for the diagnosis of viral and bacterial infections in livestock. Laboratory equipment has been provided and several expert missions were undertaken. The Middle Eastern Regional Radioisotope Centre, in co-operation with the Inshass Centre, is receiving assistance with a project to study pesticide residues in cotton seed oils and vegetables using nuclear techniques.

168. The greatest asset of the nuclear energy programme in Egypt is still the number of full-time, highly qualified scientists and engineers engaged in the various branches of nuclear science and technology who have had extensive training and have gained experience both in Egypt and abroad. Much of this training has received support from the Agency through its training course and fellowship programmes. However, by contrast, there is acute shortage of middle-grade scientific personnel and technicians whose skills are needed for the implementation of the various projects.

169. The financial resources nationally available are not on the scale necessary to maintain and expand such a broad-based programme, in particular in terms of foreign exchange needed for capital expenditures. This problem is compounded by the fact

that most of the major items of equipment are old and need to be modernized or replaced. A further priority area would be the enhancement of the local capability for repair and maintenance of existing equipment, with improved provision of spare parts, since this protects capital investment.

170. As already indicated, the largest recipient of Agency assistance has been the Inshass Nuclear Research Centre. Apart from the high priority projects in nuclear safety, radiation protection and waste management, Agency assistance is at present spread rather widely over small-scale, single-year projects supporting the programmes of many of the laboratories within the Centre. It might be pertinent if national authorities, perhaps with Agency collaboration, were to review the current fragmented programme with the aim of concentrating efforts on fewer projects so as to enhance the impact on national development.

## ETHIOPIA

### 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
	\$	\$	\$	\$		
1984	2.3	0.0	0.0	0.0	0	0
1985	2.6	0.0	0.0	0.0	0	0
1986	3.0	0.0	0.0	0.0	0	0
1987	3.4	0.0	0.0	0.0	1	0
1988	3.8	0.0	0.0	0.0	2	18

### 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 \$	\$	\$	\$	\$
1984	106.2	0.0	106.2	2.4	108.6	1.8	0.0	0.0	0.0	110.4
1985	137.5	10.0	147.5	2.9	191.6	5.6	0.0	0.0	0.0	197.2
1986	184.5	0.0	184.5	3.2	168.7	22.5	0.0	0.0	0.0	191.2
1987	137.3	0.0	137.3	2.2	97.3	12.4	0.0	0.0	0.0	109.7
1988	221.6	170.0	391.6	6.6	224.3	3.8	0.0	0.0	22.7	250.8

171. For the past six years the Agency's technical co-operation programme in Ethiopia has focused mainly on research into the health and productivity of various breeds of cattle and on the establishment of a nuclear medicine unit in the country's primary teaching hospital, Tikur Anbessa. Concomitant with the development of these two activities has been the growing awareness within the country of the need for an effective radiation protection service. In 1983, the Agency was requested to assist in strengthening the personnel monitoring service created by the Institute of Pathobiology. In addition, since 1985, isotopes have been used in the agricultural sector to study the effects of different rhizobia on the uptake by certain crops of nitrogen from nitrogenous fertilizers.

172. The approach to improving the health and productivity of indigenous cattle and cross breeds on one of the State experimental farms is through research on reproduction and nutrition. Ovarian function is monitored by radioimmunoassay of the hormone

progesterone to determine the cause of reproductive failure. This is a simple yet highly specific technique that can be used under traditional management systems. The assay kits are prepared and distributed by the Agency. In parallel with these studies, the nutritive value of different local cattle feeds is being determined to assess whether nutritional factors affect the onset of puberty, milk yield and calving interval. The results of these experiments are to be passed on to small farmers to enable them to increase milk production and improve the quality of meat.

173. In connection with the project on animal production, a regional training course on the diagnosis of rinderpest was organized with Agency assistance at the National Veterinary Institute, Debre Zeit, in 1988. Emphasis was placed on the use of enzyme-linked immunosorbent assay techniques in sero-monitoring rinderpest. Nineteen veterinary scientists from 17 African countries participated in the course.

174. The Department of Internal Medicine in Tikur Anbessa hospital has established a Nuclear Medicine Unit with the infrastructure and manpower to diagnose thyroid, renal and brain function by means of radioisotope imaging and to study levels of thyroid-related hormones by means of radioimmunoassay. With the steady increase in the number of patients referred for treatment, the Unit is now planning to expand its services with the assistance of the Agency. In addition, the Ministry of Health has, together with Agency consultants, drawn up a three-year plan for establishing the country's first radiation oncology department at the hospital. The first phase of the plan is to train a medical doctor, a medical physicist and three radiographers in different aspects of clinical radiotherapy through Agency fellowships. This training will begin in 1989.

175. Over the past six years, the scope of the radiation protection service at the Institute of Pathobiology on the Southern Campus of the University of Addis Ababa has expanded from the initial monitoring of staff who were developing radiation-attenuated vaccines to radiation workers employed by various hospitals and health centres. The Agency has provided a thermoluminescence dosimetry (TLD) system and appropriate training in radiation protection, both on-the-job locally, and abroad. Some 88 institutions are now being served with TLD badges. However, the service is restricted in its power to enforce international regulations and codes of practice because the Government draft proclamation on radiation protection has not yet been finalized. The proclamation is expected to be promulgated by the Council of Ministers during 1989.

176. An underlying feature of all the projects has been the gradual build up of trained manpower through Agency fellowships. However, two major constraints in the development of manpower remain to be addressed: the lack of nuclear sciences in the university curriculum and the shortage of engineers and technicians trained in the maintenance and repair of electronic equipment.

177. Although Agency-supported projects have been small in financial terms, they have been part of the national development plan and have benefited from governmental support through, for example, the Ministry of State Farms and the Ministry of Health. The commitment of the Government to the projects is reflected in their steady growth over the years and the present request by the Ethiopian Science and Technology Commission for assistance from the Agency in the preparation of an integrated national programme on the peaceful uses of ionizing radiation.



# GABON

## 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
	\$	\$	\$	\$		
1984	4.5	4.5	0.0	0.0	0	0
1985	5.2	0.0	0.0	0.0	0	0
1986	6.0	0.0	0.0	0.0	0	0
1987	10.2	0.0	0.0	0.0	0	0
1988	11.4	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 \$	\$	\$	\$	\$
1984	0.0	0.0	0.0	0.0	60.8	0.0	0.0	0.0	0.0	60.8
1985	0.0	0.0	0.0	0.0	-4.9	0.0	0.0	0.0	0.0	-4.9
1986	51.5	0.0	51.5	0.9	31.3	0.0	0.0	0.0	0.0	31.3
1987	126.7	0.0	126.7	2.0	28.2	0.0	0.0	0.0	12.6	40.8
1988	21.6	0.0	21.6	0.4	32.4	0.0	0.0	0.0	0.0	32.4

178. Gabon's atomic energy programme is dominated by the uranium deposit that makes the country one of the world's major producers of uranium.

179. In connection with Gabon's uranium exploitation programme, the Agency has, since 1987, been assisting the General Directorate of Mining and Geology in strengthening its capability for the treatment and interpretation of radiometric, geophysical and geological data, and in establishing a computerized data base to be used for the production of geological maps. A complete set of equipment has already been provided, and map production and training of the staff are planned for 1989.

180. For the past five years, the Agency's technical assistance programme has mainly focused on strengthening the capability of the spectrometry laboratory of the Faculty of Science, Libreville. University staff have been trained in applications of nuclear technology, in particular in the analysis of minor and trace elements contained in geological and biological samples. The laboratory had been fully operational for two years when, in 1986, the Government decided to transfer the Faculty of Science and associated laboratories to Franceville. In connection with this decision, the Agency provided additional assistance to ascertain that equipment is properly packed and stored under appropriate conditions before its transfer to the new location.

181. The Agency provided expert assistance for the elaboration of legislation on radiation protection and safety, a necessary prerequisite to an expansion of activities in the nuclear field. Draft regulations were elaborated and forwarded to the Government.

182. A multi-disciplinary programming mission comprising several experts in different fields was provided to assess the possibilities and advantages of using nuclear techniques in support of national development and to assist in the elaboration of project proposals. The mission report, including recommendations, has been sent to

the Government. It was noted that the main constraint to the establishment of an atomic energy programme was the lack of trained scientists and a lack of local institutions in which they could be trained.

## GHANA

### 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
	\$	\$	\$	\$		
1984	4.5	0.0	0.0	0.0	2	0
1985	5.2	0.0	0.0	0.0	1	0
1986	6.0	6.0	0.0	0.0	0	0
1987	3.4	6.0	0.0	0.0	0	22
1988	3.8	6.0	0.0	0.0	1	20

### 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 \$	\$	\$	\$	\$
1984	181.2	0.0	181.2	4.1	169.9	1.0	20.8	0.0	30.0	221.7
1985	303.3	10.0	313.3	6.2	184.0	9.5	29.4	0.0	37.8	260.7
1986	399.1	85.0	484.1	8.3	441.6	0.1	2.1	39.8	9.2	492.8
1987	406.9	100.0	506.9	8.1	420.4	40.2	11.1	45.6	29.6	546.9
1988	416.2	55.0	471.2	7.9	400.9	2.3	0.1	0.1	28.9	432.3

183. Ghana, which established the Ghana Atomic Energy Commission in 1963, was one of the first countries in Africa to embark upon a nuclear energy programme. Under the Commission, a National Nuclear Research Centre was established. It was originally intended that the Centre house a research reactor, but acquisition of the reactor was deferred. The Commission reoriented the objectives of the centre, and it was renamed the National Nuclear Research Institute. It was to be used to demonstrate the use of nuclear techniques and nuclear instrumentation in various fields and for research using radiation and radioisotopes to solve current problems. This programme, however, suffered great setbacks for a variety of reasons, mainly financial constraints and the fact that the first cadre of trained scientists did not stay at their posts. Successful efforts have recently been made to revive and rehabilitate the atomic energy programme and this has been reflected in the marked increase in Agency assistance since 1986. The projects that were dormant in the early 1980s were resuscitated and new ones were approved. The bulk of Agency assistance is provided to the National Nuclear Research Institute to improve its infrastructure and strengthen its research capabilities. The Institute, in carrying out its projects, collaborates with other appropriate institutions in the country. Some Agency assistance is also provided to other Government institutions.

184. Agency assistance to improve the infrastructure at the Institute has included training in the maintenance and repair of equipment and the establishment of an electronics workshop. This was prompted by the increase in the number of nuclear electronic instruments being used. Two national training courses on nuclear instrumentation were organized, one in 1985 and one in 1986. More emphasis is now

being placed on intensive individual training of engineers and of technicians with the aim of making the electronics workshop a service centre available to other laboratories.

185. The establishment of a secondary standards dosimetry laboratory (SSDL) at the Institute was first considered in 1978, but the lack of a suitably shielded room delayed the acquisition of an X-ray generator to be used for calibration until 1985. Subsequent years then saw the gradual development of a Radiation Protection Service within the SSDL. This Service provides personnel monitoring on a voluntary basis to radiation workers within the Greater Accra Region and to some in hospitals outside Accra. The Service is being expanded in 1989 to cover environmental monitoring and the measurement of radioactivity in foodstuffs. Agency assistance to review the present draft legislation on radiation protection has been approved.

186. Nuclear techniques applied to agricultural research have received the highest priority at the Institute. Agency assistance was provided for projects dealing with studies on the water requirements of certain crops, on biological nitrogen fixation, on plant breeding by radiation-induced mutation, on food preservation, and on the sterile-insect technique for suppressing an indigenous riverine species of tsetse fly.

187. The Government has a particular interest in commercial applications of irradiation for disinfesting grain, prolonging the shelf-life of perishable foods and for sterilizing medical products. A gamma irradiator has been provided and is scheduled to be operational at the end of 1989 when the first of two 50 kCi cobalt sources will be delivered. It will be used for research, and it is expected that sufficient information will be obtained with the irradiator to enable the authorities to assess the feasibility of commercializing one or more of these applications.

188. There has been collaboration since 1983 between the Institute and other institutions working in agricultural research. For example, the University of Ghana provided experimental fields for irrigation studies and laboratory facilities for the determination of nitrogen-15 in plant materials by means of emission spectrometry. These facilities were used in 1988 for a regional course on the application of isotopes and radiation techniques in studies of biological nitrogen fixation, soil/plant interactions and plant nutrition. One of the staff has served the Agency as a field expert.

189. Experiments to improve local crops genetically through mutation breeding and *in vitro* culture have been carried out in collaboration with The Cocoa Research Institute, where gamma-irradiated pollen, budwood and cacao seeds have been used for mutation breeding, and shoot tips for *in vitro* culture.

190. The Cocoa Research Institute has since received assistance from the Agency in setting up growth chambers for *in vitro* culture techniques used in selecting for disease-resistant mutants.

191. The project aimed at suppressing riverine tsetse flies by means of the sterile-insect technique has provided two laboratories with facilities for mass rearing the flies, one at the National Nuclear Research Institute and one at the Animal Research Institute. A realistic plan of action for fly production and pilot releases of sterile males is expected to be worked out by the two groups during 1989.

192. Assistance to other institutions included a project which established a Nuclear Medicine Unit at the University of Ghana Medical School, to operate as part of the clinical services of Korle Bu Hospital. The Unit received extensive Agency assistance

over many years, including scanners and training. However, the project suffered when many of the trained personnel did not return to it after fellowship training and also from lack of funds with which to obtain radioisotopes and supplies on a regular basis.

193. Researchers at the University of Ghana, the University of Science Technology and the Central Veterinary Laboratories are receiving Agency assistance to study factors such as poor nutrition, poor reproductive performance and endemic diseases that impose constraints on livestock productivity. These inter-disciplinary studies were initiated in 1986 and are producing data that are expected to lead to more efficient breeding practices.

194. Earlier constraints seem to have been gradually overcome and, since 1986, all the projects have benefited from Government commitment and a continuity in staffing. Emphasis still needs to be placed on manpower development, repair and maintenance of equipment and radiation protection. The programmes of the Nuclear National Research Institute could also benefit from being more closely linked to the other Government technical services.

## KENYA

### 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
	\$	\$	\$	\$		
1984	2.3	0.0	0.0	2.6	3	3
1985	2.6	0.0	0.0	0.3	4	16
1986	3.0	0.0	0.0	0.5	1	25
1987	3.4	0.0	0.0	0.0	1	17
1988	3.8	0.0	0.0	0.0	0	10

### 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 \$	\$	\$	\$	\$
1984	212.0	0.0	212.0	4.7	190.1	0.0	28.7	0.0	60.2	279.0
1985	160.1	0.0	160.1	3.1	196.1	0.0	11.4	0.0	27.5	235.0
1986	256.7	0.0	256.7	4.4	222.5	0.0	113.0	0.0	56.1	391.6
1987	227.8	0.0	227.8	3.6	242.6	8.0	136.0	0.0	59.3	445.9
1988	188.1	0.0	188.1	3.2	202.0	0.0	41.9	0.0	13.8	257.7

195. That the Government of Kenya attaches the highest priority to strengthening radiation protection in the country was clearly manifest by its establishing the legal framework, setting up an appropriate institutional infrastructure and making budgetary allocations to support related activities. A Radiation Protection Inspectorate was established within the Ministry of Health and it is carrying out personnel monitoring on a routine basis. The Agency provided an automatic computerized TLD system and badges as well as a gamma spectrometer for monitoring foodstuffs. A number of radiation protection officers received training through the Agency's fellowship programme. Facilities are such that an Agency regional training course attended by

14 participants from other African countries could be organized in 1988. However, the radiation protection service has still to be extended to cover all radiation workers in the country.

196. Another priority project receiving Agency support over the past five years is the upgrading of the Nuclear Science Laboratory at the Faculty of Engineering, University of Nairobi. The project, as originally conceived, aimed to provide facilities for training and research relating to a variety of nuclear techniques and to establish a service function whereby the Laboratory would undertake analyses for organizations that required them. The project was also expected to promote collaboration between the Laboratory and other institutions as the nuclear energy programme in the country expanded. The Agency assisted by providing fellowship training, long-term expert services and equipment that included a tube-excited X-ray fluorescence analysis system. However, progress was delayed owing to constraints that included insufficient staff and lack of funds. The situation has improved, since a number of staff have returned to the project and provision was made for the renovation and expansion of the buildings. A closely related project that aims to provide facilities for the maintenance and repair of electronic equipment has yet to become fully operational.

197. A recently completed, most successful project concerned non-destructive testing. It provided the Physics Laboratory of the Materials Branch of the Ministry of Transport and Communications with equipment, expert services and fellowship training which enables the Laboratory to operate a centralized service in non-destructive testing and radiography for Government institutions and private industry. The Laboratory hosted an Agency regional training course on non-destructive testing in 1987.

198. Nuclear applications in animal science were introduced through an Agency-assisted project located at the College of Biological and Physical Sciences, University of Nairobi. Nuclear techniques are being used in disease diagnosis and to study the effect of nutrition on the reproductive performance and productivity of cattle, sheep and goats. Diagnostic methods include the use of radioimmunoassay and enzyme-linked immunosorbent assay.

199. A nuclear medicine unit was established at the Kenyatta National Hospital, in Nairobi, in the early 1980s. Agency assistance provided at the initial stages included fellowship training for local staff to enable them to operate nuclear equipment such as the gamma camera acquired by the hospital in 1983. Subsequently, the Agency supplied intracavitary after-loading equipment for treating cervical cancer. Also in the medical field, a functional laboratory has been established at the Kenya Medical Research Institute for parasitological research and diagnosis involving radioisotopes and modern immunological techniques.

200. In 1987, isotope techniques were introduced for sampling and assessing water resources in several parts of the country. Recharge areas and the relationships between surface and groundwater were studied. In addition to carrying out analysis of the samples collected in Kenya, the Agency's Hydrology Laboratory trained a Kenyan geologist and a groundwater inspector. It is expected that activities will lead to a more rational use of water resources.

201. The atomic energy programme in Kenya is co-ordinated by the National Council for Science and Technology. While the current programme is in keeping with present needs, it is to be hoped that some of the existing constraints to successful implementation will be removed. Among the constraints are a shortage of counterpart funds to

support approved projects, insufficient numbers of local staff assigned to them and delays in making suitable premises available to house equipment being provided by the Agency. These problems are being addressed by the authorities.

## **LIBERIA**

### **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
	\$	\$	\$	\$		
1984	2.3	0.0	0.0	0.0	0	0
1985	2.6	0.0	0.0	0.0	0	0
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

### **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 \$	\$	\$	\$	\$
1984	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1985	0.0	0.0	0.0	0.0	2.1	0.0	0.0	0.0	0.0	2.1
1986	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
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

202. The Government only once requested Agency assistance when, in 1984, the Radiotherapy Department of the J.F.K. Medical Centre sought expert advice regarding the repair of a cobalt teletherapy unit and support for replacement of the source. The Government is fully acquainted with the services and assistance available from the Agency; however, there is lack of trained personnel in Liberia who could formulate and implement atomic energy projects, and the absorptive capacity of the country for such projects is limited.

## **LIBYAN ARAB JAMAHIRIYA**

### **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
	\$	\$	\$	\$		
1984	58.5	0.0	0.0	0.0	0	0
1985	67.6	0.0	0.0	0.0	1	0
1986	78.0	0.0	0.0	0.0	0	0
1987	88.4	0.0	0.0	0.0	0	0
1988	98.8	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 \$	\$	\$	\$	\$
1984	172.6	0.0	172.6	3.9	154.4	1.8	0.0	0.0	0.0	156.2
1985	150.1	10.0	160.1	3.1	115.7	12.8	5.8	0.0	0.0	134.3
1986	193.2	0.0	193.2	3.3	191.6	7.8	1.1	0.0	0.0	200.5
1987	155.0	0.0	155.0	2.5	160.9	85.2	3.8	0.0	0.0	249.9
1988	171.3	0.0	171.3	2.9	221.3	41.2	-52.9	0.0	0.0	209.6

203. The atomic energy programme in the Libyan Arab Jamahiriya is entirely confined to the Tajoura Nuclear Research Centre. The Centre is very well equipped, having a 10 MW research reactor, accelerators, neutron generators, irradiators and many other advanced devices. However, the current work programmes are not commensurate with the facilities available and the Centre is therefore under-utilized. The Government sought Agency assistance to set up a programme of work that would be in tune with the country's plans for socio-economic development and bring tangible benefits. Hence, in 1988, an Agency Mission comprising several experts visited Libya to assist in planning projects that would improve the use made of the Centre. The Mission also looked into radiation protection matters, both at the Centre and in the country in general. It was noted that the legal background for radiation protection at the national level was adequate, with a law on protection against ionizing radiation that is supplemented by various regulations and a law on protection of the environment. However, it was felt that a functioning authority would need to be established to provide enforcement as well as the various operational services that relate to radiation protection. It was further noted that the Centre had excellent facilities for work in various fields, including fundamental research, with the necessary radioactive waste treatment facilities to support the work. Apart from programme development, however, it was also felt important to stress manpower development, and it was hoped that specialized training to support applied research in the various fields would receive the highest priority.

204. Various activities pertaining to agriculture have been supported under the Agency's technical co-operation programme. The Department of Agriculture at the Centre has been undertaking studies on the use of urea as a substitute for imported nitrogen fertilizers in wheat cultivation. A spectrometry system to measure nitrogen-15 was provided by the Agency and an expert assisted in planning greenhouse and field experiments. It is expected that the project will lead to the development of methods for increasing fertilizer use efficiency, thereby enhancing yields. The Department is also being assisted with a mutation breeding programme aimed at developing varieties of barley that have increased salt and drought tolerance. In addition, the Agency has been providing expert services and equipment for establishing a pilot-scale facility to mass rear species of Mediterranean fruit fly, an insect pest responsible for considerable losses in citrus fruit production. Counterparts were assisted in undertaking related ecological studies in some areas of the country with a view to planning future test releases before large-scale attempts were made to eradicate the pest. A number of counterparts were trained in mass rearing techniques at the Agency's Seibersdorf Laboratory. The Department was also interested in evaluating the feasibility of setting up a programme that would lead to commercial-scale food irradiation. The Agency expert assisted by preparing a realistic programme of work,

suggesting food products whose storage life could be usefully extended by means of this technology. Three persons were given fellowship training abroad in order to set up a nucleus of local staff around which a future programme might be developed.

205. Both fresh water and seawater are used as a basis for providing potable water in the Libyan Arab Jamahiriya. In order to be able to provide the health authorities with the data needed to control water quality, the Neutron Activation Analysis Unit of the Department of Radioisotope Applications started, in 1988, a project to use neutron activation analysis to determine trace elements in fresh water and seawater. Since its inception, the objectives of this project have been widened to include determinations of trace elements in crude oils. Agency support will primarily comprise provision of expert services and fellowships for training selected staff abroad. In a related sphere, the Industrial Applications Unit was provided with pre-project assistance to formulate a work programme, following which a project was approved for 1989 to initiate tracer studies applied to the cement and oil industries, with the aim of developing a team that could eventually provide similar services to other industries in the future.

206. Between 1984 and 1988, the Agency provided assistance to the Radiation Shielding Group on a project that aimed to use locally available materials for radiation shielding. The project utilized the irradiation facilities and measuring equipment already available at the Centre, while the Agency provided additional auxiliary equipment, expert services and fellowship training.

207. The Department of Radiation Protection and Health Physics at the Centre has been receiving assistance in establishing a Radiation Protection Service. The Agency has supplied a thermoluminescence dosimetry system, film badges and related equipment. A limited personnel dosimetry service is currently available using film badges and about 400 individuals are being monitored, while occasional radiation surveys are being conducted using portable detection instruments. In connection with this service, the Department is also establishing a national secondary standards dosimetry laboratory to provide the necessary calibration facilities. The project was formulated with the assistance of an Agency expert, and the Agency has since supplied various items of equipment to be housed in a shielded room. Commissioning of the laboratory awaits the completion of the specially designed building, and in the interim period, some of the Laboratory's staff have been receiving training under the Agency's fellowship programme.

208. The development of suitable programmes for the various laboratories at the Centre to ensure that appropriate use is made of the existing facilities remains the prime objective. Such programmes will have to include manpower development schemes, including the provision of specialized training, as preparation for future work.



# MADAGASCAR

## 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
	\$	\$	\$	\$		
1984	2.3	2.3	0.0	0.0	0	0
1985	2.6	1.1	0.0	0.0	0	0
1986	3.0	3.0	0.0	0.0	1	0
1987	3.4	3.4	0.0	0.0	0	0
1988	3.8	3.3	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 \$	\$	\$	\$	\$
1984	131.4	0.0	131.4	2.9	191.2	0.0	0.0	3.2	4.7	199.1
1985	136.2	0.0	136.2	2.7	107.8	0.0	0.0	11.8	0.0	119.6
1986	53.0	0.0	53.0	0.9	82.9	0.0	0.0	1.1	0.7	84.7
1987	99.3	0.0	99.3	1.6	129.4	13.3	0.0	0.0	0.0	142.7
1988	113.1	0.0	113.1	1.9	68.0	3.8	0.0	0.0	8.4	80.2

209. In Madagascar, nuclear technology has been developed at two main focal points, namely at the "Laboratoire de physique nucléaire et de physique appliquée" (LPNPA) and at the governmental department responsible for executing decisions on the exploration and exploitation of strategic minerals, the "Office militaire national pour les industries stratégiques" (OMNIS). As far back as 1977, the Agency began to support the LPNPA in setting up a research laboratory for nuclear physics, and between 1979 and 1983 the Agency executed a \$1.5 million UNDP project on uranium exploration in support of OMNIS.

210. The past six years have witnessed a marked change in nuclear priorities in Madagascar as a result of the unfavourable world market for uranium. This change is clearly reflected in the steady growth in technical co-operation with the LPNPA and the gradual decrease in collaborative activities with OMNIS. The project to establish modern analytical techniques in the mineralogy and chemical laboratories of OMNIS was successfully completed in 1986, and the only project remaining aims to compile a computerized inventory of all radioactive mineral resources in Madagascar.

211. The Agency is now supporting the LPNPA in developing applied nuclear physics, in establishing a workshop for the maintenance and repair of nuclear instrumentation and in forming a core of radiation protection officers to monitor users of ionizing radiation in the country.

212. Very little assistance has up to the present time been requested in either medicine or agriculture. In 1987-88, a small but worthwhile project was implemented to assist the Radioagronomy Section of the national Radioisotope Laboratory in carrying out research on the use of nitrogen-15 to study the uptake of nitrogenous fertilizer in rice paddies. Rice is the largest cultivated crop in Madagascar and the main staple food. It is hoped that the project will stimulate further co-operation with the Agency on this important agricultural topic.

213. With the support of the Ministry of Higher Education and Scientific Research and practical assistance from the Agency, the LPNPA has set up laboratories for X-ray fluorescence analysis, studies of track detectors and solid-state detectors, neutron studies and studies of radioactivity in the environment. Some 30 students have gained MSc degrees since 1977 and some 50 publications have been published in national science journals.

214. The prevailing socio-economic problems often hamper the LPNPA in procuring essential items for running a research laboratory, and down-time of instruments can be long when spare parts are not available. Consequently, a request was made in 1987 for assistance in creating an effective workshop for the repair and maintenance of nuclear instrumentation. Under this project, emphasis is being placed on hands-on training and the supply of essential replacement components.

215. A very important recent development in Madagascar has been the personal involvement of the head of the LPNPA in creating a national radiation protection service. Physicists are now being trained in the use of a manual TLD system which was provided by the Agency in 1988. The aim is to create a core of radiation protection officers who will monitor radiation workers in the hospitals and in industry. Up to now, the film badges worn by some radiation workers had to be sent abroad to be read.

216. Complementing the assistance being provided by the Agency to create a personnel monitoring service in Madagascar is the advice and guidance planned for 1989 in drafting radiation protection regulations and codes of practice. Future assistance foresees the provision of quality control kits for checking diagnostic and therapeutic medical equipment and the upgrading of eight environmental monitoring stations in the country.

217. In all projects, major emphasis has been placed on manpower development. And, though the priority fields of activity are changing in line with changing national needs, fellowships are still a prime instrument for providing such training. As a reciprocal service, in particular for trainees from other African countries, the LPNPA, which has acquired new laboratory premises, has indicated its willingness to host Agency-sponsored regional training courses on appropriate topics in nuclear technology.

## MALI

### 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
	\$	\$	\$	\$		
1984	2.3	0.0	0.0	0.0	0	0
1985	2.6	0.0	0.0	0.0	0	0
1986	3.0	0.0	0.0	0.0	0	0
1987	3.4	0.0	0.0	0.0	0	5
1988	3.8	0.0	0.0	0.0	1	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 \$	\$	\$	\$	\$
1984	159.7	0.0	159.7	3.6	152.9	0.0	48.3	0.0	0.0	201.2
1985	209.2	0.0	209.2	4.1	127.8	0.0	13.3	0.0	2.5	143.6
1986	192.2	0.0	192.2	3.3	165.0	0.0	15.7	0.0	0.0	180.7
1987	144.6	0.0	144.6	2.3	270.8	0.0	0.7	0.0	0.0	271.5
1988	75.2	20.0	95.2	1.8	155.3	0.0	0.0	0.0	0.0	155.3

218. The development of agriculture and water resources are the two top-priority areas for the economic development of Mali, and Agency assistance during the past years has quite appropriately focused on them. However, certain other areas, such as human health, uranium prospecting and analysis, and radiation protection have also received assistance.

219. The agricultural sector, through the SOTUBA Agricultural Research Station, has made use of isotopic techniques to develop adequate water conservation measures and to increase crop production under dry farming conditions. Results obtained from soil-moisture investigations and more efficient use of fertilizers have led to improved crop management practices, leading to higher yields of cereals and cotton. Use of mutation breeding techniques has led to selection of promising varieties of rice and fonio (a West African wild rice) that are resistant to drought, diseases and pests. Additional investigations and experiments using these selected varieties are now under way.

220. Substantial support from the Agency has been provided to the National Directorate of Hydraulics and Energy and the National School of Engineering for assessing the country's groundwater resources, defining a water management programme and one for studying the accumulation of sediments in lakes, reservoirs and behind dams. These activities, conceived to supplement conventional methods, have been carried out in arid and semi-arid regions of the country where shortage of water inhibits development. Establishment of a water chemistry laboratory and a sedimentology laboratory by the Agency has helped to achieve the stated objectives. There is now a better understanding of the characteristics of aquifers and their recharge mechanisms; meaningful information about the silting up of reservoirs and lakes, as well as about erosion phenomena, has also been obtained. In this context, it should be mentioned that Mali is also a beneficiary of a regional project in hydrology under which further assistance is being provided, particularly in respect of training: a workshop on isotope hydrology was organized in 1987 in Bamako, attended by participants from Niger and Senegal as well as from Mali.

221. In nuclear medicine, the Agency has, since 1979, been assisting the "Point G" Hospital in establishing a nuclear medicine service and a microbiological laboratory for control and disinfection of locally produced medical supplies. The nuclear medicine service is now fully operational and is receiving patients referred to it from other medical institutions in the country. Radioimmunoassay techniques are being used for investigating thyroid and related diseases. A cadre of medical doctors and middle-grade technicians has been trained through Agency training programmes in support of the above-mentioned activities.

222. In the field of uranium prospecting and analysis, Agency support has been provided to the National Directorate of Geology and Mining for the purpose of undertaking a comprehensive evaluation of the country's uranium potential and of strengthening the uranium analysis laboratory. Expert services provided under the project have permitted the Directorate to compile and organize all available geological and geochemical data on uranium favourability that were generated from past exploration activities. The uranium analysis laboratory has been upgraded and is now being used for routine analysis of uranium and other mineral samples. Of special interest is the intensive training that has been provided, both in the country and abroad, to the national staff.

223. Since 1985, the Ministry of Health has been receiving assistance to establish a radiation protection centre charged with provision of personnel monitoring services. It is, however, recognized that any expansion of the overall atomic energy programme would necessitate the establishment of an appropriate, formal radiation protection infrastructure, including supporting legislation.

224. With Agency assistance, Mali has been tackling problems of practical and economic importance that have been accorded high priority in the development plans of the country. However, major constraints, namely a shortage of national staff to be assigned to specific projects and of national funding for projects, limit the size of the programme.

## **MAURITIUS**

### **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
	\$	\$	\$	\$		
1984	2.3	0.0	0.0	0.0	0	0
1985	2.6	0.0	0.0	0.0	0	0
1986	3.0	0.0	0.0	0.0	1	0
1987	3.4	0.0	0.0	0.0	0	0
1988	3.8	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 \$	\$	\$	\$	\$
1984	0.0	0.0	0.0	0.0	45.1	0.0	0.0	0.0	0.0	45.1
1985	146.3	25.0	171.3	3.4	54.6	0.0	0.0	0.0	0.0	54.6
1986	75.4	62.0	137.4	2.4	76.3	0.0	0.0	0.0	0.0	76.3
1987	34.1	0.0	34.1	0.5	54.0	0.0	0.0	0.0	0.0	54.0
1988	63.6	0.0	63.6	1.1	30.4	5.2	0.0	0.0	0.0	35.6

225. The Agency's programme of technical co-operation in Mauritius, which commenced in 1983, has been small but relevant to the country's development plan. It has focused on two projects, one to assist the national Sugar Industry Research Institute

in determining optimum irrigation and fertilizer regimes for sugarcane that is inter-cropped with maize, potatoes or groundnuts, and the other to introduce the sterile-insect technique as a means of suppressing fruit flies.

226. Sugar is an important export commodity and sugarcane is grown on approximately 85% of the arable land in Mauritius. However, the Government is trying to improve the economy by diversifying agricultural production. Agency assistance is aimed at optimizing irrigation and fertilization of secondary crops in cane interlines without depressing the growth of the sugarcane. To achieve this, studies are being made on the variations in soil-moisture with drip-irrigation systems and on the assimilation of fertilizer nitrogen by sugarcane when drip irrigation is the means by which fertilizer is delivered to the root system. Labelled fertilizers, drip-irrigation equipment, neutron moisture probes and an emission spectrometer, as well as short-term expert services, have been provided by the Agency for these studies. Since the Mauritius Sugar Industry Research Institute organizes regional courses on sugar-cane agronomy for scientists from developing countries in Africa, Asia and the Pacific Islands, the results of local research are being widely disseminated.

227. The commercial value of the various fruits produced by smallholders on the island is greatly depreciated by attacks from several species of fruit fly. The Government is anxious to reduce losses by suppressing or eradicating the flies by means of the sterile-insect technique. With Agency support, an extensive survey has been made of the different ecological zones and fruit-fly habitats on Mauritius. In 1989, the Agency will be training through its fellowship programme the fruit-fly project staff of the Ministry of Agriculture, Fisheries and Natural Resources in the latest mass-rearing techniques as well as in bait-spray technology.

228. Although the main thrust of the Agency's technical co-operation programme over the past six years has been in the agricultural sector, modest assistance was provided to the Victoria Hospital, Quatre Bornes, between 1984 and 1986. As the result of an advisory mission in 1984, a project was drawn up to introduce first radioimmunoassay techniques and then *in vivo* imaging procedures in the Radiotherapy Department of the hospital. The plan to introduce radioimmunoassays was successful despite limited manpower and laboratory space. However, the second phase of the project has been deferred until adequate staff and rooms are available.

229. The governmental authorities in Mauritius are aware of the health hazards of ionizing radiation. A radiation safety act has been drafted and personnel monitoring by means of film dosimeters is being carried out.

## MOROCCO

### 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
	\$	\$	\$	\$		
1984	11.3	0.0	0.0	0.0	3	0
1985	13.0	13.0	0.0	0.0	7	0
1986	15.0	0.0	0.0	3.0	4	0
1987	17.0	0.0	0.0	0.0	3	24
1988	19.0	19.0	0.0	0.0	2	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 \$	\$	\$	\$	\$
1984	58.6	0.0	58.6	1.3	117.4	1.1	32.7	9.5	13.9	174.6
1985	293.2	15.0	308.2	6.1	73.7	4.0	11.8	0.0	3.4	92.9
1986	300.1	0.0	300.1	5.1	274.8	1.3	9.9	0.0	0.0	286.0
1987	325.5	0.0	325.5	5.2	264.1	2.7	20.3	0.0	16.7	303.8
1988	222.7	0.0	222.7	3.8	209.6	0.0	112.7	0.0	5.3	327.6

230. Morocco was among the first countries to engage in technical co-operation with the Agency. The initial emphasis was on manpower development, including setting up an appropriate university course in nuclear physics. The focus was always on *applications* of nuclear techniques, and the topics receiving most attention were agriculture, medicine and the country's mineral resources. A shortage of indigenous energy supplies has caused the Government to set high priority on energy planning, production and conservation. This interest has naturally included studies of the role nuclear power generation could play among the other options.

231. In this regard, the Agency has been collaborating with the National Electricity Office in reviewing feasibility and siting studies being carried out by a foreign contractor in connection with the proposed first nuclear power plant. Furthermore, a comprehensive manpower development programme has been elaborated with Agency assistance for the personnel of the utility in charge of bid specification and tender evaluation for that plant, as well as for the staff of the regulatory body involved with site selection. Additional assistance is being provided in 1989 in connection with project management and the adoption of safety guides.

232. Concomitantly with the above activities, the authorities have, with Agency assistance, elaborated nuclear legislation and established an effective regulatory organization. The Directorate of Energy serves as the regulatory organization, while the Ministry of Public Health is concerned with radiation protection. The draft nuclear legislation is being studied by the Ministries concerned. It is important that it be promulgated as soon as possible so that the regulatory organization can take up its duties.

233. With Agency assistance, a Radiation Protection Service has been established within the Ministry of Public Health, and it is already providing personnel monitoring services to certain users on a voluntary basis. In addition, it has been empowered by decrees to control and to licence imported radioactive sources.

234. The Agency assisted the Physics Department of the University of Rabat to establish an Applied Nuclear Physics Laboratory through a multi-year, large-scale project financed by UNDP. The project made a very substantial contribution to the scientific infrastructure and upgraded the status of academic studies in the nuclear sciences at the University. Agency support is now being provided to the Radiochemistry Laboratory of the same University to introduce isotope hydrology and sedimentology into the University's curriculum and to promote the use of isotopic techniques for developing rational water management schemes. Apart from teaching, the laboratory is already conducting studies on sedimentation rates and erosion processes around dams and on groundwater resources in selected regions of the country, in collaboration with the Water Research Administration. Special emphasis has been placed on

in-service training of the staff at home and abroad. Future activities will focus particularly on determining the feasibility of providing artificial recharge of ground water reservoirs, notably for the southern coastal regions.

235. In connection with the ordering of a research reactor, the Government decided to establish an autonomous National Centre for Nuclear Energy, Science and Technology which was to serve as a focal point for all scientific work in the nuclear sciences. The Agency has provided advisory services relating to the establishment of the Centre and the utilization of the reactor.

236. Applications of radiation and radioisotopes were introduced in Morocco for the first time when the Agency assisted in establishing the Central Radioisotope Station at Tangiers. The Agency provided substantial support through on-the-job training by experts and under the fellowship programme. Studies have included the use of isotopic techniques to improve yields of cereals and legumes and to reduce the use of nitrate fertilizers. Work involving tracer techniques and soil-moisture investigations led to the development of improved cultivation practices giving higher yields of important crop plants. At present, assistance is being provided in connection with studies on biological nitrogen fixation.

237. Isotope-based techniques are also being used by the Hassan II Agronomy and Veterinary Institute for conducting studies on animal reproduction and on disease diagnosis. The Agency provided equipment for a radioimmunoassay laboratory and for strengthening the parasitology department. Work involving the assessment of the reproductive characteristics of indigenous sheep and cattle as well as the determination of the immune responses of ruminants to gastrointestinal nematode infection has been carried out successfully. Present studies involve interpretation and evaluation of data obtained on the reproductive efficiency of indigenous livestock and development of a safe vaccine against *T. annulata* in cattle. Agency support has also contributed substantially towards improving the teaching capabilities of this Institute.

238. In nuclear medicine, Agency support has focused mainly on strengthening the infrastructure of the Radioisotope Service at the Ibn Sina Hospital through the establishment of a radioimmunoassay laboratory for studying haematological disorders and thyroid function pathology, and the development of quality control procedures to ensure a better performance of instrumentation being used in nuclear medicine. Much emphasis has been placed on introducing medical staff to nuclear medicine techniques through the Agency's training programmes. Additional assistance is planned for 1989 to enable the Service to expand its activities to cover *in vivo* investigations and radioimmunoassay of tumoral markers.

239. In uranium prospecting and analysis, substantial Agency support has been provided to the "Bureau de recherches et de participations minières" for the evaluation of the uranium potential of sedimentary basins in Morocco, concentrating on the training of geologists and technicians. A radiometric laboratory for determination of uranium in rock samples was established and this has enabled the Bureau to select areas containing significant uranium potential. Long-term expert services provided by the Agency permitted the Bureau to compile and organize all available data on uranium favourability generated from past exploration. Also in connection with uranium favourability, the Department of Geology of the Ministry of Energy and Mines is also receiving Agency support, in this case in connection with geochemical studies to determine uranium distribution in the country's rich phosphatic formations. Particular emphasis has been placed on the interpretation of results employing modern computer-based data-processing methods.

240. The increase in the amount of equipment in the different national institutions in the country has necessitated setting up a unit within the existing Laboratory for Scientific Instrumentation to provide a maintenance and repair service for nuclear, electronic and related equipment at these institutions. Much emphasis has been placed on the training of trainers. Since its establishment, the unit has succeeded in repairing various items of equipment, notably for the Ibn Sina Hospital and the Agricultural Research Station at Tangiers. Additional advanced equipment for fault diagnosis as well as training is being provided in 1989.

241. It is apparent that Agency assistance to Morocco covers a great number of different sectors important to national development. Concentration on the priorities established in the country's development plan will increase the importance of the Agency's technical co-operation with Morocco, in particular if local scientific manpower can be assured for the projects selected.

## NIGER

### 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
	\$	\$	\$	\$		
1984	2.3	0.0	0.0	0.0	0	1
1985	2.6	0.0	0.0	0.0	0	0
1986	3.0	0.0	0.0	0.0	0	0
1987	3.4	0.0	0.0	0.0	1	0
1988	3.8	0.0	0.0	0.0	0	8

### 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 \$	\$	\$	\$	\$
1984	91.4	0.0	91.4	2.0	152.8	0.0	0.0	0.0	11.0	163.8
1985	185.2	0.0	185.2	3.6	175.3	0.0	0.0	0.0	2.7	178.0
1986	126.1	20.0	146.1	3.2	63.1	0.0	0.0	0.0	5.1	68.2
1987	170.9	80.0	250.9	4.0	112.7	0.0	0.0	0.0	0.0	112.7
1988	206.1	0.0	206.1	3.5	136.9	0.5	0.0	0.0	9.7	147.1

242. During the past five years, the Agency's technical co-operation with Niger has concentrated on evaluation of the country's groundwater resources and on the establishment of a radiation protection inspectorate for the industrial mining and milling of uranium.

243. In connection with the mining and milling of uranium, Agency support to the Directorate of Mines and Geology assisted with the establishment of an inspectorate at Arlit for checking the effectiveness of radiation protection services provided by the foreign contracting companies. Inspectors and technicians were trained and regulations for radiation protection in this industry were elaborated. Related to this, the National Office for Mining Resources received assistance for the establishment of a maintenance and repair laboratory specifically to maintain equipment provided to the inspectorate; it is, however, also offering a service for instruments belonging to other



bodies. Of special significance was the national training course on maintenance and repair of instruments organized by the Agency in 1987 that was attended by national staff from a number of different institutions.

244. In agriculture, radioisotope techniques have been introduced to support research being carried out jointly by the Niger National Institute for Agricultural Research and the University of Niamey with the aims of identifying high-yield cowpea varieties with high nitrogen-fixing capacity, and improved crop cultivation practices, especially those that can be applied in the rural environment. Additional support in the form of training, provision of nitrogen-15 and expert guidance is being provided under the regional project on biological fixing of nitrogen.

245. Substantial support from the Agency has been provided to the Directorate of Water Resources and the Department of Geology, University of Niamey, with a view to introducing isotope techniques in hydrology to supplement the other methods of investigation currently being used by the two institutions. Emphasis has been put on evaluation of the country's groundwater resources through a better understanding of aquifer characteristics and mode of recharge and through determination of national groundwater exploitation practices. The results will be used to plan the development of future human settlements in these arid regions of the country. The salient feature of this project, apart from manpower development, has been the setting up of a radiocarbon laboratory for groundwater dating. This facility is not only being used in support of activities in Niger, but for similar studies in the other Sahelian countries. Both institutions have also benefited from support provided under the regional project in hydrology. In this regard, a workshop on isotope hydrology organized in Niamey in 1988 was attended by twelve participants from Niger as well as by participants from the other Sahelian countries.

246. In the animal sciences, Agency support is being provided to the Higher School of Agriculture, University of Niamey, to investigate methods of improving the reproductive efficiency of indigenous breeds of sheep and for training graduate-level staff in the application of nuclear techniques. The results obtained from these experiments are regularly published and distributed as part of the University's research activities.

247. The Agency has also assisted the University of Niamey in setting up a nuclear analytical laboratory within the existing Radioisotope Institute. It is currently being used for training post-graduate students completing their master and third-cycle degrees and for providing analytical services to various local users such as the mining industry, the agriculture and food sectors, and bodies concerned with the environment. Training of a core of researchers and technicians through Agency training programmes at home and abroad has been the dominant feature of this support.

248. While the nuclear energy programme assisted by the Agency is closely linked to the development plans of the country, some constraints remain to be addressed, mainly the shortage of manpower available and the lack of legislation on radiation protection that covers all fields in which ionizing radiation is used.

## NIGERIA

### 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
	\$	\$	\$	\$		
1984	42.8	42.8	0.0	0.0	0	3
1985	49.4	49.4	0.0	0.0	1	4
1986	57.0	57.0	0.0	0.8	2	2
1987	64.6	64.6	0.0	0.0	5	0
1988	72.2	72.2	0.0	0.0	5	15

### 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 \$	\$	\$	\$	\$
1984	39.6	0.0	39.6	0.9	177.2	0.0	537.7	0.0	1.5	716.4
1985	71.8	0.0	71.8	1.4	74.9	0.0	360.6	0.8	5.4	441.7
1986	184.1	5.0	189.1	2.5	232.1	0.0	304.0	0.0	15.9	552.0
1987	208.9	60.0	268.9	4.3	268.8	10.2	141.7	0.0	47.8	468.5
1988	302.9	0.0	302.9	5.1	244.6	35.6	91.5	0.0	50.3	422.0

249. Nigeria became a Member State in 1964 and technical co-operation with the Agency commenced in the latter part of the 1960s. The original projects were based on assistance to individual institutes, but in recent years the Federal Government has become more involved, itself taking the lead in matters relating to radiation protection, and to services to third parties involving nuclear techniques. It is also playing a more co-ordinating role with regard to individual projects.

250. There are at present three centrally organized projects – in Ibadan, Ife and Zaria. In Ibadan, the Federal Radiation Protection Service has responsibility for radiation protection nation-wide. Within the framework of a multi-year project initiated in 1982, the Agency is providing assistance to the Service through the provision of essential equipment for radiation monitoring, calibration and dosimetry data processing, together with expert services and training of staff. However, the Service operates without the authority of national legislation and is at present short of staff and funds, as yet unable to perform its functions in full. At present, a “regional” radiation protection service to serve Zaria is being built up as an adjunct to the Federal Service based at Ibadan.

251. Recently, the Government established two energy research centres, one at Ife and one in Zaria, to serve as centres specializing in nuclear science. Following the recommendations of a preparatory mission in 1987, the Agency provided the Centre for Energy Research and Development at Ife with equipment and experts to enable the Centre to offer analytical services to various sectors, for example agriculture and mining. In the northern part of the country, the Centre for Energy Research and Training, Zaria, received assistance under a multi-year project for the repair and re-installation of an existing neutron generator. Additional analytical techniques were introduced, and experts gave guidance on sample preparation and data interpretation.

252. With regard to the use of nuclear techniques to improve agriculture and animal husbandry, some of the earliest projects included studies of nutrient cycling in grassland ecosystems with a view to increasing yields, and, under a UNDP-financed project, studies of animal nutrition, including feedstuffs and animal parasites. In addition, there was a most successful nine-year project that served to eradicate the tsetse fly *Glossina palpalis palpalis* in a 1500 square kilometre agricultural zone of north-central Nigeria. Extrabudgetary donations were provided by Belgium, the Federal Republic of Germany, Italy, Sweden and the United Kingdom, which enabled the Agency to provide expert services and training, as well as the equipment needed for laboratory and field work, this including a cobalt-60 irradiation source for sterilizing the tsetse flies. This activity was also supported by a co-ordinated series of Agency research contracts. There has been a very marked decrease in trypanosomiasis in cattle as a result, and a positive impact on public health. In 1988, at the end of the first phase of the project, the Agency supported a regional training course at the project headquarters in Vom which attracted twenty participants from twelve African countries. A continuation project developed methods to restrict re-invasion, and another, awaiting funding, seeks to eliminate a second species, *Glossina technoides*, from the project area.

253. The use of radioisotopes for improving crop production has been supported by the Agency through provision of labelled fertilizers and equipment. In 1986, the Institute of Agricultural Research and Training, University of Ife, initiated studies using nitrogen-15 to elicit the various mechanisms of biological fixation of nitrogen to determine farming practices that would increase the production of cowpea, soybean and other legumes. A related project initiated in 1987 at the Anambra State University of Technology, Enugu, seeks to determine the most efficient method of utilizing atmospheric nitrogen, with a focus on mixed-cropping practices involving rice, soybean and cowpea. The prime objective of both projects is to reduce imports of nitrogen fertilizers.

254. The Department of Agronomy of the University of Ibadan has been undertaking studies using neutron probes to determine the effect of soil type and irrigation on the productivity and yield of the oil palm, a project for which the Agency supplied soil-moisture measuring equipment: in Umudike, work is being undertaken at the National Root Crops Research Institute on mutation breeding and *in vitro* culture to improve root crops and tubers.

255. The National Animal Production Research Institute of Ahmadu Bello University is involved in a four-year inter-disciplinary research programme aimed at improving livestock production and health. RIA techniques are being used to investigate major livestock diseases such as trypanosomiasis, as well as the effects of disease, and nutritional and reproductive factors on the productivity of indigenous breeds of cattle, sheep and goats. RIA test kits are being provided by the Agency, and this project too is accompanied by an Agency research contract programme. In addition to the fellowship training provided, two Nigerians participated in a Agency-organized regional training course on rinderpest diagnosis.

256. As a result of the hot humid climate, coupled with the action of pests and the difficulties of storage, post-harvest losses of staple food products in Nigeria are high. Furthermore, sprouting and decay of yam and onions limit the period over which these products are marketable. In 1986, an Agency team visited Nigeria and recommended that steps be taken to determine the feasibility of setting up a pilot-scale food irradiation facility so that the Government could determine if there was a commercial

future for such treatment. In 1988, a study was initiated at the University of Ife to elaborate a plan of work, seek a suitable site for the facility and select commodities that should be studied.

257. The Agency's assistance to Nigeria in nuclear medicine began in 1973, and at present there are two projects receiving Agency support. The University of Ibadan's College of Medicine is strengthening its capability for working with radionuclides, including improvement of facilities for *in vitro* and *in vivo* studies, and the initiation of radiopharmaceutical production. Fellowship training is being provided for physicians and technical staff. Another project is concerned with improving the radiotherapy services at the Lagos University Teaching Hospital, where the three radiotherapists are faced with treating several hundred patients from Nigeria and neighbouring countries using two old therapy machines. It is envisaged that an additional therapy machine will be provided by the Agency, together with a computerized facility for treatment planning.

258. A large-scale manpower development project running since 1977 has been supporting the teaching and training facilities of the Department of Physics at the University of Ife, receiving funding from the United States of America as well as from the Agency's Technical Assistance and Co-operation Fund.

259. Nigeria is building up a sufficient body of well-qualified staff capable of developing and implementing an effective nuclear science programme; where additional specialized training is needed, this can be provided through one of the Agency's training programmes. At present, the on-going projects are still treated somewhat in isolation, and this may be resulting in unnecessary duplication of effort. To strengthen the Federal Government's co-ordinating role, there is, perhaps, a need for a national co-ordinating authority to link these projects and to promote collaboration between institutes to ensure that the impact of Agency assistance on the development of the country as a whole is optimal. In view of the growing use being made of nuclear techniques in medicine and research, it will be important to promulgate radiation protection legislation as soon as possible and to provide the National Radiation Protection Service with additional staff and funds to assure the safe use of radiation and radioisotopes.

## SENEGAL

### 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
	\$	\$	\$	\$		
1984	2.3	0.0	0.0	0.0	0	1
1985	2.6	0.0	0.0	0.0	0	1
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	3.8	0.0	0.8	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 \$	\$	\$	\$	\$
1984	195.6	60.0	255.6	5.7	159.6	5.1	17.7	51.6	16.3	250.3
1985	155.2	0.0	155.2	3.0	95.8	50.9	3.2	4.4	0.0	154.3
1986	78.3	0.0	78.3	1.3	126.2	0.0	0.0	22.9	0.0	149.1
1987	149.3	50.0	199.3	3.2	90.7	1.3	0.0	0.0	0.0	92.0
1988	116.9	0.0	116.9	2.0	133.4	31.4	0.0	0.0	6.8	171.6

260. Use of nuclear techniques in Senegal has been mainly confined to agriculture and medicine. Agency assistance provided for agricultural programmes has contributed a great deal to the development of this sector. Assistance in medicine has supported public health programmes by making available facilities for the use of radioisotopes in clinical medicine. While Agency assistance has been in keeping with the country's needs, its extent has been restricted by limitations in facilities, resources and trained staff. The need to establish a radiation protection infrastructure and related legislation is paramount.

261. Agricultural research is performed mainly at the Senegalese Agricultural Research Institute in Bambey and at its experimental stations located in the various ecological regions of the country. The programmes at the institute involving use of nuclear techniques are soil/plant studies, particularly in the dry zone for improving rain-fed rice crops, and phosphorus and nitrogen uptake studies in respect of cereal crops. The Agency has provided assistance to these programmes for many years, and the Institute has been able to establish a well-equipped isotope laboratory. The services of a number of experts specializing in soil fertilization and soil physics were provided, while radioactive and stable isotopes were supplied for laboratory, greenhouse and field investigations. The Agency also awarded a number of fellowships to senior scientists requiring training in the use of nuclear techniques in agricultural research. The Institute is also being supported by the Agency in conducting studies aimed at improving the reproductive efficiency and health of native and imported livestock. This involves analysis of the reproductive characteristics of bovine females. To achieve these objectives, a laboratory for the analysis of progesterone using RIA was established and further assistance is being provided to strengthen the existing laboratory facilities for disease diagnostics. The RIA kits are being provided by the Agency.

262. In hydrology, the Agency has been assisting, since 1984, the Department of Geology of the University of Dakar in carrying out hydrological studies with the aim of evaluating the groundwater resources in the Casamance and Ferlo regions. These constitute the main groundwater reserves of the country and are particularly suited to agricultural development. Studies to elucidate the mechanisms that govern groundwater-recharge and the origins of the aquifer water are about to be completed and the information gathered will be provided to the Ministry of Water Resources to enable them to develop a national water management programme. Much emphasis has been placed on training of research staff and technicians under the Agency training programmes, including the regional project on hydrology for the Sahelian countries.

263. Medical applications of radioisotopes are primarily centred on the "Hôpital A. le Dantec". Investigations undertaken at the hospital include thyroid uptake measurements and thyroid scanning. Under an on-going project, the Agency is providing

assistance jointly to the Hospital and the Faculty of Medicine, comprising provision of a scanner and an automatic counting system, together with the services of an expert in nuclear medicine to introduce staff to the new techniques. Through this assistance, scintigraphic procedures, which already constitute the major part of the work at the hospital, are to be further expanded.

264. The Institute for Applied Nuclear Technology of the University of Dakar provides facilities for research and training in the nuclear sciences and to provide centralized services in radiation protection and in repair and maintenance of equipment. It is also expected to promote, by its activities and its services to other Government institutions, the expansion of the nuclear energy programme in the country. The Agency, through a project financed by UNDP, has assisted with the establishment of laboratories for radiation protection, radiochemistry and electronics relating to the repair and maintenance of equipment.

265. In December 1988, an Agency RAPAT mission visited Senegal to assess the existing status of radiation protection activities; it identified needs and made recommendations to the Government. It was noted that no relevant legislation existed, and that there was no organized radiation protection service at the national level. The RAPAT mission recommended the promulgation of radiation protection legislation as a top priority together with establishment of a means for implementation.

## **SIERRA LEONE**

### **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
	\$	\$	\$	\$		
1984	2.3	0.0	0.0	0.0	0	0
1985	2.6	0.0	0.0	0.0	0	0
1986	3.0	0.0	0.0	7.3	1	0
1987	3.4	0.0	0.0	0.0	0	0
1988	3.8	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 \$	\$	\$	\$	\$
1984	87.6	0.0	87.6	2.0	80.1	0.5	0.0	0.0	0.0	80.6
1985	35.7	0.0	35.7	0.7	66.8	0.0	0.0	0.0	10.6	77.4
1986	47.6	0.0	47.6	0.8	26.0	0.0	0.0	0.0	0.0	26.0
1987	21.2	0.0	21.2	0.3	38.2	0.0	0.0	0.0	16.1	54.3
1988	29.4	0.0	29.4	0.5	47.0	0.0	0.0	0.0	0.0	47.0

266. During the past seven years, Agency technical co-operation in Sierra Leone has focused on two main activities: establishment and maintenance of a nuclear science laboratory, and development of nuclear techniques for application in medicine.

267. The project establishing a nuclear science laboratory was initiated in 1974 and was located in the Physics Department of Fourah Bay College, University of Sierra Leone. The long-term objective was to develop and apply nuclear analytical techniques in support of investigations undertaken by various institutions and government departments in Sierra Leone, as well as to provide opportunities for research and the training of university students. These objectives have largely been met. For example, since the early 1980s, the curriculum of the science faculty has included introductory studies into the uses of radiation and isotopes. Staff members and post-graduate students of science departments other than physics are encouraged to use radioisotope techniques in their research wherever indicated.

268. The Radioisotope Unit of Connaught Hospital, Freetown, Sierra Leone, established with Agency assistance, has recently been upgraded to become a nuclear medicine unit, with provision of a medical laboratory capable of undertaking diagnostic services for patients from all over the country. Among the techniques introduced is the use of RIA for thyroid uptake examinations. Eventually, the RIA laboratory is expected to undertake local production of RIA kits using imported bulk reagents. Close co-operation exists between the nuclear science laboratory in Fourah Bay College and the Radioisotope Unit of the Connaught Hospital. The Nuclear Science Laboratory undertakes quality control tests and oversees radiation safety and waste disposal, as well as the training of students who might eventually become involved in radioisotope work at the hospital.

269. While appreciable progress has been made in the above-mentioned fields, absence of radiation protection legislation and shortage of local resources to support projects will militate against any major expansion of the atomic energy programme for the time being.

## **SUDAN**

### **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
	\$	\$	\$	\$		
1984	2.3	0.0	0.0	0.0	1	15
1985	2.6	0.0	0.0	0.0	4	0
1986	3.0	0.0	0.0	0.0	0	0
1987	3.4	3.4	0.0	0.0	2	0
1988	3.8	3.8	0.0	0.0	1	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 \$	\$	\$	\$	\$
1984	203.0	0.0	203.0	4.5	290.1	0.0	7.1	0.0	67.3	364.5
1985	297.7	32.0	329.7	6.5	333.9	0.7	157.2	0.0	49.6	541.4
1986	291.4	5.0	296.4	5.1	484.9	0.1	38.5	0.0	67.9	589.4
1987	277.4	0.0	277.4	4.4	522.8	21.5	18.6	0.0	43.4	606.3
1988	273.1	0.0	273.1	4.6	186.3	0.0	9.8	0.0	48.6	244.7

270. Sudan is one of the few countries in Africa that established an autonomous Atomic Energy Commission. The Commission requests assistance on behalf of other institutions in the country and is responsible for co-ordinating all programmes involving the use of atomic energy. In 1984, a Radiation Protection Service was established under the Ministry of Health, and Agency assistance provided equipment for personnel monitoring and area surveillance in addition to expert services and fellowship training. Subsequently, in 1987, a RAPAT mission visited Sudan and, on the basis of recommendations made, the Government promulgated radiation protection legislation. Agency assistance is currently being provided to various technical ministries and to the University of Khartoum, and covers the medical, agricultural, hydrological and geological sectors as well as nuclear analytical techniques.

271. An early start was made in the field of medicine when the Radiation and Isotope Centre of the Ministry of Health was established in 1967 to provide facilities for radiotherapy and nuclear medicine. The Centre has benefited from Agency assistance under many projects. Equipment, including scanners and a gamma camera, were provided together with extensive training for nuclear medicine specialists, physicists and technicians. Support was also provided to establish a SSDL at the Centre.

272. Agriculture-related activities have included studies of livestock productivity and disease diagnosis, the distribution and fate of pesticides and, more recently, mutation breeding. With the establishment of a radioisotope laboratory at Soba by the Veterinary Research Administration, much of the activities in the animal sciences were being undertaken at the new laboratory. Emphasis was on the production of radiation-attenuated vaccines against parasites and the use of RIA techniques for early detection of pregnancy, reproductive diseases and infectious diseases. Recently, activities at the Veterinary Faculty of the University of Khartoum have been revitalized: applications of diagnostic techniques, including enzyme-linked immunosorbent assay, are being developed. At present, the various animal science activities are proceeding satisfactorily at both the University and the national laboratory at Soba.

273. The heavy use of pesticides on vegetables and cotton crops necessitated a study of the distribution and fate of pesticides in the environment. Located at the Wad Medani Research Station, this project has benefited from the provision of expert services and the supply of equipment and labelled chemicals for investigations. In 1986, a mutation breeding project was initiated with the aim of developing disease resistant varieties of sugarcane. In line with the recommendations of a mission in 1988, activities will be expanded to include cotton and selected vegetable crops in 1989.

274. Applications of nuclear techniques in exploration for minerals and studies of water resources initiated at the University of Khartoum resulted in the development of a curriculum and training programme in uranium geology and exploration methods.



Scientific and technical staff from the University and the national Geological Survey Department have been trained in the techniques of preparing rock samples for geochemical analysis. A project on the use of isotopes in hydrology was initiated for studying the dynamic behaviour of groundwater systems, including recharge. Such studies are essential for developing the appropriate use of groundwater resources in Sudan.

275. A large-scale, multi-year project initiated in 1980 has established a nuclear science laboratory in the Physics Department of Khartoum University. Modern equipment has been provided, including Moessbauer spectrometry and X-ray fluorescence analytical systems, and a neutron generator. Fellowship training for local staff and expert services have enabled the laboratory to fulfil the objective of serving as a national centre for various types of advanced analysis, and as a training centre for university students and others in the use of nuclear techniques in different disciplines.

276. In order to provide a national facility for the repair and maintenance of nuclear electronic and related equipment, and to provide for the construction of certain simple instruments to suit local needs, the Agency assisted the Atomic Energy Commission to establish a nuclear electronics workshop. Demonstration and test equipment as well as electronic kits were supplied, and an expert provided training on the principles of preventive maintenance and advice on the further development of the project.

277. The Atomic Energy Commission is strengthening its links with the various technical ministries of the Government to encourage use of nuclear techniques in support of their sectoral programmes. It was noted above that the country now has a legal basis to enforce radiation protection and safety regulations; however, the Radiation Protection Service at the Ministry of Health will need to be strengthened and provided with additional staff and more operational funds to cover the radiation protection needs of the country.

## TUNISIA

### 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
	\$	\$	\$	\$		
1984	6.8	0.0	0.0	0.0	1	0
1985	7.8	0.0	0.0	0.0	3	0
1986	9.0	0.0	0.0	1.6	1	0
1987	10.2	0.0	0.0	0.0	1	0
1988	11.4	0.0	0.0	0.0	4	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 \$	\$	\$	\$	\$
1984	86.6	0.0	86.6	1.5	110.8	0.0	22.9	0.0	3.2	136.7
1985	159.1	0.0	159.1	3.1	133.5	0.0	9.3	0.0	21.6	164.4
1986	182.8	0.0	182.8	3.1	115.5	0.0	17.6	0.0	19.5	152.6
1987	186.3	10.0	196.3	3.1	142.3	0.0	6.3	0.0	8.5	157.1
1988	409.0	0.0	409.0	6.9	114.7	0.0	0.0	0.0	0.0	114.7

278. Tunisia became a Member State of the Agency in 1957 and has been involved in the technical assistance programme since the early 1960s. While initial priorities were in nuclear power planning, radiation protection and nuclear medicine, other sectors where Agency assistance could be of benefit to national development, including agriculture, animal husbandry, industrial applications, hydrology and the eradication of certain species of fruit fly, were subsequently identified. This has resulted in a significant increase in the amount of assistance provided to Tunisia over the years. The Agency-assisted projects in Tunisia, undertaken individually under the jurisdiction of the appropriate ministries, are all firmly rooted in the economic development plan of the country.

279. In connection with studies being carried out by the Ministry of Energy and Mines and the national Gas and Electricity Company to assess the feasibility of a long-term nuclear power programme, the Agency has provided advisory services and computer-based energy-planning codes, such as WASP and MAED, for programme planning. At the same time, assessments of possible sites for a nuclear power plant have been carried out to provide information for decision making. Three possible sites have been identified and the Agency is supporting more detailed studies. In addition, the Agency is also providing advisory services for the elaboration of nuclear legislation and regulations. A draft decree established a national atomic energy commission, and related safety and radiation protection regulations have been prepared. With Agency assistance, a National Centre for Radiation Protection was established to provide radiation protection services in the country, to perform inspections of installations making use of ionizing radiation, and to support training and research in radiological protection. The Centre is now providing personnel dosimetry services to more than 6000 radiation workers and undertaking inspections. Additional assistance planned for 1989-90 is to focus on establishing calibration facilities to assure reliable radiation measurement.

280. The "Services des radioisotopes" of the Salah Azaiz Cancer Institute constitutes the only nuclear medicine service in the country and receives patients on referral from other medical institutions. A multi-year Agency project aims to improve the Institute's facilities for the processing of data derived from the gamma camera system and to introduce radioimmunoassay and related procedures. Though dynamic studies can now be undertaken using the old gamma camera, to cope with the ever increasing number of investigations performed daily, a new gamma camera is being provided. As part of the project, seven medical doctors and three technicians have received specialist training.

281. Research in agriculture using isotope studies has been carried out at different institutions and has covered work on various topics, for example soil/water/plant relationships at the National Agricultural Research Institute, soil-moisture studies at the

Rural Engineering Research Centre, and biological fixation of nitrogen at the National Institute of Forestry Research. The dominant feature of these projects has been, apart from manpower training, the development of improved cultivation methods suited to arid and semi-arid conditions. Additional studies on nitrogen fixation by trees are still under way and are expected to lead to the selection of trees that will help to improve the fertility of poor and marginal soils; this could contribute significantly to the success of the country's reforestation programme. Tunisia is also a beneficiary of a regional project additionally involving Algeria and Morocco which provides experts to conduct surveys of Mediterranean fruit-fly infestation, to determine the economic loss caused by this insect pest and to assess the benefits that could be realized if it were to be eradicated.

282. In animal production, Agency support is being provided to the National Institute for Agronomic Research to develop methods for increasing sheep production. A radioimmunoassay laboratory has been established; the assay kits for progesterone measurement are prepared and supplied by the Agency.

283. Since 1985, the Agency has been assisting the Directorate of Water Resources in applying radiotracer techniques together with non-nuclear methods to evaluate the surface water resources in various regions of the country. The results obtained will be used as criteria for the design and construction of hydraulic installations. The Directorate has also benefited from assistance provided under the regional hydrology project.

284. With substantial support from the Agency, a non-destructive testing laboratory was established at Gabes to provide quality control services to the petrochemical industry, oil refineries, operators of oil and gas pipelines and other users. Applications of gamma and X-ray radiography and other non-destructive testing services to make control measurements in the field on pipelines have now become routine operations for the staff. The laboratory is currently used as a centre for training inspectors and technicians.

## UGANDA

### 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
	\$	\$	\$	\$		
1984	2.3	0.0	0.0	0.0	0	0
1985	2.6	0.0	0.0	0.0	0	0
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

## 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 \$	\$	\$	\$	\$
1984	11.6	20.0	31.6	0.7	35.9	0.0	0.0	0.0	0.0	35.9
1985	29.8	30.0	59.8	1.2	70.2	3.1	0.0	0.0	0.0	73.3
1986	23.8	0.0	23.8	0.4	41.2	8.7	0.0	0.0	0.0	49.9
1987	81.2	0.0	81.2	1.3	155.1	17.4	0.0	0.0	12.7	185.2
1988	179.8	20.0	199.8	3.4	114.7	0.0	0.0	0.0	0.0	114.7

285. Uganda initiated a nuclear energy programme in 1960 in collaboration with the Agency. The national co-ordinating role was undertaken by the Radioisotope Committee in the Physics Department at Makerere University. However, unstable local conditions caused a deterioration in the existing infrastructure and many trained personnel were lost to the programme. Since 1986, efforts have been made to rehabilitate the infrastructure, and it has been possible to revitalize Agency assistance to priority projects.

286. The joint medical Radioisotope Unit of Mulago Hospital and the Medical School carries out useful work in thyroid uptake studies and scans. Currently the Agency is assisting the Unit to replace some old equipment so that work can be continued, and experts are providing training and advice to improve the quality of current activities.

287. On-going assistance has been provided to an animal science programme being jointly undertaken by the Veterinary Faculty of Makerere University and the Entebbe Livestock Experimental Station. A radioimmunoassay laboratory has been established and work has focused on collecting milk samples and examining cattle. A project on plant breeding at the Eastern Agricultural Station, Soroti, has been plagued with considerable logistic and other difficulties. Nevertheless, excellent results have been achieved, notably, in the development of mite-resistant strains of cassava through mutation breeding. Largely as a result of Agency fellowship training of key personnel within the Tsetse Control Department, the Uganda Tsetse Research Organization in Tororo and the Entomology Division of Makerere University, the Government has initiated an integrated tsetse control programme with the ultimate objective of using conventional tsetse population suppression techniques together with releases of sterile insects to eradicate tsetse flies in critical areas of the country.

288. Assistance is being provided in radiation protection through a project implemented at the Physics Department of Makerere University. Equipment has been provided and two counterparts were trained at the regional training course on radiation protection which was held in Nairobi. At this stage, the project merely has a training function and upgrades the local knowledge of radiation protection requirements. It is hoped that the Government will be able to establish a proper radiation protection infrastructure, including the necessary legislation, in due course, with adequate staffing to render it effective.

289. Nuclear techniques could be usefully employed to tackle other problems of importance to the country. An expansion in the overall programme would benefit from the establishment of a central co-ordinating authority, able to allocate priorities in accordance with the national development plan, and would have to be accompanied by a strengthening of radiation protection activities.

## UNITED REPUBLIC OF TANZANIA

### 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
	\$	\$	\$	\$		
1984	2.3	2.3	0.0	0.0	0	12
1985	2.8	2.8	0.0	0.0	0	0
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	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 \$	\$	\$	\$	\$
1984	353.2	70.0	423.2	9.5	227.0	6.4	0.0	0.0	13.2	246.6
1985	284.5	0.0	284.5	5.6	307.3	52.2	0.0	0.0	0.0	359.5
1986	178.7	0.0	178.7	3.1	515.9	0.0	0.0	0.0	0.0	515.9
1987	188.6	0.0	188.6	3.0	238.6	0.0	47.1	0.0	17.6	303.3
1988	229.1	0.0	229.1	3.9	195.5	0.0	4.9	0.0	15.6	216.0

290. The United Republic of Tanzania became a Member State in 1976, and its technical co-operation with the Agency commenced in 1977 with two projects, one in the field of agriculture and one to support teaching and research in nuclear physics. Both projects were with the University of Dar-es-Salaam. Manpower development in the nuclear sciences has continued to be mainly concentrated at the University, and there has been regular collaboration with the Agency since that time. The Physics Department has been able to establish very good facilities for graduate and post-graduate teaching as well as for research in nuclear science. Two analytical techniques were introduced, X-ray fluorescence and Moessbauer spectroscopy, and training in these techniques abroad has been supported by the Agency's fellowship programme. Trace elements are determined in biological and biomedical materials and in samples collected as part of an effort to study environmental pollution. Measurements have also been made on iron ores and corrosion products to demonstrate the potential of Moessbauer spectroscopy in industrial applications. The Physics Department of the University now aims to consolidate its existing nuclear capabilities and programme before seeking to introduce additional techniques.

291. With the gradual increase in applications of nuclear techniques at the beginning of the 1980s, a National Radiation Commission was formed in 1984 as the governmental body responsible for implementing the Radiation Protection Act that came into force in 1983. Remarkable progress has been made by the Commission since then in establishing a national radiation protection service. Codes of practice and licensing regulations have been drafted on the lines recommended in the Agency's Basic Safety Standards. Four professionals and six technicians have been trained as radiation officers. A thermoluminescence dosimetry system has been installed at the Commission for monitoring some 450 radiation workers and a gamma spectrometer has been

provided to check radionuclide contamination of foods and the environment. Assistance in setting up a calibration laboratory is foreseen in a project approved for 1989 and 1990.

292. In support of the work of the Commission, the staff, including the radiation protection officers, are anxious to acquire the necessary know-how for maintaining and repairing the electronic equipment that they use. With assistance under the same project, the Commission will be helped to set up a central workshop for servicing and repairing nuclear instrumentation. Technicians and adequate facilities are available for this undertaking in the new and spacious quarters of the Commission at the Arusha International Conference Centre.

293. Agricultural projects in the past six years have covered studies on the fates of pesticides and herbicides at the Tropical Pesticide Research Institute. A radioisotope laboratory was set up at the Institute to initiate a research programme on acaricide residues in meat and milk, on the fate of pesticides used against the tsetse fly and on screening for effective herbicides.

294. Following a visit in 1985 by a group of FAO/IAEA consultants, the Sokoine University of Agriculture is being supported in making investigations of the reproductive performance of livestock. Studies being introduced include, inter alia, the use of enzyme-linked immunoassay (ELISA) techniques to screen for salmonella. The impact of this project will be evaluated in 1990. That year will also see the initiation of a project at the Animal Diseases Research Institute to introduce DNA probes and ELISA techniques in the immunodiagnosis of animal diseases such as trypanosomiasis, brucellosis, African swine fever, rinderpest and foot-and-mouth disease.

295. A project to eradicate the tsetse fly by means of the sterile-insect technique was initiated in 1984. The facilities for mass-rearing certain fly species at the Tsetse and Trypanosomiasis Research Institute in Tanga are now fully operational and adequately staffed to meet the requirements of prospective pilot releases on the island of Zanzibar. Field work on Zanzibar in preparation for releases of sterile flies was carried out in 1988. A common strategy for the future of the project is to be defined by the Tanzania Livestock Research Organization and the Zanzibar Department of Livestock Development.

296. In medicine, the Amani Medical Research Centre was assisted in setting up a specially sensitive RIA technique to detect malaria sporozoites in mosquitoes. The assay tool that was introduced should be useful in providing additional information on the epidemiology of malaria in the Amani region. The Agency also assisted the Tanzania Tumour Centre to set up a cobalt-60 radiotherapy machine donated by Harvard Medical School, United States of America. Currently, assistance is directed to the Muhimbili Medical Centre, the country's main referral centre for clinical problems, where a radioimmunoassay laboratory is being established to provide a regular diagnostic service for determining levels of thyroid-related hormones. As this is the first RIA laboratory to be established in the United Republic of Tanzania, it is expected that its work will have a marked impact on the diagnosis of hormone-function disorders. Considerable on-the-job training was given as part of this project also, and a technician is being trained at the Agency's Seibersdorf Laboratory to maintain instrumentation.

297. With the steady increase in volume of technical assistance provided to Tanzania over the past six years, there is a growing need for the National Radiation Commission to strengthen its co-ordinating function.

## ZAIRE

### 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
	\$	\$	\$	\$		
1984	2.3	0.0	0.0	0.0	1	0
1985	2.6	0.0	0.0	0.0	0	0
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

### 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 \$	\$	\$	\$	\$
1984	111.8	30.0	141.8	3.2	169.8	22.8	0.0	26.1	16.7	235.5
1985	154.5	0.0	154.5	3.0	161.2	8.0	40.2	1.2	0.0	208.6
1986	163.5	0.0	163.5	2.8	140.9	3.5	45.8	0.0	0.0	190.2
1987	327.1	85.0	392.1	6.3	131.6	5.2	16.5	1.6	66.4	221.3
1988	226.4	0.0	226.4	3.8	376.4	38.6	0.0	0.0	11.3	426.3

298. Zaire operates a nuclear research centre (the Regional Centre for Nuclear Studies) in Kinshasa under an autonomous Nuclear Energy Commission. The Centre has a Triga Mark II research reactor as its principal facility. The Agency co-operates almost exclusively with the Centre. Recently there has been particular emphasis on promoting greater operational safety of the reactor and related facilities and upgrading its instrumentation. The research laboratories associated with the reactor have also been assisted with the aim of strengthening on-going activities and introducing additional nuclear techniques.

299. Under Agency assistance, an emergency plan was elaborated; emergency equipment was provided together with intensive training of operators and technicians. Operational reliability and radiological safety of the reactor have been improved through replacement of some old monitoring and control equipment. Additionally, an underwater optical inspection of the reactor was conducted by Agency experts which revealed corrosion problems in the bottom of the reactor tank; the authorities are addressing these problems. Further assistance is planned to upgrade the experimental capacity of the reactor once it becomes operational again.

300. The Central Analytical Laboratory has received Agency assistance to develop activation analysis to be used in support of environmental studies and on samples deriving from mining. At the same time, a data-base is being set up that will store information deriving from surveys of radioactive mineral deposits, and this will enable the laboratory to prepare related geological maps.

301. The Nuclear Chemistry and Physics Department of the Centre has received equipment and training to enable it to produce locally kits used for radioimmunoassay in support of biological, medical and clinical studies. Through the stimulus provided by this support, the Department has been able to prepare reagents for routine radioimmunoassay applications using iodine-125 and technetium-99m. The most

common radiopharmaceuticals used in thyroid uptake studies are being prepared by the Department for use in diagnostic applications. Much emphasis is now being placed on work involving the development of quality control practices. During 1988, however, local preparation of technetium-99m generators was interrupted by the need to shut down the research reactor for maintenance.

302. The Radioagronomy Department at the Centre uses isotopes to determine the water requirements of certain crops such as maize, rice and soybean, and to study biological fixation of nitrogen. The Department also has programmes on plant breeding by induced mutation and on the use of radiation for grain disinfestation and food preservation. All these programmes have received Agency assistance during the past five years. The experiments to improve crop production and the efficiency of fertilizer practices have led to the development of improved cultivation methods, while nitrogen fixation studies to increase the yields of legumes are under way. The search for improved varieties of rice, grain and legumes through mutation breeding and *in vitro* culture is being carried out in collaboration with the Institute for Agricultural Research to obtain higher yields and better resistance to pests and diseases. The food preservation methods that have been developed to extend the shelf-life of vegetables use a combined treatment comprising solar dehydration and irradiation.

303. Agency support has also promoted safety in the use of ionizing radiation sources and protection of the environment through the establishment of a Radiation Protection Department at the Centre. It is charged with monitoring occupationally exposed workers under both normal and emergency situations as well as with monitoring environmental radiation. Assistance has also been provided for the elaboration of legislation on radiation protection; a draft has been prepared and it is being reviewed by the Commission.

304. Agency support for hydrology has enabled the Centre to expand its studies on flow rates and sediment dynamics in waterways in and around the city of Kinshasa with the objective of developing effective flood and erosion control measures. The deposition of sediments behind the Inga dam is also being monitored.

305. The considerable amount of nuclear instrumentation available at the Centre has necessitated the establishment of a maintenance and repair laboratory. A core of technicians is being formed, and a management strategy for servicing is being designated.

306. Through extrabudgetary funds made available by the United States of America, assistance was provided to the University of Kinshasa to develop methods for the production of liquid fuel from Zairian coal. Nuclear analytical techniques are being applied to optimize the processes by which the sulphur content is reduced. The results of these investigations will be passed on to the mining sector with a view to practical application.

307. The Regional Centre for Nuclear Studies has been providing valuable support to the scientific infrastructure of the country, and Agency assistance has materially improved the capacity of the Centre to provide services based on nuclear techniques. It is to be hoped that some of the constraints, such as lack of funds for further development and for regular operation, will be overcome in due course.



## ZAMBIA

### 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
	\$	\$	\$	\$		
1984	2.3	2.3	0.0	0.0	1	0
1985	2.6	2.6	0.0	0.0	0	0
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	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 \$	\$	\$	\$	\$
1984	318.6	49.0	367.6	8.2	269.8	1.1	18.4	0.0	66.6	355.9
1985	413.6	102.0	515.6	10.1	262.4	56.6	9.8	0.0	10.8	339.8
1986	454.8	7.0	461.8	7.9	379.6	0.0	4.7	0.0	10.8	394.9
1987	602.2	35.0	637.2	10.2	783.9	36.6	11.6	0.0	2.8	834.9
1988	382.9	20.0	402.9	6.8	593.7	12.7	8.5	0.0	2.5	617.4

308. Scientific research in Zambia in all fields, including atomic energy, is centred on the National Council for Scientific Research, created in 1967. As an addition to the Council's specialized research units using non-nuclear methods, a Radioisotope Research Unit was added in 1969, the year in which Zambia became a Member State of the Agency. Technical co-operation projects were initiated soon afterwards, and the Council was also given responsibility for co-ordinating all atomic energy programmes in the country, including those receiving Agency support.

309. The Radioisotope Research Unit has been receiving Agency assistance since 1981 to establish by stages laboratories for nuclear analytical techniques. A new complex of buildings for the Unit was completed by the Government in 1987, the year when the neutron generator to be used for activation analysis was commissioned. The range of analytical methods for which equipment is available includes source-excited X-ray fluorescence, Moessbauer, gamma and atomic absorption spectrometry, as well as a low-level counting system with associated liquid nitrogen equipment for detector cooling. Analyses are made routinely on minerals and industrial raw materials with a capability extending to trace-element analysis. However, the facilities are under-utilized, primarily because of a shortage of qualified staff.

310. The Unit took delivery of a multi-purpose gamma irradiator incorporating a 100 kCi cobalt-60 source for pilot-scale studies that include sterilization of medical products and food preservation. The irradiator was installed in its specially designed and shielded facility that forms a part of the building complex already referred to. Feasibility studies supported by Agency experts have highlighted uses as sterilization of pharmaceuticals and peat soil (to increase yields of soybean), as well as disinfection of grain, and extension of the shelf-life of fruits, tea and kapenta (dried fish). An intensive training programme in the operation, maintenance and use of the facility was set up that included a project-related fellowship and a scientific visit.

311. The Technical Services Unit of the Council is responsible for maintaining and repairing the nuclear instruments in the research laboratories at the Council's headquarters and in the field stations. The Agency has assisted the Unit in improving the skills of its technical staff and in introducing better management practices. However, the project is seriously affected by the rapid turnover of staff. In 1989, a regional training course on maintenance of nuclear instrumentation will be hosted by the Council, with some 20 participants from several African Member States attending.

312. The Council's Livestock and Pest Research Centre received assistance to introduce the sterile-insect technique to control the tsetse fly in certain areas of the country. Facilities for rearing were established at Chilanga, but these were contaminated by dust from a local cement factory. With the Government funds allocated in 1988, new facilities are being built at Mumbwa in 1989. It is hoped that pilot-scale field releases can still be undertaken in the same year. The Toxicology Laboratory of the Council has been receiving support in investigations on the susceptibility and resistance of ticks to different groups of acaricides, since tick-borne diseases are a serious threat to livestock in Zambia.

313. The Council's Tree Improvement Research Centre is propagating wild forest trees to exploit their potential as sources of fruit, timber, oil and medicinal compounds. The Agency is assisting efforts to attain genetic improvements by introducing irradiation as a means of inducing mutations. Since the initiation of the project in 1985, a tissue-culture laboratory has been equipped and on-the-job training given on *in vitro* culture techniques.

314. The Agency is also providing assistance to governmental institutions outside the Council. The Ministry of Health is receiving assistance to set up a national radiation protection service. In 1988 the Agency provided a manual thermoluminescence dosimetry system and guidance on drafting regulations for licensing radiation sources. An estimated 600 radiation workers are now being monitored. In 1989 and 1990, a calibration laboratory will be established and guidance will be given on implementation of regulatory measures.

315. The Geological Survey Department is receiving assistance from the Agency in introducing modern methods of presenting, interpreting and storing data on uranium resources in Zambia. Assistance has also been provided to the Department of Water Affairs, working in conjunction with the Department of Geology of the University of Zambia and the Water Resources Unit of the National Council of Scientific Research, to determine the recharge and other characteristics of the aquifers from which the major urban regions of Lusaka and Kabwe draw a substantial part of their domestic water supplies. Analysis of the naturally occurring isotopes in water samples is being undertaken by the Agency's Hydrology Laboratory in Vienna.

316. The Agency is assisting the Department of Physics of the University of Zambia to expand its facilities for teaching nuclear physics. The continuing manpower constraints in the fields of medicine, agriculture and industry have prompted the University to develop an advanced programme of studies in the nuclear sciences that would lead to an MSc degree.

317. The atomic energy programme in Zambia has proceeded at a fast pace and accordingly there has been a marked increase in Agency assistance in recent years. Development has been facilitated by the Government support to the programme, as manifested by the amount of Government funds made available for capital development, for recurrent costs and as a counterpart contribution to Agency assisted

projects. However, this fast expansion has stretched the meagre staff resources to the limit, with resulting under-utilization of a number of facilities. Efforts to recruit and train additional staff as well as to establish a more far-reaching programme of manpower development should be given particular attention, and existing activities should be consolidated before further expansion of the technical co-operation programme is sought.

## ZIMBABWE

### 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
	\$	\$	\$	\$		
1984	0.0	0.0	0.0	0.0	0	0
1985	0.0	0.0	0.0	0.0	0	0
1986	6.0	0.0	0.0	0.0	0	1
1987	6.8	0.0	0.0	0.0	0	0
1988	7.6	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 \$	\$	\$	\$	\$
1984	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1985	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1986	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1987	0.0	0.0	0.0	0.0	17.8	0.0	0.0	0.0	0.0	17.8
1988	139.2	3.0	142.2	2.4	62.6	0.0	0.0	0.0	0.0	62.6

318. Zimbabwe, which became a member of the Agency in 1986, began its participation in the Agency's technical co-operation programme in 1988. Initially, attention was paid to radiation protection as a pre-requisite for starting an atomic energy programme. Whereas legislation exists, there are as yet no operational radiation protection services. Therefore a project was started to provide staff training as well as equipment and dosimeters for personnel monitoring. Two radiation protection officers have now been trained under the Agency fellowship programme and a third has participated in a regional training course on radiation protection. A national training course is envisaged for 1989 as well as provision of further expert services. A Waste Management Advisory Programme Team (WAMAP mission) visited Zimbabwe in 1988 and a RAPAT mission has been scheduled for 1989.

319. In 1988, the Agency provided assistance to two small-scale projects. One is concerned with the use of tracer techniques in studying the movement of tsetse flies. The other project, located the Godfrey Huggins' School of Medicine, University of Zimbabwe, deals with the use of nuclear techniques in haematological diagnosis. As the School of Medicine already has a functional laboratory and has been undertaking routine haematological investigations with radionuclides, assistance being provided by the Agency is primarily to augment the quality and range of nuclear haematology studies and to promote the use of these techniques in relevant clinical research by training local medical and technical staff.

320. Following an Agency-sponsored pre-project mission in 1988, the Department of Hydrology of the Ministry of Water Resources Development will from 1989 be receiving assistance to apply radioisotope techniques in sampling and evaluating water resources. It is planned to establish an isotope hydrology laboratory. In the meantime, precipitation samples will be sent for analysis at the Agency's Hydrology Laboratory in Vienna. Another pre-project assistance mission recommended the establishment of a multi-year project to support studies of animal reproduction, nutrition and disease control to be carried out at the Faculty of Veterinary Science in 1989 and future years.

321. In the field of cancer treatment, the Radiotherapy Centre at Parirenyatwa Hospital, Harare, has a linear accelerator and a telecobalt therapy unit. However, this equipment is not being utilized for the treatment of patients owing to lack of qualified staff. To address this problem, a programme for in-service training for specialists is to be established to enable the Centre to commence radiotherapy treatment. The training of radiotherapists will receive assistance from WHO, while the Agency will provide training for the medical physicists.

322. The main constraint to the development of an atomic energy programme in Zimbabwe is the lack of trained personnel. Emphasis will have to be placed on manpower development, making the maximum use of Agency support in this area.

## REGIONAL ACTIVITIES

### 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 \$	\$	\$	\$	\$
1984	318.5	0.0	318.5	7.1	207.8	0.0	0.0	0.0	1.2	209.0
1985	199.8	0.0	199.8	3.9	255.5	0.0	0.0	3.9	0.0	259.4
1986	221.1	0.0	221.1	3.8	215.2	0.0	7.3	0.0	26.9	249.4
1987	481.1	0.0	481.1	7.7	780.6	0.0	52.1	0.0	5.7	838.4
1988	619.8	30.0	649.8	10.9	782.1	0.0	55.0	0.0	2.9	840.0

323. The idea of establishing regional projects grew from the recognition that many countries faced similar problems and that there was a great deal to be gained if persons charged with similar tasks and responsibilities in these countries could be brought together. There is a steadily growing interest in training and working together, especially when there is a common natural basis for so doing, for example in tsetse fly or fruit fly control, in the parallel use by neighbouring countries of a common aquifer or water course, or in fostering improvements in agricultural practices.

324. Seen in terms of the impact on the development prospects of individual countries, all regional projects are concerned with high-priority topics. The projects themselves fall into two main groups: there are projects that are of interest to all countries in the region – dealing, for example, with radiation protection – and those which are of common interest to a specific group of countries – such as the North African fruit fly infestation study (Algeria, Morocco and Tunisia) or the hydrology studies in the Sahelian region (Mali, Niger and Senegal). There is also variation in the form of the projects: while some offer training courses or workshops, others provide a broader range of assistance, including expert visits and supplies of equipment. Most regional

projects are closely linked to national projects; the latter provide the country-specific inputs while the regional projects reinforce the local ones by providing for "the common elements".

325. At present, all regional projects are funded from the Agency's Technical Assistance and Co-operation Fund, with the exception of one involving Egypt and Sudan that is concerned with the Nile as a water resource; this is being financed from extrabudgetary resources contributed by the Federal Republic of Germany.

326. There have been 16 regional projects since 1980 devoted to training activities. The fields covered were instrument maintenance, analytical techniques, hydrology, radiation protection, animal husbandry, agriculture, nuclear medicine and tsetse fly control. The number of participating countries ranged from 6 to 16, and some 200 participants were trained. A further training project, on the use of microcomputers, was undertaken by running one or more of a set of standardized courses in each of six participating countries, individual sessions being run as national courses with many trainees. A total of 167 persons were trained and, at the end, the computers used for the courses were presented, one to each country.

327. All African Member States have been invited to seek support under a regional radiation protection project, its aim being to help countries to establish appropriate infrastructures and services relating to nuclear safety. Provision of all types of assistance has been envisaged, depending on the specific needs.

328. Fourteen Member States are participating in a regional livestock project. Areas being supported include hormone assay, disease diagnosis and nutrition. The kits for various types of assay are being furnished by the Agency's Seiberdorf Laboratory. A regional expert manages the project, visiting the individual countries to provide technical advice and to ensure project co-ordination. A project on biological nitrogen fixation was initiated in 1987 to serve six countries, but two further countries joined in 1988; the primary objective of the project is to reduce the local need for nitrogen fertilizers, not only to save on foreign exchange but also to reduce environmental damage to water resources.

329. The Agency is actively assisting Member States in establishing facilities for the repair and maintenance of nuclear equipment. Many problems in this area are common to the various participating countries — for example, difficult climatic conditions, power supply problems and absence of proper maintenance strategies — so that the regional project adds an additional dimension to country projects

330. In all regional projects, the transfer of technology and expertise among countries is encouraged. Personal contacts are promoted which often lead to further technical co-operation between the developing countries involved. The awareness of the benefits that can be derived from a more formal framework of regional co-operation have recently led African Member States to take concrete initiatives in this direction.

## IV. PROJECTS CONCLUDED DURING 1988: ACHIEVEMENTS

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331. In the following pages, brief accomplishment summaries are given for 126 projects – excluding training courses – which were “operationally” completed during 1988. For the two projects cancelled during this period, the reasons leading to cancellation are given. This chapter replaces the list of projects completed or cancelled during the year under review, traditionally given in Annex VII of the report.

332. 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.

333. 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.

### ■ AFG/4/002

#### NUCLEAR INSTRUMENTATION

COMPLETED: 88-04-06

TOTAL COST: US \$44,187.33

OBJECTIVES:

TO ESTABLISH A MODEST LABORATORY FOR NUCLEAR INSTRUMENTATION.

ACHIEVEMENTS:

This one-year project started in 1984, but it was not until mid-1986 that the last items of equipment could be delivered. An Agency expert visited the recipient institute in mid-1984, assisted the local staff in organizing the nuclear electronics laboratory and identified equipment in need of repair or replacement. As it is not possible to proceed with further assistance due to conditions prevailing in 1988, it was decided to consider the project completed and to provide follow-up assistance when circumstances allow.

### ■ ALB/2/005

#### NUCLEAR ANALYTICAL LABORATORY

COMPLETED: 88-04-06

TOTAL COST: US \$245,336.20

OBJECTIVES:

TO UPGRADE EXISTING FACILITIES FOR THE DETERMINATION OF TRACE ELEMENTS IN BIOLOGICAL AND ENVIRONMENTAL SAMPLES.

**ACHIEVEMENTS:** A 150 kV, 2.5 mA neutron generator for fast neutron activation analysis and related expert services were provided. The equipment is being fully used, primarily for analysis of agricultural, geological and industrial samples. The neutron laboratory is well organized, with properly established supporting activities and a reliable radiation protection service.

■ **ALG/1/007** **METROLOGY AND MAINTENANCE OF NUCLEAR INSTRUMENTATION**

**COMPLETED:** 88-12-31 **TOTAL COST:** US \$100,345.25

**OBJECTIVES:** TO IMPROVE PREVENTIVE MAINTENANCE OF NUCLEAR INSTRUMENTATION SYSTEMS, ON-SITE REPAIRS AND CALIBRATION.

**ACHIEVEMENTS:** There are a considerable number of nuclear electronic devices in service in Algeria, a substantial amount of which was provided through the Agency's technical co-operation programme. The High Commissariat for Research requested Agency assistance to enable it to establish a maintenance, repair and calibration service for such equipment. Based on the recommendations of a review mission early in 1986, Agency experts provided training on the use of microprocessors in nuclear instruments. They also assisted with a national training course on nuclear electronics attended by 24 participants representing various national institutions. Related servicing and calibration equipment was provided and one of the local staff was given fellowship training at the Agency's Seibersdorf Laboratory that included group training in maintenance of spectrometry instrumentation. The metrology and maintenance laboratory is now operational.

■ **ALG/3/003** **URANIUM PROSPECTION**

**COMPLETED:** 88-02-26 **TOTAL COST:** US \$55,145.29

**OBJECTIVES:** ASSESSMENT OF THE URANIUM RESOURCE POTENTIAL.

**ACHIEVEMENTS:** The Chemistry Laboratory of the Materials Development Centre, Commissariat for New Energies, wished to carry out radiometric surveys in the Hoggar region of southern Algeria in order to be able to assess uranium mineralization and its favourability for exploitation. Through Agency assistance, a vehicle was equipped with a gamma-ray spectrometer and gamma logging equipment for use in car-borne radiometric reconnaissance for uranium ores. As a follow-up, in 1987, a local staff member was granted a fellowship that provided specialized training on processing and interpreting data from car-borne as well as aerial surveys. Work using the facility is now in progress and data are being collected.

■ **ALG/5/005** **FOOD IRRADIATION**

**COMPLETED:** 88-10-19 **TOTAL COST:** US \$256,399.48

**OBJECTIVES:** PROMOTING PILOT-SCALE FOOD IRRADIATION RESEARCH WITH A VIEW TO COMMERCIALIZATION.

**ACHIEVEMENTS:** Since 1979, the Government of Algeria has been engaged in food irradiation research, with support from the Agency. A pilot-irradiation facility was commissioned in 1983, and shelf-life extension studies initially considered potatoes,

onions and garlic. Agency experts assisted with planning the research programme, commissioning the equipment, dosimetry and training. Five project-related fellowships for training in all aspects of food irradiation technology and one scientific visit were approved. Experiments were expanded to include dates and cereals, and the facility was upgraded in 1986 by provision of a larger (30 kCi) cobalt-60 irradiation source. The skills acquired and the information obtained concerning the technical and economic feasibility of food irradiation has led the Government to consider purchasing from its own resources a semi-industrial irradiator to carry the programme one step further towards commercial implementation. Negotiations for the purchase of this semi-industrial irradiator are now under way, following expert advice on selection criteria.

■ **ALG/8/004**

**NUCLEAR TECHNIQUES IN SEDIMENT TRANSPORT STUDIES**

COMPLETED: 88-08-29

TOTAL COST: US \$37,873.64

OBJECTIVES:

TO STUDY EROSION AND SEDIMENT TRANSPORT IN SEMI-ARID AREAS IN ALGERIA BY THE USE OF NUCLEAR TECHNIQUES.

ACHIEVEMENTS:

Sedimentological and hydrological data have been gathered in order to assess sediment deposition and erosion effects in dams and reservoirs in semi-arid regions of Algeria. Advice was provided to the Government on a national anti-erosion programme which is expected to reduce the heavy loss of agricultural land and to protect the water engineering structures. Two fellowships for training abroad were granted.

■ **ALG/8/005**

**INDUSTRIAL RADIOGRAPHY**

COMPLETED: 88-03-14

TOTAL COST: US \$129,614.95

OBJECTIVES:

TO ESTABLISH A NON-DESTRUCTIVE TESTING LABORATORY IN CONNECTION WITH TRANSPORT AND STORAGE OF PETROLEUM PRODUCTS.

ACHIEVEMENTS:

The Centre for Development of Energy Conversion planned to establish an industrial non-destructive testing laboratory capable of examining welds and castings using radiographic techniques. The Agency provided various items of equipment including devices suitable for obtaining radiographs in the field using a mobile laboratory. An expert provided training in the course of two visits, and eighteen inspectors and operators were trained and have obtained various levels of qualification and certification in non-destructive testing. The suppliers of the gamma-mat crawler radiography device also provided special training on the use of the technique. Project related fellowship training was granted for one local operator for 1989. The mobile laboratory is being used on a routine basis to check the quality of oil-pipeline and storage-vessel components and the use of the technique is being extended to other industrial sectors.



■ BOL/1/007	<b>SECONDARY STANDARDS DOSIMETRY LABORATORY</b>
OBJECTIVES:	<p>COMPLETED: 88-03-17 <span style="float: right;">TOTAL COST: US \$54,426.59</span></p> <p>ESTABLISHMENT OF A NATIONAL DOSIMETRY AND CALIBRATION CENTRE IN ORDER TO IMPROVE RADIATION PROTECTION SERVICES AND THE RELIABILITY AND ACCURACY OF CLINICAL DOSIMETRY.</p>
ACHIEVEMENTS:	<p>Owing to local economic and infrastructural constraints, it was not possible to meet the original objectives, namely to establish a national dosimetry and calibration centre. The project was, therefore, reformulated with the agreement of the <i>United Kingdom</i>, the donor of the extrabudgetary funds, and, following delivery of certain items of calibration equipment, an expert provided training on its use. Dosimetry and calibration services were established that are being used to calibrate radiation protection instruments, and one of the staff gained additional experience through a project-related scientific visit.</p>
■ BRA/1/022	<b>SECONDARY STANDARDS DOSIMETRY LABORATORY</b>
OBJECTIVES:	<p>COMPLETED: 88-11-04 <span style="float: right;">TOTAL COST: US \$301,454.74</span></p> <p>INCREASE OF PRECISION AND ACCURACY OF RADIATION MEASUREMENTS THROUGH IMPROVEMENT OF CALIBRATION PROCEDURES. INTRODUCTION OF THE ALANINE-ESR METHOD FOR HIGH-DOSE MEASUREMENT.</p>
ACHIEVEMENTS:	<p>Significantly better precision and accuracy in the use of radiation measuring equipment has been achieved by improving calibration procedures. Several items of equipment for calibration were provided, among them an X-ray machine and a cobalt-60 therapy unit. Experts provided training on calibration procedures, radiation metrology, and assembly and alignment of calibration stands. A fellowship was also granted.</p>
■ BRA/4/028	<b>FUEL ELEMENT DESIGN AND ENGINEERING</b>
OBJECTIVES:	<p>COMPLETED: 88-11-04 <span style="float: right;">TOTAL COST: US \$26,177.63</span></p> <p>ASSISTANCE IN DESIGN AND IRRADIATION TESTING OF NUCLEAR FUEL ELEMENTS FOR PRESSURIZED WATER REACTORS.</p>
ACHIEVEMENTS:	<p>NUCLEBRAS was provided with expert advice on quality assurance in fuel element design and manufacturing, including those aspects relating to selection, qualification and supervision of suppliers providing materials and components. Furthermore, a system was established to make possible the purchase of materials and components on the Brazilian market.</p>
■ BRA/5/013	<b>PLANT MUTATION BREEDING</b>
OBJECTIVES:	<p>COMPLETED: 88-12-31 <span style="float: right;">TOTAL COST: US \$39,755.63</span></p> <p>TO IMPROVE TROPICAL AND SUBTROPICAL CROPS OF ECONOMIC IMPORTANCE TO BRAZIL.</p>

**ACHIEVEMENTS:** The activities, funded by an extrabudgetary contribution from the Federal Republic of Germany, resulted in a great improvement in some crops of importance to Brazil through the use of mutation breeding technology. At the start, it was decided that activities should concentrate on a few selected crops, namely rice, citrus and bananas. A well-equipped laboratory was established, laboratory technicians were trained to work with in-vitro technology, and proper conditions were set up to train students and research workers.

■ **BRA/5/018**

**NITROGEN UTILIZATION**

**COMPLETED:** 88-11-22

**TOTAL COST:** US \$90,806.42

**OBJECTIVES:**

STUDIES OF NITROGEN FIXATION IN GRASSES, PARTICULARLY SUGAR CANE, AND ON THE ASSOCIATION OF VESICULAR ARBUSCULAR MYCORRHIZA WITH LOCAL FUNGUS SPECIES AND THEIR EFFECT ON THE UPTAKE OF MAJOR ELEMENTS.

**ACHIEVEMENTS:**

The project provided expert advice as well as equipment for the Centre for Nuclear Energy in Agriculture in connection with studies on nitrogen fixation and for increasing the local production of nitrogen-15. The counterparts, as well as graduate and post-graduate students, were taught how to label plant material with nitrogen-15.

■ **BRA/6/008**

**RADIOISOTOPES IN CLINICAL MEDICINE**

**COMPLETED:** 88-12-09

**TOTAL COST:** US \$116,542.14

**OBJECTIVES:**

ESTABLISHMENT OF A REGIONAL CENTRE FOR RADIOIMMUNOASSAY TO SERVE NORTH-EASTERN BRAZIL.

**ACHIEVEMENTS:**

A radioimmunoassay (RIA) laboratory was established to serve north-eastern Brazil with the aid of an extrabudgetary contribution from the Federal Republic of Germany. Two technicians were trained and they are now capable of preparing basic immunoassay reagent solutions, of performing assays for the determination of thyroid-related hormones, of utilizing gamma counters, and of applying appropriately the WHO RIA programme for evaluation of assays.

■ **BRA/6/010**

**RADIOISOTOPES IN MEDICINE**

**COMPLETED:** 88-11-25

**TOTAL COST:** US \$312,021.12

**OBJECTIVES:**

TO ENABLE IEN AND IPEN TO DEVELOP SUITABLE INFRASTRUCTURE FOR RADIOISOTOPE PRODUCTION WITH CYCLOTRONS FOR MEDICAL USES.

**ACHIEVEMENTS:**

This project was funded by an extrabudgetary contribution from the Federal Republic of Germany. A suitable infrastructure was developed at the Institute of Nuclear Engineering (IEN) and at the Institute for Nuclear Energy and Research (IPEN) for radioisotope production using their cyclotrons, and routine production on a large scale is now possible. This was achieved by providing Agency experts to give advice and training on radioisotope production, quality control of cyclotron-produced radiopharmaceuticals, cyclotron maintenance, and use of targets, as well as spare parts for the two cyclotrons. The cyclotron at IEN is

now supplying iodine-123 to hospitals on a routine basis, and that at IPEN is producing gallium-67. Furthermore, methods have been developed to label several pharmaceuticals with iodine-123, bromine-77 and indium-111.

■ **BRA/9/016**

**NUCLEAR POWER PROGRAMME**

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COMPLETED: **88-07-12** TOTAL COST: **US \$45,761.75**

OBJECTIVES: ESTABLISHMENT OF AN EFFICIENT REGULATORY BODY IN ORDER TO ENSURE ADEQUATE SAFETY.

ACHIEVEMENTS: The National Nuclear Energy Commission's capability in the areas of safety analysis, licensing, and inspection of nuclear power plants was increased. Several Agency experts provided support and training in probabilistic risk analysis. Four fellowships were granted and two scientific visits were approved.

■ **BUR/4/005**

**NUCLEAR INSTRUMENTATION**

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COMPLETED: **88-12-19** TOTAL COST: **US \$50,799.87**

OBJECTIVES: TO STRENGTHEN THE NUCLEAR INSTRUMENTATION AND NUCLEAR ELECTRONICS ACTIVITIES AT THE UNIVERSITY.

ACHIEVEMENTS: With the assistance provided under this project, repair and maintenance of all equipment at the Department of Chemistry of Rangoon University has been carried out. The counterparts were also able without outside help to assemble four single-channel analysers (Eurocard plug-in system) that form a part of the IAEA radiation measuring units for laboratory use.

■ **CHI/4/011**

**THERMOHYDRAULIC ANALYSIS FOR CORE CONVERSION**

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COMPLETED: **88-12-20** TOTAL COST: **US \$13,732.21**

OBJECTIVES: TO DEVELOP THE APPROPRIATE COMPUTER CODES TO COMPLETE STUDIES ON THE CONVERSION OF EXPERIMENTAL NUCLEAR REACTORS FROM HIGH- TO LOW-ENRICHMENT FUEL.

ACHIEVEMENTS: The Nuclear Reactor Physics staff of the Chilean Nuclear Energy Commission were given training to prepare them for participation in the conversion of the core of the La Reina reactor from high- to low-enrichment fuel and for assisting in studies related to making the reactor at Lo Aguirre operational. As a part of this process, computer codes for thermohydraulic and accident analysis were developed with the assistance of Agency experts. Continuing interaction has been established between the staff and the experts, which will enable problems in the future to be solved as they arise, allowing the local team to build up well-founded experience in thermohydraulics.

■ **CHI/6/008**

**NUCLEAR CARDIOLOGY**

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COMPLETED: **88-12-30** TOTAL COST: **US \$29,276.67**

OBJECTIVES: TRAINING AND COMPUTER USE IN NUCLEAR MEDICINE, PARTICULARLY IN CARDIOLOGY.

**ACHIEVEMENTS:** The Nuclear Medicine Centre of the Jose Joaquin Aguirre Hospital of the University of Chile sought assistance for a programme to improve health care at the hospital and to strengthen training and research facilities. As a result of this successful project, new clinical applications using the refitted-image processing technique were introduced – the computer and software required having been provided by the Agency: an expert assisted with training and development of specialized computer programmes for nuclear cardiology. The counterpart later organized courses to train appropriate medical staff in the city and from peripheral medical centres in the proper use of the technique and how to evaluate the data clinically. In addition to being made the national co-ordinator for regional programmes on instrument quality control, the counterpart has also served as an Agency expert in other countries of the region, a reflection of the effective transfer of technology achieved by the project.

■ **CHI/9/007**

**THERMOLUMINESCENCE DOSIMETRY**

**COMPLETED: 88-03-15**

**TOTAL COST: US \$48,432.24**

**OBJECTIVES:**

ESTABLISHMENT OF A CENTRAL NATIONAL PERSONNEL DOSIMETRY SERVICE.

**ACHIEVEMENTS:**

A central national personnel dosimetry service was established capable of providing radiation monitoring services for 1000 persons using thermoluminescence dosimetry (TLD). Criteria for the measurement of low doses were determined, and the requirements for a natural radioactivity monitoring programme also using TLD were established.

■ **CHI/9/008**

**EVALUATION OF RESEARCH REACTOR SAFETY REPORT**

**COMPLETED: 88-12-20**

**TOTAL COST: US \$75,393.43**

**OBJECTIVES:**

TO TRAIN AND PREPARE A CORE OF PERSONNEL WHICH WILL BE INVOLVED IN THE LICENSING AND REGULATION OF NUCLEAR INSTALLATIONS.

**ACHIEVEMENTS:**

The objective of the project was to train a group of professionals who would form the core of Chile's nuclear regulatory body. In the period 1983 to 1986, five experts provided training on safety analysis of research reactors, safety in their siting, regulation and technical standards, environmental radioactivity and meteorological considerations, and dose evaluation. Two fellowships were funded, and a further project-related one is being funded in 1989. Two staff were given a chance to gain practical experience by means of a programme of scientific visits. The results were (i) adoption of specific licensing regulations for nuclear installations, (ii) establishment of environmental and safety regulations for application at institutional and national level, and (iii) improvement of environmental radioactivity monitoring programmes. This allows the Division of Nuclear Safety and Radiation Protection to handle all matters concerning the safe operation of research reactor installations.

■ CHI/9/011

**SEISMIC TELEMETRY NETWORK**

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COMPLETED: 88-12-12 TOTAL COST: US \$108,174.20

OBJECTIVES: EXTENSION AND OPTIMIZATION OF EXISTING TELEMETRIC NETWORK IN ORDER TO IDENTIFY PROSPECTIVE AREAS OF NUCLEAR POWER PLANT SITING.

ACHIEVEMENTS: The Chilean Nuclear Energy Commission aimed to complete a study on the feasibility of constructing a nuclear power station in 1985. The seismological conditions in Chile make site selection in terms of seismicity of great importance. The Agency assisted in extending the seismic telemetry network and upgrading computational techniques, both by providing experts and related equipment. There has been a substantial contribution to an understanding of the seismicity of the country, and the network proved to be most valuable for studies of recent earthquakes (3 March 1985, epicentre Valparaiso; 13 September 1987, epicentre Rancagua). The details of these and other studies have been published in a series of articles and theses written by Chilean authors. The project is considered to have been extremely successful in terms of effective implementation, practical value and as a support for continuing activities in the future.

■ COL/1/004

**CRYOGENIC SERVICES**

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COMPLETED: 88-03-15 TOTAL COST: US \$68,357.23

OBJECTIVES: PROVISION OF A RELIABLE SUPPLY OF LIQUID NITROGEN.

ACHIEVEMENTS: A nitrogen liquefier and spare parts were acquired. The equipment is being used in support of activation analysis and carbon-14 dating.

■ COL/3/009

**NUCLEAR RAW MATERIALS**

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COMPLETED: 88-02-23 TOTAL COST: US \$29,700.00

OBJECTIVES: TO DETERMINE URANIUM FAVOURABILITY TO PREPARE A REVISED PROGNOSTIC MAP, AND TO DEVELOP A LONG-TERM WORK PROGRAMME.

ACHIEVEMENTS: Expert advice was provided which allows the Institute for Nuclear Affairs to determine on its own uranium favourability, to prepare a revised prognostic map, and to develop a long-term programme of work. The experts also advised on automatic data processing.

■ COL/5/009

**SYMBIOTIC NITROGEN FIXATION**

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COMPLETED: 88-05-05 TOTAL COST: US \$28,139.71

OBJECTIVES: TO IMPROVE FODDER CROP PRODUCTION AND PASTURE IN THE LLANOS THROUGH RESEARCH INTO FERTILIZER UPTAKE, INCLUDING STUDIES OF ALUMINIUM TOXICITY.

**ACHIEVEMENTS:** Under the direction of an Agency expert, a plan was developed for investigating the effectiveness of various fertilizers, including phosphorus sources, as well as symbiotic nitrogen fixation, with reference to pastures and fodder crops in different climatic areas. Several experiments were set up during 1987 and 1988. Procedures were established to assure proper co-ordination of experiments at the various research stations of the Columbian Agricultural and Livestock Breeding Institute. A seminar was held by the expert at the Agronomy Department of the Colombian National University, and this has resulted in closer collaboration between post-graduate students and the project staff.

■ **COL/8/010**

**ISOTOPES IN HYDROLOGY**

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**COMPLETED:** 88-12-09

**TOTAL COST:** US \$238,897.79

**OBJECTIVES:**

TO SET-UP FACILITIES FOR STABLE ISOTOPE ANALYSIS IN HYDROLOGICAL INVESTIGATIONS.

**ACHIEVEMENTS:**

The Institute of Nuclear Affairs sought Agency assistance to establish an isotope hydrology laboratory. The footnote-a project received substantial extrabudgetary funds from the Federal Republic of Germany, while certain components were financed from funds-in-trust and the Agency's Technical Assistance and Co-operation Fund. The major items of equipment provided were a mass spectrometer and an automatic liquid scintillation counter. The former was installed and calibrated with the help of an Agency expert who, in subsequent visits, also provided on-the-job training. Two further experts advised on studies involving naturally occurring stable isotopes and natural-tritium enrichment methodologies. One project-related fellowship was granted and the project was complemented by Agency research contracts. Though the objective was achieved, there is a residual difficulty with the maintenance and repair required to assure proper refunctioning of the equipment in the future.

■ **COS/1/005**

**APPLIED NUCLEAR PHYSICS**

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**COMPLETED:** 88-12-20

**TOTAL COST:** US \$257,299.29

**OBJECTIVES:**

DEVELOPMENT OF NUCLEAR PHYSICS AT THE UNIVERSITY: A DATA ACQUISITION AND ANALYSIS SYSTEM FOR USE WITH THE EXISTING EXPERIMENTAL FACILITIES.

**ACHIEVEMENTS:**

The capability for teaching and research of the Nuclear Physics Department of the University of Costa Rica was strengthened. In the course of ten visits, experts provided training on X-ray fluorescence analysis, use of solid-state nuclear track detectors, neutron activation analysis as applied to alloy determination, and associated topics. A particular emphasis was placed on acquisition and processing of data using computers and related software. Various items of equipment, including an isotopic neutron generator, radiation detectors and computer hardware were provided; of the US \$201000 spent on equipment, some \$116000 were approved from the Technical Assistance and Co-operation Funds, while some \$85000 were extrabudgetary funds provided by the United States of America. Two project-related fellowships were supported, one in Jamaica, one in the USA. The Department has achieved national recognition of the services it can provide, with special expertise being built up in studies of environmental contamination.

■ COS/3/003

**URANIUM PROSPECTION**

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COMPLETED: 88-12-21

TOTAL COST: US \$119,207.11

OBJECTIVES:

ASSESSMENT OF THE COUNTRY'S URANIFEROUS POTENTIAL.

ACHIEVEMENTS:

The Government of Costa Rica, initially through the National Development Corporation and, since 1984, through the National Mining Company, has been establishing the infrastructure for its comprehensive exploration programme aimed at assessing the country's uranium resource potential. The project was designed to complement a UNFSSD-financed project that, inter alia, is charged with evaluating the resources identified. Agency experts provided training in uranium analysis and in field exploration techniques, with emphasis on geological and geochemical aspects, while an atomic absorption spectrometer and peripheral computer equipment for data analysis were provided. With the functional infrastructure established, activities were initiated to gather basic information on uranium and other mineral resources, and the data have been compiled in a form which has made possible the determination of areas worthy of further field research – to be studied under the complementary project.

■ COS/5/007

**HORMONE PROFILES IN CATTLE**

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COMPLETED: 88-12-21

TOTAL COST: US \$58,926.83

OBJECTIVES:

TO INCREASE THE REPRODUCTIVE EFFICIENCY OF ZEBU CATTLE AND TO STUDY HORMONE PROFILES.

ACHIEVEMENTS:

Zebu cattle account for most of Costa Rica's cattle population and provide the bulk of the meat produced for export and domestic consumption. The reproductive efficiency of this breed is low. The Agency assisted the School of Veterinary Medicine of the National University by providing an expert to train staff in radioimmunoassay and enzyme immunoassay techniques as well as various items of related equipment. A viable radioimmunoassay laboratory has been established, able to measure protein and steroid hormones using solid- and liquid-phase systems. New information has been documented on the various aspects of Zebu reproductive physiology, behaviour and production, including: (a) progesterone profiles during the post-partum period in normal and oestrus-synchronized adult cows; (b) morphological changes in the cervix during involution post-partum; (c) variable responses in the endocrine system as a result of introducing restricted suckling regimens, leading to improved production; (d) reproductive behaviour of pre-pubertal heifers given different types of supplementary feeding during the dry-season. In addition, in Holstein/Jersey dairy cattle, the relationship between the length of the post-partum period and milk fever, dystocia, retained placenta and metritis has been defined.

■ CUB/6/007

**NUCLEAR CARDIOLOGY**

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COMPLETED: 88-12-30 TOTAL COST: US \$337,671.73

OBJECTIVES: TO IMPROVE DIAGNOSIS, PROGNOSIS AND TREATMENT OF CARDIOVASCULAR DISEASES.

ACHIEVEMENTS: The project made a very significant impact on the improvement of the quality of diagnosis, prognosis and treatment of ischaemic cardiopathy at the Institute of Cardiology and Cardiovascular Surgery, by means of nuclear cardiological techniques utilizing the gamma camera supplied under the project. Expert services were provided to commission the camera and advise the counterpart staff about the safe handling of radioisotopes and pharmaceutical practices, and to instruct them on various nuclear cardiology techniques. Training of counterpart staff was financed at medical institutions in Argentina, Brazil and Mexico.

■ DRK/5/002

**FERTILIZER USE EFFICIENCY STUDIES**

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COMPLETED: 88-09-29 TOTAL COST: US \$148,339.23

OBJECTIVES: TO ESTABLISH A CAPABILITY TO USE NITROGEN-15 AND RADIOISOTOPES FOR RESEARCH AIMED AT MORE EFFICIENT UTILIZATION OF FERTILIZERS AND GREEN MANURES BY FIELD CROPS.

ACHIEVEMENTS: Provision of an emission spectrometer for nitrogen-15 analysis and a liquid scintillation counter, as well as items of laboratory equipment, labelled fertilizers and chemicals, together with experts to advise on sample preparation, instrument use and the planning and carrying out of greenhouse and field experiments, have enabled the two counterpart institutes to initiate studies aimed at increasing agricultural production. Results to date indicate that (a) rice and maize production can be increased by about 10% by appropriate application of biological fertilizers such as farmyard manure or azolla, and (b) that soybean production can be increased by enhancing biological nitrogen fixation. At present, soybean cultivars are being tested for high nitrogen-fixing potential using nitrogen-15 as tracer.

■ DRK/6/002

**RADIATION THERAPY**

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COMPLETED: 88-12-19 TOTAL COST: US \$51,987.83

OBJECTIVES: TO UPGRADE THE RADIATION SOURCE OF A COBALT-60 TELE THERAPY UNIT USED FOR THE TREATMENT OF CANCER PATIENTS AND FOR RESEARCH ON BIOLOGICAL EFFECTS OF RADIATION.

ACHIEVEMENTS: A 4000 Ci cobalt-60 gamma radiation source was provided by the Agency to replace the original (1970) 3900 Ci source at the Pyongyang People's Hospital No.2 which had decayed to an unacceptable output. The source has been installed and calibrated with the help of the suppliers and is now being used treat up to 60 cancer patients per day, a three-fold increase.



■ ECU/3/005

**URANIUM PROSPECTION**

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COMPLETED: 88-12-19

TOTAL COST: US \$117,434.98

OBJECTIVES:

IDENTIFICATION OF AREAS FAVOURABLE FOR URANIUM DEPOSITION.

ACHIEVEMENTS:

This project has primarily received support through expert services. As a result of prospecting activities, two areas showing favourable uranium characteristics were identified. Exploratory drilling was carried out in one of these areas (Puyanco), and studies using the borehole logging technique were undertaken. As part of the training activities, the staff concerned with uranium exploration at the Ecuadorian Atomic Energy Commission acquired field experience in prospecting and exploration techniques which is providing a foundation for continuing studies and research. The field studies were manifestly assisted by a gift-in-kind of two vehicles by the Government of Spain. In the course of the project, a total reassessment of uranium favourability in Ecuador was undertaken, and a new prognostic map was produced to serve as a basis for future work.

■ ECU/5/009

**NUCLEAR TECHNIQUES IN AGRICULTURE**

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COMPLETED: 88-12-30

TOTAL COST: US \$242,301.58

OBJECTIVES:

STUDIES ON AGRICULTURAL PRODUCTION AND DEVELOPMENT OF METHODS FOR INCREASING IT.

ACHIEVEMENTS:

This major agricultural project provided extensive training for local staff. Agency experts advised on, inter alia, soil fertility studies, soil physics, nitrogen-15 analysis and fertilizer management for tree crops. A range of equipment items was provided in support of training and field studies. As a result of the project, very successful research work on fertilizer and water-use efficiency was carried out utilizing nuclear techniques for the most important agricultural products of the Ecuadorian economy. In order to use the results obtained fully, i.e. to have a significant impact on agricultural production, a publication giving practical guidance for farmers is being compiled. As a result of this project, consideration has been given to a large-scale field research programme at the national level. However, additional laboratory facilities for the radioisotope work would be necessary as well as a formal co-operation agreement between the Ecuadorian Atomic Energy Commission and the National Agricultural Research Institute. Some problems arising with electronic units in the equipment provided are being solved as a contribution through a related project ECU/5/012 approved in 1988.

■ EGY/0/008

**TELETYPE-COMPATIBLE TERMINAL**

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COMPLETED: 88-09-26

TOTAL COST: US \$24,323.09

OBJECTIVES:

TO STRENGTHEN THE NUCLEAR INFORMATION CENTRE BY ESTABLISHING ON-LINE ACCESS TO THE IAEA'S INIS DATA BASE.

ACHIEVEMENTS:

The Nuclear Information Centre of the Atomic Energy Authority in Egypt acquired through this project a capability for on-line information retrieval for scientific staff at the Nuclear Research Centre, government institutions and

universities, using the INIS and AGRIS databases in Vienna. Suitable hardware and software were provided, together with expert services to install the equipment and train staff in its use. A connection between the terminal in Cairo and the IAEA computer in Vienna via the international telecommunications network was established.

■ EGY/1/013

**NEUTRON SPECTROMETRY**

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COMPLETED: 88-09-26

TOTAL COST: US \$101,076.99

OBJECTIVES:

UP-GRADING OF A TRIPLE-AXIS NEUTRON SPECTROMETER.

ACHIEVEMENTS:

A triple-axis neutron spectrometer which was supplied in 1965 under a previous Agency project to the Reactor and Neutron Physics Department was upgraded and recommissioned. Initially, an Agency expert made an on-the-spot inspection of the equipment, reviewing the problems that rendered it unserviceable, and proposed solutions. A new control unit and a measurement unit, as well as other devices and spare parts, were provided and the supplier installed these components and tested them. Since the equipment can only be used by highly qualified technical personnel and by physicists with a knowledge of data processing, two fellowships were granted. The equipment is being utilized to study uranium and thorium ores and their compounds.

■ EGY/1/018

**MOESSBAUER SPECTROMETRY (AL-AZHAR)**

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COMPLETED: 88-09-29

TOTAL COST: US \$52,126.56

OBJECTIVES:

TO ENHANCE THE CAPABILITY OF THE MOESSBAUER LABORATORY IN CARRYING OUT TRAINING AND RESEARCH.

ACHIEVEMENTS:

The Physics Department, Faculty of Science, Al-Azhar University, needed a Moessbauer spectrometer to carry out its current activities in research and training. Owing to lack of foreign exchange, the university could not provide the instrument from its own resources. The spectrometer was provided utilizing an extrabudgetary contribution from the Government of the United Kingdom. Measuring time is shared between the Minerals Scientific Group (studying the effects of the Aswan High Dam on the clay constituents of Egyptian agricultural soils and the characterization of Egyptian coal), the Industrial Applications Group (studying corrosion behaviour, the role of iron in the cement industry, and various topics relating to the steel industry), and a group studying the magnetic properties of ferrites and amorphous alloys.

■ EGY/2/003

**PHYSICO-CHEMICAL STUDIES OF ACTINIDES**

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COMPLETED: 88-09-30

TOTAL COST: US \$76,715.05

OBJECTIVES:

PHYSICO-CHEMICAL STUDIES ON ACTINIDE ELEMENTS.

ACHIEVEMENTS:

This project was supported by an extrabudgetary contribution from the Government of the United States of America as well as from the Agency's Technical Assistance and Co-operation Fund. The facilities of the Nuclear Chemistry Department of the Nuclear Research Centre were upgraded by providing additional equipment to support an on-going programme on physico-chemical studies of actinide compounds. The main item provided was a spectrometer.

The facilities are now being used not only by the actinide chemistry group but also by the staff of other groups at the Centre, including three PhD candidates. An expert trained local personnel to undertake analyses and delivered lectures on actinide processing chemistry and technology, and on actinide separation; these were attended by over 30 participants. The expert also helped to develop a programme of long-term research in actinide chemistry and identified specific topics which are now being pursued by the local staff.

■ EGY/5/009

**RADIOISOTOPES IN ANIMAL SCIENCE**

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COMPLETED: 88-09-29

TOTAL COST: US \$105,251.87

OBJECTIVES:

ESTABLISHMENT OF A LABORATORY TO CARRY OUT ENDOCRINOLOGICAL STUDIES ON FARM ANIMALS USING RADIOIMMUNOASSAY TECHNIQUES.

ACHIEVEMENTS:

Assay facilities for reproductive hormones were set up at the Radiobiology Department of the Nuclear Research Centre where studies are being made on the reproductive physiology of the buffalo. Guidance was given on laboratory techniques and sample collection. A training course including lectures and demonstrations on the technique of radioimmunoassay was provided and attended by 20 staff. A fellowship was granted. Results have been obtained on some 1000 samples and these are being correlated with clinical observations.

■ EGY/9/016

**RADIATION PROTECTION**

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COMPLETED: 88-09-26

TOTAL COST: US \$82,166.24

OBJECTIVES:

TO IMPROVE RADIOLOGICAL SAFETY AT THE RADIOISOTOPE PRODUCTION LABORATORY THROUGH MODERNIZATION OF ITS FACILITIES.

ACHIEVEMENTS:

The radiological safety equipment in the Radioisotope Production Laboratory of the Nuclear Research Centre was reviewed and additional items provided (the original equipment was more than 20 years old). An expert assisted in installing the equipment and in undertaking calibrations, and training in its use was provided. The project has not only helped to ensure that the radiation protection requirements for the safety of the workers will be fulfilled during the production of radioisotopes for medical, industrial and other uses, but that there would be an increase in the productivity of the laboratory.

■ GAB/1/002

**NUCLEAR SPECTROMETRY**

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COMPLETED: 88-04-12

TOTAL COST: US \$89,518.97

OBJECTIVES:

TO ESTABLISH A LABORATORY FOR HIGH RESOLUTION ALPHA-, BETA- AND GAMMA-SPECTROSCOPY PRIMARILY TO ANALYSE GEOLOGICAL AND BIOLOGICAL SAMPLES.

ACHIEVEMENTS:

A laboratory was established in the Faculty of Science of the University at Libreville and supplied with alpha, beta and gamma spectrometric equipment. An expert provided on-the-job training, and a member of the staff was awarded fellowship training abroad on maintenance and repair of equipment. The laboratory was used for two years for training, analysis of mineral samples and assessment of radium in uranium tailings, at which time the Government decided to move the University to another location (Franceville). An Agency

expert was sent to advise on and assist in storing the equipment under suitable conditions, i.e in a closed, air conditioned, dust-free room, pending its transfer to the new university buildings.

■ **GAB/9/003**

**RADIATION PROTECTION**

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COMPLETED: **88-09-29**

TOTAL COST: **US \$6,464.80**

OBJECTIVES:

TO STRENGTHEN THE LOCAL CAPABILITY FOR ENVIRONMENTAL RADIOACTIVITY MONITORING WITH PARTICULAR REFERENCE TO MINING AND MILLING OPERATIONS AND TO ESTABLISH A NATIONAL RADIATION PROTECTION AUTHORITY.

ACHIEVEMENTS:

Following approval of the project, the Government of Gabon decided to move the inspectorate for radiation protection in mining and milling, establishing it at Mounana, where no premises are available at present. As a result of this decision, the Government requested the Agency to postpone activities until suitable premises and adequate staffing would warrant a new project.

■ **GRE/9/012**

**MONITORING BACKGROUND RADIATION LEVELS**

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COMPLETED: **88-12-30**

TOTAL COST: **US \$28,365.97**

OBJECTIVES:

TO FACILITATE THE SYSTEMATIC MONITORING OF BACKGROUND RADIATION AND TO IMPROVE GENERAL RADIATION PROTECTION IN CONNECTION WITH RADIOACTIVE CONTAMINATION OF THE MARINE ENVIRONMENT.

ACHIEVEMENTS:

Under this project, the Agency supplied a gamma-spectrometry system which is being used by the National Centre for Marine Research for the analysis of marine samples (sea water, sea grass, algae and fish). Special attention is being given to long-lived radionuclides in order to determine the new marine radioactive-contamination status following the Chernobyl accident. A scientific visit to similar laboratories in Belgium, France and Italy was organized for the counterpart, to enable her to acquire additional experience abroad.

■ **GUA/3/003**

**URANIUM PROSPECTION**

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COMPLETED: **88-12-01**

TOTAL COST: **US \$107,971.03**

OBJECTIVES:

TO ESTABLISH THE METHODOLOGY, SET UP THE INFRASTRUCTURE AND TRAIN NATIONAL PERSONNEL NEEDED FOR EXPLORATION PROJECTS.

ACHIEVEMENTS:

The primary objective was the establishment of the necessary infrastructure to start uranium exploration in Guatemala. The activities carried out under the project included the setting up of a fluorimetric laboratory for low-level uranium analysis, the supply of radiometric field equipment, the provision of experts in laboratory and uranium exploration, and the training of counterpart staff. As a result, radiometric reconnaissance surveys were carried out over likely geological formations and six anomalous areas warranting further study were defined; many samples collected during previous surveys were analysed.

■ GUA/5/006

**MEDFLY ERADICATION PROGRAMME**

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COMPLETED: 88-11-04

TOTAL COST: US \$80,173.82

OBJECTIVES:

INCREASE WORKING CAPABILITY AND QUALITY CONTROL AT A MEDFLY REARING FACILITY.

ACHIEVEMENTS:

Significant improvements were obtained in production and quality control at the Mediterranean fruit-fly rearing facility of the counterpart institution. A workshop was held on the principles and practices relating to the sterile insect technique, carried out by international experts for national staff. Incubators and other laboratory apparatus were supplied.

■ HAI/8/002

**UNDERGROUND WATER RESEARCH AND EXPLORATION**

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COMPLETED: 88-12-31

TOTAL COST: US \$2,500.00

OBJECTIVES:

APPLICATION OF ISOTOPE TECHNIQUES IN INVESTIGATIONS ON GROUNDWATER DYNAMICS AND SALINITY.

ACHIEVEMENTS:

This small project (US \$2500) financed by UNDP has had a significant impact on the work of the counterpart organization: the laboratory services provided by the Agency's Seibersdorf Laboratory served as a basis for comparing the results of chemical analyses obtained by the counterpart, while the results of the isotopic analyses carried out to study the groundwaters in the Port-au-Prince area (published in the Proceedings of the International Symposium on Isotope Techniques in Water Resource Development, IAEA, Vienna (1987) STI/PUB/757) were applied to studies of underground water reservoirs.

■ HUN/4/004

**CYCLOTRON LABORATORY**

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COMPLETED: 88-06-27

TOTAL COST: US \$1,958,750.91

OBJECTIVES:

ACQUISITION OF A CYCLOTRON FOR NUCLEAR STRUCTURE RESEARCH AND PRODUCTION OF RADIOISOTOPES.

ACHIEVEMENTS:

Under this project, initiated in 1979, the Institute of Nuclear Research, Debrecen, received a cyclotron and ancillary equipment. The cyclotron was put into operation in 1985. 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 the industrial, agricultural and medical fields, including isotope production. The Institute also organizes meetings, seminars, and group and individual training.

■ ICE/8/004

**ISOTOPES IN GEOTHERMAL STUDIES**

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COMPLETED: 88-05-31

TOTAL COST: US \$319,808.38

OBJECTIVES:

EXPLORATION AND EVALUATION OF GEOTHERMAL RESOURCES, GLACIERS AND GROUNDWATER.

**ACHIEVEMENTS:** A team of geothermal specialists familiar with the application of isotopic techniques has been established at the Science Institute of the University of Iceland. The physical properties of the complex TOCK-water vapour system was investigated in several geothermal areas. Mathematical models of the reservoirs have been developed for studying the hydropower and geothermal resources.

■ **IND/5/010**

**NUCLEAR RESEARCH IN AGRICULTURE**

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**COMPLETED:** 88-12-02

**TOTAL COST:** US \$62,338.49

**OBJECTIVES:**

TO IMPROVE THE QUALITY AND QUANTITY OF AGRICULTURAL PRODUCTION THROUGH THE USE OF NUCLEAR AND OTHER MODERN RESEARCH TECHNIQUES.

**ACHIEVEMENTS:**

A co-ordinated series of five projects under the title of "Nuclear research in agriculture" (IND/5/010-014) and having the overall objective of improving the quality and quantity of agricultural production through the use of nuclear as well as other modern research techniques involved four national institutes, namely the Indian Agricultural Research Institute (IARI), the Indian Veterinary Research Institute (IVRI), the National Dairy Research Institute (NDRI), and the Bhabha Atomic Research Centre (BARC) of the Indian Atomic Energy Commission. The first of the projects (IND/5/010) served as the "umbrella" project for the series, while the four remaining projects were designed to respond to the specific needs at the various institutions. The whole series was funded through the extrabudgetary contributions made available by Sweden through the Swedish International Development Authority (SIDA). The total sum committed in the period 1977 to 1982 was close to US \$2.2 million. The projects were operational over the period 1979-1988. The principal objective of the co-ordinated series of projects was to strengthen the research capabilities in agriculture by training and developing manpower, in particular by introducing staffs to new and modified techniques useful for improving crop production on the one hand and animal nutrition and health, and hence productivity, on the other. Work done is reported under the individual sub-projects. Project co-ordination was achieved using Agency experts, both in-house and external, to support local planning, the aims being to ensure optimum collaboration and to avoid duplication of effort. These visits were funded under the "umbrella" project.

■ **IND/5/011**

**NUCLEAR RESEARCH IN AGRICULTURE**

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**COMPLETED:** 88-12-02

**TOTAL COST:** US \$594,840.74

**OBJECTIVES:**

TO IMPROVE THE YIELD AND QUALITY OF MAJOR AGRICULTURAL CROPS THROUGH MUTATION BREEDING, AND THE EFFICIENT USE OF FERTILIZERS AND IRRIGATION WATER.

**ACHIEVEMENTS:**

Two linked projects (IND/5/011 and 014) provided the principal inputs to crop improvement and involved BARC and IARI. Radiation-induced mutation breeding resulted in the release for use by farmers of four improved varieties of crop plant, namely groundnut, pigeon pea, mung bean and jute. In addition, several other mutants are being evaluated, as are mutant varieties of rice, sesame, mustard, wheat and barley. Furthermore, fertilizer-use studies brought recognition of the value of ammonium polyphosphates as phosphate fertilizers, and they are now being produced commercially. Nitrogen uptake studies gave rise

to a farming practice that uses rotation of deep-rooting crops to bring deep nitrogen up to the shallow root zone of cereals; the zinc deficiency discovered to be an important negative factor in Indian soils is being counteracted by applying zinc in conjunction with the nitrogen fertilizer urea. Work on the persistence and degradation of chlorinated hydrocarbon pesticides appears to show that they might be more acceptable in developing countries such as India than research undertaken elsewhere has suggested. Hydrological studies were also undertaken in the arid Gujarat and Rajasthan regions, with a view to ensuring more rational use of groundwater resources. Considerable emphasis was laid on training, and 33 fellowships and three scientific visits were funded. In addition to the areas mentioned, experts also provided on-the-job training in mutation breeding, uptake of nutrients and micronutrients by the roots, and soil microbiology. Equipment to support these studies was provided. (See also the report on project IND/5/010.)

■ **IND/5/012**

**NUCLEAR RESEARCH IN AGRICULTURE**

COMPLETED: 88-12-02

TOTAL COST: US \$534,993.26

OBJECTIVES:

TO DEVELOP FEEDSTUFFS FROM AGRICULTURAL/INDUSTRIAL BY-PRODUCTS FOR THE EFFICIENT PRODUCTION OF MILK, MEAT AND WOOL, AND, IN THE ANIMAL HEALTH FIELD, TO PRODUCE VACCINES TO COMBAT PARASITIC AND PROTOZOAN INFECTIONS.

ACHIEVEMENTS:

IVRI has successfully conducted water metabolism and mineral requirement studies relating to cattle and buffalo, and good progress has been made in studying parasitic infections in Kashmir. Work on large animal respiration calorimetry has yet to commence, this having suffered from delays in inputs from the Indian Government (facilities and supporting equipment). The staff have themselves initiated work using the methodology for measuring the energy requirements of sheep in a small respiration chamber using equipment provided under the project. It was noted that several of the 19 IAEA fellows trained under the project have not subsequently been available for project-related work. (See also the report on project IND/5/010.)

■ **IND/5/013**

**NUCLEAR RESEARCH IN AGRICULTURE**

COMPLETED: 88-12-02

TOTAL COST: US \$313,387.62

OBJECTIVES:

TO DEVELOP FEEDSTUFFS FROM AGRICULTURAL/INDUSTRIAL BY-PRODUCTS FOR THE EFFICIENT PRODUCTION OF MILK, MEAT AND WOOL, AND, IN THE ANIMAL HEALTH FIELD, TO PRODUCE VACCINES TO COMBAT PARASITIC AND PROTOZOAN INFECTIONS.

ACHIEVEMENTS:

NDRI has been conducting isotope-aided studies aimed at improving animal husbandry. Inter alia, research aimed at providing sufficient energy and nitrogen for growing and lactating cattle and buffalo has included work on the use of locally available forage (such as beerseem and alfalfa) and agroindustrial waste products (such as straw and molasses) as feeds following suitable treatments and upgrading; this work is continuing. Similar work on the nutritional requirements of goats will be of value to the poorer farmers and villagers who cannot afford cattle or buffaloes. A clinical treatment has been developed for selenium poisoning (Degnala disease) and work on selenium metabolism is

expected to lead to preventive dietary modification for animals at risk. Practical guidelines on disease prevention are also expected to result from work on the interrelationship between poor vitamin A utilization (night blindness in livestock) and low dietary zinc. Radioimmunoassay techniques have been used effectively to study many aspects of reproductive efficiency, though field studies are still needed to relate results to practical implementation for the 90% of cattle and buffalo tended at the village level. Eleven fellowships were awarded in project-related fields. (See also the report on project IND/5/010.)

■ **IND/5/014**

**NUCLEAR RESEARCH IN AGRICULTURE**

COMPLETED: 88-12-02

TOTAL COST: US \$594,801.90

OBJECTIVES:

TO IMPROVE THE YIELD AND QUALITY OF MAJOR AGRICULTURAL CROPS THROUGH MUTATION BREEDING, AND THE EFFICIENT USE OF FERTILIZERS AND IRRIGATION WATER.

ACHIEVEMENTS:

Two linked projects (IND/5/011 and 014) provided the principal inputs to crop improvement and involved BARC and IARI. Radiation-induced mutation breeding resulted in the release for use by farmers of four improved varieties of crop plant, namely groundnut, pigeon pea, mung bean and jute. In addition, several other mutants are being evaluated, as are mutant varieties of rice, sesame, mustard, wheat and barley. Furthermore, fertilizer-use studies brought recognition of the value of ammonium polyphosphates as phosphate fertilizers, and they are now being produced commercially. Nitrogen uptake studies gave rise to a farming practice that uses rotation of deep-rooting crops to bring deep nitrogen up to the shallow root zone of cereals; the zinc deficiency discovered to be an important negative factor in Indian soils is being counteracted by applying zinc in conjunction with nitrogen fertilizer urea. Work on the persistence and degradation of chlorinated hydrocarbon pesticides appears to show that they might be more acceptable in developing countries such as India than research undertaken elsewhere has suggested. Hydrological studies were also undertaken in the arid Gujarat and Rajasthan regions, with a view to ensuring more rational use of groundwater resources. Considerable emphasis was laid on training, and 33 fellowships and three scientific visits were funded. In addition to the areas mentioned, experts also provided on-the-job training in mutation breeding, uptake of nutrients and micronutrients by the roots, and soil microbiology. Equipment to support these studies was provided. (See also the report on project IND/5/010.)

■ **INS/1/010**

**SECONDARY STANDARDS DOSIMETRY LABORATORY**

COMPLETED: 88-12-19

TOTAL COST: US \$326,219.56

OBJECTIVES:

TO ESTABLISH IN BATAN AN SSDL WHICH WILL FUNCTION AS A REFERENCE LABORATORY FOR RADIATION DOSIMETRY AT THE NATIONAL LEVEL.

ACHIEVEMENTS:

The project established a Secondary Standards Dosimetry Laboratory (SSDL) in Jakarta, providing calibration and dose measuring equipment to cover the dose ranges of interest to users in the country. Experts made seven visits in the period 1980-87 to undertake training and to assist with setting up and calibrating the equipment. The SSDL is now providing calibration services for



radiation measuring devices in use in hospitals and clinics, in industry (non-destructive testing, logging, gauging) and in the various research centres of the National Atomic Energy Agency (BATAN) on a routine basis. It is also providing services for the measurement of radiation outputs from therapeutic sources in hospitals. The SSDL Jakarta has been appointed by the national authorities as the National Calibration Facility in Indonesia.

■ **INS/5/018**

**AGRICULTURAL PRODUCTION**

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COMPLETED: **88-12-31** TOTAL COST: **US \$1,644,643.02**

OBJECTIVES: TO MAKE MORE EFFECTIVE USE OF ISOTOPE AND RADIATION TECHNIQUES IN NATIONAL RESEARCH EFFORTS AIMED AT INCREASING AGRICULTURAL PRODUCTION.

ACHIEVEMENTS: Both development and immediate objectives of this UNDP-financed and Agency-executed project have been successfully met. Facilities for isotope and radiation-aided research on practical agricultural problems have been strengthened at the Centre for the Application of Isotopes and Radiation (CAIR), both by way of trained personnel and equipment. Effective use has been made of isotope and radiation methodologies for production-oriented research in the fields of plant breeding, soil, fertilizer and crop management practices, control of insect pests, effective and safe use of pesticides, and on animal nutrition and reproduction. Some of the results have already been released to farmers (e.g. improved varieties of wet-land rice, soybean, upland rice and mung bean; animal feed supplements in the form of solid molasses and mineral blocks made from agroindustrial by-products; better soil-moisture and nitrogen-fertilizer practices for multiple and sequential cropping systems under rain-fed conditions such as upland rice/soybean/cowpea or upland rice/corn/cowpea, and for the use of Azolla as a source of biologically fixed nitrogen in rice paddies). Entomological research has provided valuable dispersion data on the brown plant hopper and the stemborer (rice insect pests) and on screening rice and soybean plants for insect-pest resistance. Technology for slow-release pesticides for cotton, sugarcane and soybean and problems relating to persistence in the rice/fish ecosystem were also studied. In these areas, effective co-operation has been established between CAIR, other national agricultural research institutes of the Ministry of Agriculture and the universities.

■ **INS/9/009**

**RADIATION PHYSICS**

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COMPLETED: **88-12-19** TOTAL COST: **US \$8,419.41**

OBJECTIVES: TO ESTABLISH GRADUATE PROGRAMME IN TEACHING RADIATION PHYSICS AND REACTOR SAFETY.

ACHIEVEMENTS: The expert assigned under the project provided the necessary advice on the design of a curriculum and training programme appropriate for the graduate course at the Bandung Institute of Technology.

■ INT/1/018

**NUCLEAR DATA TECHNIQUES AND INSTRUMENTATION**

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COMPLETED: 88-05-31

TOTAL COST: US \$982,001.13

OBJECTIVES:

TRANSFER OF TECHNOLOGY AND KNOW HOW REQUIRED TO MAKE NUCLEAR MEASUREMENTS IN DEVELOPING COUNTRIES, INCLUDING PROMOTION OF COLLABORATION.

ACHIEVEMENTS:

Seventeen expert missions to thirteen countries were organized. Thirty-one fellowships and six scientific visits were awarded in respect of eight countries. Over 120 items of equipment were provided to the various participating institutes. The project has resulted in the transfer of appropriate technology and know-how required for undertaking nuclear measurements. Co-ordination of research efforts has been achieved through promotion of collaboration between the institutes in the various countries.

■ INT/4/089

**POWER AND SAFETY MANPOWER DEVELOPMENT**

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COMPLETED: 88-04-06

TOTAL COST: US \$24,249.57

OBJECTIVES:

TO DEVELOP CONCEPT FOR THE PLANNING AND ORGANIZATION OF NATIONAL TRAINING COURSES IN NUCLEAR POWER AND SAFETY.

ACHIEVEMENTS:

The approach of the Agency on how to assist its developing Member States in the planning and organization of national training courses on nuclear power, safety and the fuel cycle has been analysed. Possible training courses in various relevant subject areas have been identified, and the expected demand for these courses assessed. Based on the analysis, a country-specific approach has been adopted, focusing on in-depth studies of the particular needs of individual countries which require such Agency assistance.

■ INT/4/090

**NUCLEAR POWER PROMOTION (EXPERT GROUP)**

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COMPLETED: 88-04-15

TOTAL COST: US \$50,000.00

OBJECTIVES:

SENIOR EXPERT GROUP MEETING TO STUDY MECHANISMS FOR PROMOTING NUCLEAR POWER IN DEVELOPING COUNTRIES.

ACHIEVEMENTS:

The Expert Group met three times in 1986 and twice in 1987, and the final report on its study was published in August 1987 (Promotion and Financing of Nuclear Power Programmes in Developing Countries, IAEA, Vienna, STI/PUB/777). Recommendations were made for expanded or strengthened Agency programmes to assist developing countries to plan and implement nuclear power programmes. Among the areas considered were the availability of an integrated package of assistance from the Agency, the need for regional co-operation and exchange of information and results relating to energy and nuclear power planning studies, and for close co-operation with the World Bank. Member States are using the publication as an aide-memoire in planning energy and nuclear power options.

■ IVC/5/013

**PHYSIOLOGY OF HEVEA**

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COMPLETED: 88-04-20

TOTAL COST: US \$178,433.64

OBJECTIVES:

TO IMPROVE THE QUALITY AND TO INCREASE THE QUANTITY OF RUBBER PRODUCED.

ACHIEVEMENTS:

The project succeeded in establishing a physiology laboratory of international standard for applied research in rubber tree breeding and rubber production. In addition to local training, one overseas fellowship was granted. The new research methods introduced and developed under the project have led to a substantial decrease in the number of rubber trees with 'dry cuts', from 30% to less than 5%, and to an increase in rubber production per tapper and day of 250% in 1985 (with respect to the situation in 1970). The results have contributed towards expanding the rubber plantations, which have increased from 12,000 hectares in 1971 to 49,745 hectares in 1987. The new exploitation methods developed under the project are also contributing to the rubber industry in other countries, since over 35 scientific papers and books were issued or published.

■ KEN/6/007

**RADIOISOTOPES IN PARASITOLOGY**

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COMPLETED: 88-12-19

TOTAL COST: US \$107,912.33

OBJECTIVES:

TO DEVELOP RADIOISOTOPE TECHNIQUES FOR DIAGNOSING PARASITIC INFECTIONS

ACHIEVEMENTS:

The project was formulated following an advisory mission to the Kenyan Medical Research Institute in 1985. Radioisotopes were to be used for diagnosis of infections such as leishmaniasis, malaria, filariasis and schistosomiasis, endemic in Kenya. The project was financed by an extrabudgetary contribution from the United Kingdom. Through provision of essential equipment and supplies, including chemicals, a functional laboratory has been established for parasitological research involving modern immunological techniques. An Agency expert spent three months at the project and not only trained Kenyan scientists, but also assisted them in performing experiments using molecular biological techniques (DNA cloning and hybridization, etc.). In support of future activities by Kenyan scientists, three nationals were recommended for further training, in addition to one fellow trained using project funds. The related co-ordinated research programme was successfully completed in October 1988.

■ KEN/8/004

**NON-DESTRUCTIVE TESTING**

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COMPLETED: 88-12-19

TOTAL COST: US \$144,995.68

OBJECTIVES:

INTRODUCTION OF NON-DESTRUCTIVE METHODS FOR TESTING MATERIALS AS A SERVICE TO LOCAL INDUSTRY

ACHIEVEMENTS:

The Ministry of Transport and Communications sought Agency assistance in upgrading its Materials Branch facilities, which are responsible for testing a wide variety of materials, to enter into the field of non-destructive testing (NDT). Extra-budgetary contributions by the United States of America resulted in the establishment of a well-equipped NDT laboratory. Staff were trained in practical

applications of NDT techniques, with special emphasis on the use of gamma radiography, by Agency experts, three of whom provided some 10 months of practical guidance. The laboratory is now being used by the Kenya Bureau of Standards, industry and others in Kenya for all types of non-destructive testing (X-ray, radiographic, ultrasonic, dye penetrant, magnetic particle etc.). Furthermore, its capabilities have opened up the possibility of engaging in bilateral activities with other countries. Two Kenyan nationals were trained in support of the project by means of project-related fellowships, while one gained additional experience by means of a scientific visit to similar institutions in Indonesia, Malaysia and Thailand.

■ **KUW/8/002**

**USE OF ISOTOPE HYDROLOGY**

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CANCELLED: **88-07-26**

OBJECTIVES:

TO DETERMINE THE AGE OF THE GROUND WATER OF SOME AQUIFERS IN KUWAIT

REASON FOR CANCELLATION:

The analyses of environmental isotopes in water samples were done by Agency's Isotope Hydrology Section and did not require any funding from the Department of Technical Co-operation.

■ **LIB/5/005**

**FOOD PRESERVATION BY IRRADIATION**

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COMPLETED: **88-04-21**

TOTAL COST: **US \$14,173.84**

OBJECTIVES:

ESTABLISHMENT OF A FOOD IRRADIATION PROGRAMME.

ACHIEVEMENTS:

An expert was assigned to the Tajoura Nuclear Research Centre to evaluate the technological and economic feasibility of setting up a programme leading to commercial-scale food irradiation. He recommended food products to be irradiated, and formulated a realistic programme of work. In order to build up local expertise, one fellowship was granted for training at the International Facility for Food Irradiation Technology at Wageningen, Netherlands, and two project-related ones for training in Hungary.

■ **MAG/1/004**

**NUCLEAR PHYSICS**

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COMPLETED: **88-08-30**

TOTAL COST: **US \$362,585.55**

OBJECTIVES:

ESTABLISH RESEARCH AND TRAINING FACILITIES IN APPLIED NUCLEAR PHYSICS.

ACHIEVEMENTS:

The Faculty of Science of the University of Madagascar established a Nuclear Physics Laboratory with Agency assistance in 1977. In 1979, a seven-year project was approved in which the laboratory was to be steadily upgraded to be able to undertake studies of value to the national economy using applied nuclear techniques. In the period 1981 to 1987, ten Agency experts visited the University to assist with commissioning of equipment and training. The principal techniques introduced were X-ray fluorescence analysis, gamma spectrometry and solid-state nuclear track detection for radon determination. The success of the project motivated the University to expand the services the

laboratory was offering to provide maintenance and repair services for nuclear and electronic equipment used at other institutions in Madagascar. Equipment provided included X-ray fluorescence and gamma spectrometry systems, semiconductor detectors, a cryogenic system, and computer hardware and software used for data analysis. Four fellowships were awarded, of which two were for training at the University and two for training abroad. Three electronic technicians were also trained, one of them attending an Agency training course. At present, quantitative and other types of analysis are being carried out on variety of samples, including geological, organic and alloy specimens. Research student have received training and the maintenance and repair facilities have been strengthened.

■ **MAG/3/004**

**NUCLEAR RAW MATERIALS**

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COMPLETED: **88-08-29**

TOTAL COST: **US \$371,295.93**

OBJECTIVES:

EXPLORATION AND DEVELOPMENT OF URANIUM RESOURCES IN THE FORT DAUPHIN AREA. IDENTIFICATION OF OTHER SUITABLE EXPLORATION TARGETS. UPGRADING OF THE URANIUM ANALYSIS LABORATORY.

ACHIEVEMENTS:

The Government of Madagascar had been receiving Agency assistance in defining its possible uranium resources. In 1979, this project was established to be complementary to a UNDP-supported one. Following prospection in a number of areas, a detailed study was made of the uranium ore deposits (uranothorianite) in the Fort Dauphin region to assess their economic viability. Favourable areas for uranium prospecting in this region were selected, and a work plan was prepared. To support this work, the capacity of the analytical laboratory supporting the exploration programme was enhanced by the provision of additional equipment, and on-the-job training was provided on methods of analysis by fluorimetric, radiometric and atomic absorption methods. Such training was also provided in relation to uranium exploration using geochemical techniques and radiometric equipment; two complete teams were trained. Further training was provided in France and in Canada to selected staff in the form of eight project-related and one project-funded fellowships. The staff are now able to analyse and evaluate survey data, and have also been to organize the wealth of data gathered in a computer-based management system.

■ **MEX/9/029**

**RADIOACTIVE WASTE TREATMENT AND DISPOSAL**

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COMPLETED: **88-03-07**

TOTAL COST: **US \$25,000.00**

OBJECTIVES:

TO ADVISE ON INFRASTRUCTURE NEEDED FOR RADIOACTIVE WASTE TREATMENT AND DISPOSAL RESULTING FROM THE OPERATION OF THE LAGUNA VERDE NPP.

ACHIEVEMENTS:

A study concerning the on-site storage of radiation wastes was conducted as a preliminary to the design and construction of the on-site storage facility of the Laguna Verde Nuclear Power Plant.

■ MLI/5/004

**RADIOISOTOPES IN AGRICULTURE**

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COMPLETED: 88-09-07

TOTAL COST: US \$141,632.80

OBJECTIVES:

INCREASE CROP PRODUCTION UNDER DRY FARMING CONDITIONS THROUGH DEVELOPMENT OF ADEQUATE WATER CONSERVATION MEASURES.

ACHIEVEMENTS:

Nuclear and related equipment for soil-moisture studies and training in its use was provided, as well as a vehicle so that data could be collected in the field. In addition, five project-related fellowships were awarded. Four experts undertook eight missions in the period 1980-88, and topics of specific interest were modification of physical properties of soils, methods to improve water conservation as part of water uptake studies, and use of nitrogen-15 as tracer to study nitrogen uptake in relation to yields. Data were collected from three regions in Mali, and at present specific management practices are being developed to improve water conservation for rain-fed crops.

■ NIC/5/002

**WATER BALANCE STUDIES**

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COMPLETED: 88-11-18

TOTAL COST: US \$32,162.13

OBJECTIVES:

TO IMPROVE THE MANAGEMENT OF WATER RESOURCES.

ACHIEVEMENTS:

The project, through the acquisition of neutron soil-water probes, a tensiometer and computer software, has made it possible to improve water-balance studies for selected crops in the more fertile regions of Nicaragua, thereby permitting an expansion of and more practical approach to mathematical modelling of water balance. This is leading to better management of water resources. Following on from these studies, work is being planned on the use of isotopic techniques for optimization of fertilizer use.

■ NIC/8/003

**ISOTOPIC HYDROLOGY IN MINING**

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COMPLETED: 88-11-18

TOTAL COST: US \$44,831.23

OBJECTIVES:

TO DETERMINE THE ORIGIN OF GROUNDWATER FLOODING THE EL LIMON GOLD MINE USING ISOTOPE TECHNIQUES WITH A VIEW TO OBTAINING A BETTER UNDERSTANDING OF GROUNDWATER RECHARGE AND THE DEVELOPMENT OF METHODS FOR COPING WITH THE FLOODING PROBLEM.

ACHIEVEMENTS:

Isotope techniques were introduced to study the hot water flooding at the "El Limon Gold Mines". It was noted that (a) water flooding in the mines was coming from a deep regional system, probably from the Marabios mountains, (b) the water was being heated by a local geothermal anomaly, and (c) complementary studies were needed, involving drilling of new wells in the vicinity of the mines, with the intention of diverting the water from the geological formations of the mines.

■ NIR/5/011

**STERILE-MALE TECHNIQUE FOR CONTROL OF TSETSE FLY**

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COMPLETED: 88-11-22

TOTAL COST: US \$1,965,853.38

OBJECTIVES:

TO INVESTIGATE THE ADVANTAGES, EFFICACY AND ECONOMICS OF THE STERILE-INSECT-RELEASE TECHNIQUE FOR CONTROLLING OR ERADICATING A RIVERINE SPECIES OF TSETSE FLY AND THE USE OF THIS TECHNIQUE ON A LARGE SCALE UNDER CHARACTERISTIC CONDITIONS.

ACHIEVEMENTS:

This major project received extrabudgetary funding from the Governments of Belgium, the Federal Republic of Germany, Italy and Sweden, and gifts-in-kind from the Governments of the German Democratic Republic and the United Kingdom. The objectives of the project were achieved, with the eradication of the tsetse fly *Glossina palpalis palpalis* from the 1500 square kilometre project area. There has been the expected marked decrease in the incidence of trypanosomiasis in cattle as a result. The laboratory in Vom and the project sub-station are now very well equipped, while more than ten Nigerian staff have been trained in various aspects of the sterile insect technique as applied to tsetse flies, including breeding and rearing. Consideration is being given to extending these activities to other areas.

■ PAN/2/003

**RADIOPHARMACEUTICALS**

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COMPLETED: 88-11-04

TOTAL COST: US \$199,679.30

OBJECTIVES:

QUALITY CONTROL OF RADIOLABELLED COMPOUNDS.

ACHIEVEMENTS:

This multi-year project aimed to establish quality control of radiopharmaceuticals using chemical, physical and biological techniques. Two project-related fellowships for the chief counterpart provided specialized training, while a staff member was granted a scientific visit to relevant institutes in Denmark and Sweden. Training in laboratory organization, and techniques and procedures in quality control was undertaken by Agency experts using a range of equipment provided under the project. A laboratory has been set up at the Specialized Analysis Institute of the University of Panama and its services help to ensure proper quality control of the radiopharmaceuticals being increasingly used in medical diagnosis and therapy at various hospitals in the country.

■ PAR/1/002

**NUCLEAR SCIENCE**

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COMPLETED: 88-12-21

TOTAL COST: US \$483,476.96

OBJECTIVES:

TO ESTABLISH A LABORATORY FOR APPLICATIONS OF NUCLEAR TECHNIQUES AND RESEARCH.

ACHIEVEMENTS:

A well organized nuclear measurements laboratory was set up to serve groups requiring analytical services (including gamma, Moessbauer and X-ray spectrometry, diffraction analysis and thermoluminescence dosimetry); analyses are performed in connection with plant physiology (crop improvement), animal nutrition and environmental studies, as well as chemical and physical studies, in support of the technological development of the country. Some of the staff were trained to "trainer" level, and the laboratory is now regularly used for training. A national training course (March/April 1987), an

ARCAL course (November/December 1987) and an ARCAL workshop (April/May 1988) have been held there, while a further ARCAL training course is envisaged for 1989. Training has also been provided to selected staff to ensure proper maintenance and servicing of the equipment, and they are now capable of solving efficiently the majority of nuclear instrumentation problems.

■ PER/0/008

**NUCLEAR RESEARCH CENTRE**

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COMPLETED: 88-12-02

TOTAL COST: US \$174,649.87

OBJECTIVES:

TO SUPPLEMENT THE ACTIVITIES OF THE REACTOR PHYSICS LABORATORY. TO INTRODUCE REACTOR KINETIC STUDIES WITH PULSED SOURCES.

ACHIEVEMENTS:

An extrabudgetary contribution from the Government of Finland funded the project. It provided the basis for the Peruvian Nuclear Energy Institute to obtain a more powerful computer and peripherals for the use of scientists in different fields of research (including work being done under project PER/9/011). The support is also linked to the Government of Finland's support for the expansion of the use of the neutron generator (project PER/1/007). A spectrometric and a liquid nitrogen system were also provided, the latter to avoid the difficulties that had been experienced in assuring regular supplies from abroad, essential for the delicate semiconductor detectors used in spectrometry. Subsequently, spares for this unit were obtained. As additional support, three project-related fellowships were awarded.

■ PER/0/016

**NUCLEAR ENERGY PROGRAMME MONITORING AND SUPPORT**

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COMPLETED: 88-12-30

TOTAL COST: US \$119,148.21

OBJECTIVES:

TO PROMOTE EFFICIENT MANAGEMENT OF IPEN'S LARGE-SCALE NUCLEAR ENERGY PROGRAMME.

ACHIEVEMENTS:

The large-scale nuclear development programme launched by Peru relating to assessment of the country's nuclear raw material potential, the application of isotope techniques in medicine, biology and agriculture, the establishment of a nuclear research centre at Huarangal, and several UNDP financed projects being executed by the Agency made it necessary, in response to recommendations made by UNDP, to provide for a time a liaison officer and office in the country to co-ordinate technical co-operation activities in the nuclear field. A status has now been achieved whereby the prime responsibility for such functions should be taken over by the Peruvian Nuclear Energy Institute.

■ PER/1/007

**NUCLEAR ANALYTICAL SERVICES**

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COMPLETED: 88-12-20

TOTAL COST: US \$161,176.69

OBJECTIVES:

TO ENHANCE IPEN'S CAPABILITY FOR TRACE ELEMENT ANALYSIS BY NUCLEAR ACTIVATION ANALYSIS OF INTEREST IN THE MEDICAL, AGRICULTURAL AND ENVIRONMENTAL SCIENCES AS WELL AS TO INDUSTRY.

ACHIEVEMENTS:

The project was made operational through an extrabudgetary contribution from the Government of Finland. The installation of a gamma spectrometry and an irradiation sample transfer system has resulted in an expansion of work utilizing



a 14 MeV neutron generator for fast-neutron activation analysis. Studies include determination of nitrogen in food protein samples, and aluminium and silicon in rock samples, as well as elemental uranium analysis in yellow-cake samples using delayed-neutron counting techniques. These and other analyses serve both the public and private sectors in the country.

■ PER/2/010

**PRODUCTION AND USE OF RADIOISOTOPES**

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COMPLETED: 88-12-02

TOTAL COST: US \$76,262.91

OBJECTIVES:

TO PREPARE FOR THE PRODUCTION OF RADIONUCLIDES AND LABELLED COMPOUNDS AND TO EXTEND NUCLEAR MEDICINE ACTIVITIES IN THE PILOT CENTRE FOR NUCLEAR BIOLOGY AND MEDICINE.

ACHIEVEMENTS:

The project made possible the expansion of activities relating to nuclear medicine at the Pilot Centre for Nuclear Biology and Medicine of the Peruvian Nuclear Energy Institute in Lima, through the improvement of procedures and application of nuclear techniques in the production of labelled compounds and radiopharmaceuticals, in particular those used in nuclear medical diagnostics. An Agency expert provided guidance on quality control of radiopharmaceuticals. The project has enabled the Centre to extend the services it provides to government hospitals where such diagnostic studies are available as part of health care.

■ PER/4/008

**NUCLEAR POWER PLANNING**

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COMPLETED: 88-03-18

TOTAL COST: US \$43,242.99

OBJECTIVES:

FEASIBILITY STUDY ON ECONOMICS OF NUCLEAR POWER IN THE COUNTRY; TRAINING OF PERSONNEL.

ACHIEVEMENTS:

A pre-feasibility study on the economics of nuclear power in Peru was prepared with Agency expert assistance in 1983. Two further experts assisted in updating it in 1984, following which two Peruvian consultants assisted in a review undertaken at the Agency in Vienna. In 1985, "Electroperu" and the Peruvian Nuclear Energy Institute jointly studied the report, subsequently requesting that the economic data regarding the various electricity generating options be reassessed. In 1987, an Agency mission reviewed the status of the project. In view of the Government's decision to concentrate efforts and manpower in the nuclear field on the Huarangal Research Centre and the shift in priorities for producing electricity to gas-fuelled thermal plants, the project was considered completed.

■ PER/9/015

**ENVIRONMENTAL RADIOACTIVITY**

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COMPLETED: 88-11-18

TOTAL COST: US \$69,192.76

OBJECTIVES:

ESTABLISHMENT OF NATIONAL ENVIRONMENTAL MONITORING NETWORK AND EVALUATION OF RADIATION DOSES RESULTING FROM THE ENVIRONMENT.

ACHIEVEMENTS:

Particular attention was focused on a review of the environmental impact of activities at the Huarangal Research Centre site (where the RP-10 reactor has been installed) and on an assessment of collective population dose. Equipment

provided made possible complementary studies on aerosol characteristics. Assistance was also given to planning for a large-scale radioecology research programme relating to the Amazon Basin and to suggesting new working procedures for the national fall-out monitoring programme, with particular reference to radionuclide monitoring in the coastal and marine environment and radiological control of food imports.

■ PHI/0/006

**NUCLEAR MATERIALS ACCOUNTING**

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COMPLETED: 88-11-18

TOTAL COST: US \$30,226.89

OBJECTIVES:

TO ESTABLISH A NATIONAL COMPUTERIZED SYSTEM OF ACCOUNTING AND CONTROL (SSAC) OF NUCLEAR MATERIALS.

ACHIEVEMENTS:

The computerization of the Philippine nuclear materials accounting system was completed in 1986 by the Philippine Atomic Energy Commission (PAEC), following recommendations made by Agency experts. The National Computerized System of Accounting for and Control of Nuclear Materials has since undergone extensive testing and is now in routine use. A presentation of the System was made by the representative of the PAEC during the Agency's international training course on "The Basic State System of Accounting for and Control of Nuclear Materials", held in the USSR in October 1986.

■ PHI/4/016

**QUALITY ASSURANCE/QUALITY CONTROL TRAINING CENTRE**

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COMPLETED: 88-12-21

TOTAL COST: US \$316,668.20

OBJECTIVES:

ESTABLISHMENT OF A TRAINING CENTRE FOR QUALITY ASSURANCE/QUALITY CONTROL IN NUCLEAR POWER PLANTS.

ACHIEVEMENTS:

This project was funded by an extrabudgetary contribution from the United States of America. A training centre concerned with quality assurance (QA) and quality control (QC) in connection with the operation of nuclear power plants, with particular reference to the Philippines Nuclear Power Plant No.1 (PNPP-1), was set up and equipped with basic instruments for non-destructive testing, including eddy-current and ultrasonic test equipment. A series of national training courses were held (general employee training on QA/QC; QA relating to nuclear fuels; pre-operation QA for PNPP-1; start-up QA for PNPP-1; a trainers' course on ultrasonic and eddy-current testing methods; use of these methods in industrial applications). The project assisted the Government by developing manpower for QA/QC purposes; with the moratorium on nuclear power activities in the Philippines, the primary purpose of the project had ceased, and the project was closed. Nevertheless, the training provided will be put to good use in support of local industry, thereby promoting national development.

■ PHI/4/017

**NUCLEAR ENGINEERING EDUCATION**

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COMPLETED: 88-12-19

TOTAL COST: US \$146,839.12

OBJECTIVES:

IMPROVEMENT OF THE NUCLEAR ENGINEERING EDUCATION PROGRAMME WITH SPECIAL REFERENCE TO COMPUTATIONAL CAPABILITIES AND REACTOR ANALYSIS.

**ACHIEVEMENTS:** The VAX-II/750 computer of the Philippine Atomic Energy Commission was upgraded by provision of hardware and peripherals. The system was to be used to run various computer programs used in the nuclear industry (e.g. codes such as COBRA or IRT). The system has been employed both for training and for producing a chapter of the final safety analysis report for the Philippines Nuclear Power Plant No.1. Between 1983 and 1985, Agency experts gave training on the use of the various codes, while a fellowship at a reactor training centre abroad was granted. Funding was both from extrabudgetary contributions by the United States of America and from the Agency's Technical Assistance and Co-operation Fund. In view of the moratorium on the nuclear power programme in the Philippines, the project was reviewed and further activities suspended.

■ **PHI/9/014**

**NUCLEAR EMERGENCY PLANNING**

**COMPLETED: 88-10-19**

**TOTAL COST: US \$164,534.89**

**OBJECTIVES:** TO REVIEW THE OVERALL CO-ORDINATION OF EMERGENCY RESPONSE PLANS AND TO IMPROVE CAPABILITIES FOR ACCIDENT MONITORING.

**ACHIEVEMENTS:** It was envisaged in 1984 that the emergency plans and preparedness programme in connection with the Philippines Nuclear Power Plan No.1 would have been completed, reviewed and tested in a full-scale exercise by the end of 1985. The Agency was asked to assist with the review, and with provision of equipment, including monitoring and communications systems. Training was provided by means of four project-related fellowships and the sending of one of the counterparts to attend a large-scale exercise in Malmö, Sweden. The emergency response plans were developed but, with the moratorium on the nuclear power programme, further activities were placed in abeyance.

■ **POR/1/002**

**SECONDARY STANDARDS DOSIMETRY LABORATORY**

**COMPLETED: 88-10-19**

**TOTAL COST: US \$267,011.74**

**OBJECTIVES:** TO START THE OPERATION OF A SSDL.

**ACHIEVEMENTS:** The project to establish a Secondary Standards Dosimetry Laboratory (SSDL) in Portugal started with two counterpart institutes. In 1986, it was decided to concentrate all SSDL activities in the Department of Radiological Protection and Safety of the National Laboratory of Engineering and Industrial Technology of the Ministry of Industry and Technology. The Department received a protection-level secondary standards system, an X-ray unit and transmission chamber system, a cobalt-60 teletherapy unit for calibration purposes and a panoramic irradiator. Experts assisted with the planning and design of a laboratory, and training was also provided. The SSDL laboratory is now operational. (Assistance in the fields of medical physics and clinical dosimetry for the San Francisco Gentil Institute of Oncology originally included and provided for in this project were transferred from 1987 to project POR/6/002.)

■ **POR/1/003**

**ACCELERATOR UTILIZATION**

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COMPLETED: **88-07-12**

TOTAL COST: **US \$178,226.65**

OBJECTIVES:

TO REJUVENATE THE VAN DE GRAAFF ACCELERATOR AT LNETI.

ACHIEVEMENTS:

With funding provided using an extrabudgetary contribution from the United States of America and the Agency's Technical Assistance and Co-operation Fund, the Van de Graaff accelerator was equipped with facilities to carry out research in the fields of atomic physics and nuclear solid-state physics. Essential equipment items included a computer system, a multichannel analyser, a semi-conductor detector and vacuum equipment. Experts assisted with setting up the equipment and provided training. Three fellowships in related fields were granted. A research team is presently working in the aforementioned fields; the analytical techniques, particularly proton-induced X-ray emission and Rutherford back-scattering, are being introduced as effective tools for studies relating to, inter alia, biology, aerosols, and silicon devices.

■ **POR/2/010**

**RADIOPHARMACEUTICAL DEVELOPMENT**

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COMPLETED: **88-10-19**

TOTAL COST: **US \$140,232.94**

OBJECTIVES:

TO STRENGTHEN THE INSTRUMENTAL CAPABILITIES OF THE LABORATORY.

ACHIEVEMENTS:

Following on from two Agency projects on radioisotope production (POR/2/007; POR/4/009), this footnote-a project, which was financed by the Federal Republic of Germany and the United States of America, aimed to strengthen the capabilities of the National Laboratory with regard to production and distribution of technetium-99m labelled radiopharmaceuticals and radioimmunoassay (RIA) kits. In addition to provisions of equipment, experts assisted with project planning and training, the latter supported by four fellowships for local staff. Labelled radiopharmaceuticals and solid phase RIA kits are now being produced and distributed to Portuguese nuclear medicine centres and to the State endocrinology laboratory. Research efforts are being extended to include the chemistry of technetium with a view to improving the formulations, use and mechanisms of action of these radiopharmaceuticals.

■ **POR/3/007**

**URANIUM EXPLORATION**

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COMPLETED: **88-12-01**

TOTAL COST: **US \$85,466.02**

OBJECTIVES:

TO IMPROVE BOREHOLE LOGGING SYSTEMS AND LOGS INTERPRETATION AND FACILITATE URANIUM EXPLORATION ACTIVITIES.

ACHIEVEMENTS:

Improvement of the borehole logging activities through provision of gamma logging equipment and a computer system has been achieved. Better understanding of the borehole logging techniques was imparted to national counterparts, and advice on data interpretation and on airborne radiometric surveying was provided through expert missions. A scientific visit was awarded to familiarize a staff member with up-to-date geological survey techniques.

■ **POR/8/003**

**LOW-LEVEL RADIOACTIVITY MEASUREMENTS**

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COMPLETED: **88-05-02**

TOTAL COST: **US \$46,615.38**

OBJECTIVES:

TO ESTABLISH A CAPABILITY FOR MEASURING NATURAL RADIOCARBON SAMPLES FROM VARIOUS SOURCES.

ACHIEVEMENTS:

Under this footnote-a project financed by the United States of America, an automatic liquid scintillation spectrometer was provided for the National Laboratory's newly established radiocarbon laboratory. Measurements of carbon-14 included work in the fields of geology, hydrology and archeology. However, a need to increase the national activities in isotope hydrology was felt and it was decided to create an environmental isotopes laboratory; this is being undertaken via project POR/8/004, initiated in 1986 as a complementary project. Work on carbon-14 analysis is proceeding satisfactorily, and the two laboratories share the work on hydrological investigations.

■ **POR/9/006**

**RADIATION PROTECTION IN URANIUM MINING AND MILLING**

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COMPLETED: **88-05-11**

TOTAL COST: **US \$1,266.24**

OBJECTIVES:

TO ESTABLISH A RADIATION MONITORING SYSTEM AND REGULATIONS FOR RADIATION PROTECTION IN MINING AND MILLING OF URANIUM.

ACHIEVEMENTS:

Following a preparatory expert mission to Portugal and further discussions with governmental authorities, it was decided not to implement the project in the form originally planned. Two radiological safety projects have been approved for 1988, and the extent to which radiation protection in uranium mining and milling is covered by one or both of the projects is now under consideration.

■ **RAF/0/002**

**MICROCOMPUTERS**

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COMPLETED: **88-09-08**

TOTAL COST: **US \$321,416.64**

OBJECTIVES:

TO TRAIN SCIENTISTS AND ENGINEERS IN THE USE OF DESK-TOP COMPUTERS AND MICROPROCESSORS WITH THE AIM OF PROMOTING THEIR USE IN THE NUCLEAR ENERGY PROGRAMMES.

ACHIEVEMENTS:

Through this regional project on microcomputers, originally requested by three African governments, scientists and engineers from six African countries learnt how to use desk computers and how to program for scientific studies such as X-ray fluorescence and Moessbauer spectrometry. The introductory course was followed by 19 participants in Ghana, 15 in Kenya, 17 in Madagascar, 14 in the Sudan, 15 in Tanzania and 15 in Zambia. A follow-up interfacing course was followed by 8 engineers in Madagascar, 9 in Sudan, 15 in Tanzania and 6 in Zambia, and advanced course in FORTRAN programming was followed by 13 participants in Ghana and 21 in the Sudan. Subsequently, each participating country received one of the desk computers and printers used for the course.

■ RER/5/002

**NUCLEAR APPLICATIONS IN AGRICULTURE**

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COMPLETED: 88-12-20

TOTAL COST: US \$353.62

OBJECTIVES:

ESTABLISHMENT OF SPECIAL FACILITIES FOR MUTATION TECHNIQUES.

ACHIEVEMENTS:

Following a preparatory mission undertaken by an Agency staff member, it was accepted that the objectives of this project could better be met if the activities were undertaken as national projects with similar objectives but in which the specific needs of the different countries in respect of mutant varieties could be more effectively catered for. The funds reserved for this regional project were, therefore, reallocated.

■ RER/9/002

**COMPUTER-AIDED SAFETY ANALYSIS**

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COMPLETED: 88-11-04

TOTAL COST: US \$1,073,683.97

OBJECTIVES:

INSTALLATION AND USE OF SAFETY RELATED COMPUTER CODES SUCH AS SIMULATIONS OF NUCLEAR REACTOR ACCIDENTS.

ACHIEVEMENTS:

Many countries embarking on or having nuclear power programmes do not have access to sufficiently powerful computing facilities as are now needed for computer-aided safety analyses, e.g. loss-of-coolant accident studies. Furthermore, access to certain major codes is restricted. This regional project was set up in response to requests from several countries that operate or have an interest in WWER reactors. The Agency was given permission to install the codes on its computer, and has been allowed to make this facility available for training and performing studies in Vienna. Computer time was funded through a sub-contract. Consultants from Bulgaria, Czechoslovakia, Hungary, Poland, Turkey and Yugoslavia made use of the facility and of workshops and study groups that were set up to validate the codes (using experimental results offered by Hungary, obtained on its experimental loop facility). A total of 293 visits by consultants was financed under the project in the period 1984-88. The project has resulted in improved possibilities for safety analysis relating to WWER reactors.

■ ROK/1/006

**SECONDARY STANDARDS DOSIMETRY LABORATORY (SSDL)**

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COMPLETED: 88-12-20

TOTAL COST: US \$250,088.55

OBJECTIVES:

TO ESTABLISH A SECONDARY STANDARDS DOSIMETRY LABORATORY TO PROVIDE CALIBRATION SERVICES AT THE THERAPY AND AT THE RADIATION PROTECTION LEVEL.

ACHIEVEMENTS:

Following the technical assistance provided under the project, the Department of Radiation Standards of the National Institute of Health of the Ministry of Health and Social Affairs is providing (a) calibration services for radiation measuring instruments, (b) quality control for radiation-generating systems used in medicine, and (c) personnel dosimetry services for radiation workers. The Department is participating in the Agency's high-dose intercomparison system and postal dose intercomparison service for SSDLs. The Government has already designated the Department as the National Calibration Laboratory.

■ ROK/4/012

**NUCLEAR MANPOWER DEVELOPMENT**

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COMPLETED: 88-12-20 TOTAL COST: US \$151,863.06

OBJECTIVES: TRAINING OF QUALIFIED MANPOWER FOR NUCLEAR PROJECTS (REQUIREMENTS, MANAGEMENT AND IMPLEMENTATION, EVALUATION).

ACHIEVEMENTS: Two Agency experts evaluated the training policy of the Korea Electric Power Corporation as well as the training programme, staff and materials at the nuclear training centre at the Kori Nuclear Power Plant site. Their recommendations considered organization and structure, in addition to aspects referred to above, so that the development of manpower would be appropriate for the expanding nuclear power programme of the country. Three national training courses were successfully organized, namely on (a) management of pre-project activities, (b) nuclear power project management – tools and methods, and (c) maintenance of nuclear power plants: twenty-one Agency experts were involved in these, and 125 nationals from the counterpart organizations received training.

■ ROK/4/017

**REVIEW OF NUCLEAR MANPOWER PROGRAMME**

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COMPLETED: 88-12-20 TOTAL COST: US \$32,127.63

OBJECTIVES: TO DEVELOP A NATIONAL TRAINING PROGRAMME TO MEET THE INCREASING DEMAND FOR TRAINED LOCAL MANPOWER RELATED TO COMPLEX TECHNOLOGIES REQUIRED FOR THE COUNTRY'S NUCLEAR POWER PROGRAMME.

ACHIEVEMENTS: A mission comprising four Agency experts reviewed the nuclear training programme of the Korea Advanced Energy Research Institute (KAERI) and provided advice on planning future training programmes to meet the objectives of the Korean nuclear manpower development programme. The related Korean organizations now have the expertise, experience and resources to identify training needs and to provide the training appropriate for the necessary manpower development in nuclear fields.

■ ROK/5/021

**PESTICIDE RESIDUES**

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COMPLETED: 88-12-20 TOTAL COST: US \$48,527.78

OBJECTIVES: APPLICATION OF RADIOTRACER TECHNIQUES TO DETERMINE THE FATE, BEHAVIOUR AND DEGRADATION MECHANISMS OF POLLUTANTS.

ACHIEVEMENTS: The rapid economic development of the country has brought in its train contamination of the environment by industrial wastes and pesticides. In a joint effort between the Institute of Environmental Science and the College of Agriculture of Chung Buk National University, Cheong Ju, it was planned to study the fate of pollutants to enable the Government to take corrective measures where needed. With the assistance provided by the project, which was funded by an extrabudgetary contribution from the United States of America, the College of Agriculture has established facilities for the use of labelled compounds in assessing pesticide residues in soil. The counterpart is now engaged in studies to determine the fate, behaviour and degradation

mechanisms of pollutants using radiotracer techniques. The data are being used by the Office of the Environment in Korea to review and reflect on environmental policy making.

■ ROK/5/024

**ISOTOPE-AIDED STUDIES ON MULBERRY PHYSIOLOGY**

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COMPLETED: 88-12-20

TOTAL COST: US \$38,965.31

OBJECTIVES:

TO INCREASE SPROUTING OF MULBERRY IN SPRING IN ORDER TO INCREASE COCOON PRODUCTION FOR THE SILK INDUSTRY.

ACHIEVEMENTS:

The Republic of Korea has a significant silk industry but the degree of non-sprouting of mulberry reduced cocoon production by some 70% between 1976 and 1982. The Mulberry Research Division of the Sericultural Experimental Station, after trying other approaches, sought assistance for studies of nutritive physiology using isotope aided techniques. The project has enabled the Division to set up a research programme to study non-sprouting in mulberry, and when positive data and applied techniques for crop improvement have been determined, the information will be transmitted to sericultural farmers for practical application.

■ ROM/1/005

**APPLIED ACTINIDE RESEARCH**

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COMPLETED: 88-12-01

TOTAL COST: US \$618,871.51

OBJECTIVES:

INVESTIGATION OF ACTINIDE COMPOUNDS FOR PRACTICAL APPLICATIONS: THE STABILITY OF GLASS TO BE USED FOR STORAGE OF NUCLEAR WASTE; THERMOLUMINESCENCE PHENOMENA FOR DOSIMETRY; AND DEVELOPMENT OF SOLAR BATTERIES.

ACHIEVEMENTS:

An Agency expert trained counterparts in the use of laser-excitation studies on the chemistry and structure of actinide compounds. The aim is to develop glass matrix materials to serve as long-term storage for nuclear waste, thermoluminescence materials and solar batteries. One fellowship and two scientific visits were awarded to counterpart staff to study measurement techniques and experimental methodologies in advanced laboratories. A computer-controlled laser-source spectrometry system, a vacuum system and sample polishing unit, as well as a thermoluminescence dosimetry system, were procured in support of these activities. The work is now proceeding satisfactorily, especially as regards characterization of uranium compounds at various stages of the nuclear fuel cycle.

■ ROM/1/008

**X-RAY FLUORESCENCE SPECTROMETRY**

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COMPLETED: 88-01-04

TOTAL COST: US \$51,978.39

OBJECTIVES:

TO INCREASE THE PRODUCTION OF NON-FERROUS METALS THROUGH RAPID ON-STREAM ANALYTICAL CONTROL OF CONCENTRATIONS DURING THE FLOTATION PROCESS.

ACHIEVEMENTS:

The Agency provided the Institute of Research, Technological Engineering and Planning for Non-Ferrous Minerals at Baia Mara with specialized equipment to be used for rapid, on-stream analytical control of non-ferrous metal and impurity concentrations during the flotation process. The X-ray fluorescence



analysis can be set up for simultaneous determination of copper, zinc, lead and iron in different matrices. The technique has proven itself to be useful for optimizing process control in the metal industry. The Institute's close links with industry are expected to contribute to an increase in such industrial applications of nuclear methods in the country.

■ ROM/2/007

**NUCLEAR TECHNIQUES IN MATERIALS ANALYSIS**

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COMPLETED: 88-05-31

TOTAL COST: US \$43,330.17

OBJECTIVES:

STUDIES OF CORROSION AND SURFACE CONTAMINATION OF METALS AND ALLOYS USING MOESSBAUER SPECTROSCOPY TECHNIQUES.

ACHIEVEMENTS:

The Institute for Physics and Technology of Materials has a programme for studying the behaviour of materials, including those used in nuclear reactors. The project aimed to introduce X-ray fluorescence applications to study corrosion and surface contamination. Agency support comprised the provision of a Moessbauer spectrometer and a cryogenic unit for cooling semiconductor detectors.

■ ROM/4/010

**ASSISTANCE FOR NUCLEAR POWER STATIONS**

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COMPLETED: 88-12-31

TOTAL COST: US \$696,900.00

OBJECTIVES:

A) CHECKING OF PHWR-TYPE FUEL ELEMENT PERFORMANCE THROUGH IRRADIATION AND OUT-OF-PILE TESTING. B) IRRADIATION TESTING OF STEEL FOR NUCLEAR POWER PLANT COMPONENTS. C) TREATMENT OF LOW AND MEDIUM LEVEL RADIOACTIVE WASTE.

ACHIEVEMENTS:

This project was funded by UNDP and executed by the Agency. PHWR-type fuel elements were manufactured and their performance was checked through irradiation and out-of-pile testing. Irradiation tests of steel components for Cernavoda Nuclear Power Plant were performed. A small reactor waste treatment plant was installed, mainly for the Triga research reactor, with the purpose of collecting data for the design of a large plant for the nuclear power station. Over the period 1983-88, twenty-three Agency experts were involved in the training and advisory programmes, with topics ranging between design of devices for irradiation testing of steels, zero-power reactor technology and waste management procedures. Additional training was provided by means of five project-funded or -related fellowships. In addition to a semi-conductor detector and a video monitoring system for remote viewing, a broad range of miscellaneous items of equipment was obtained to improve local laboratory facilities. The irradiation tests were covered by a sub-contract.

■ ROM/5/004

**SOIL FERTILITY STUDIES**

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COMPLETED: 88-04-20

TOTAL COST: US \$56,717.00

OBJECTIVES:

TO IMPROVE THE EFFICIENCY OF THE BIOLOGICAL NITROGEN FIXATION PROCESS IN LEGUMINOUS PLANTS, WITH AN EXTENSION TO CEREALS AND INDUSTRIAL CROPS, IN ORDER TO INCREASE THE YIELD.

**ACHIEVEMENTS:** The Agency's assistance has strengthened the applied research capability of the Research Institute for Cereals and Industrial Crops. Local staff were trained to undertake various types of nitrogen analysis by an Agency expert in connection with soil fertility and fertilizer uptake studies. The laboratory was provided with a nitrogen-15 analyser, a sample preparation line, electrophoretic chromatographic equipment, and other miscellaneous items of laboratory equipment and supplies. National field trials have indicated that, with improved methods of fertilizer application and more efficient crop management practices, a 20% increase in yield could be achieved in a number of crops of economic importance.

■ **SIN/1/004**

**NUCLEAR ANALYTICAL TECHNIQUES**

**COMPLETED: 88-08-02** **TOTAL COST: US \$288,622.16**

**OBJECTIVES:** APPLICATION OF THE PIXE TECHNIQUE FOR DETERMINATION OF MINOR AND TRACE ELEMENTS IN DIFFERENT MATERIALS.

**ACHIEVEMENTS:** A well-equipped central nuclear analytical laboratory has been established in the Department of Physics of the National University of Singapore. Three different types of X-ray analytical equipment were introduced (radioisotope, tube-excited X-ray fluorescence and proton-induced X-ray emission analysis), were put into routine operation and are being applied for accurate determinations of minor and trace elements in environmental, industrial and medical samples. In the course of the project, four Agency experts in six visits reviewed progress and gave training in the various types of X-ray analysis, as well as instruction regarding sample preparation. Further training was provided in the form of a fellowship and a scientific visit. Thirty-nine research papers have resulted from the project and most have been published. Furthermore the teaching capability of the Department has been enhanced; undergraduate students are regularly receiving instruction, while seven Agency fellows from other countries have also been trained at the University.

■ **SIN/8/008**

**RADIOISOTOPES IN HYDROLOGY**

**COMPLETED: 88-08-02** **TOTAL COST: US \$147,606.72**

**OBJECTIVES:** TO INTRODUCE A CAPABILITY FOR USING TRACER TECHNIQUES IN SEDIMENT TRANSPORT PROBLEMS RELATED TO AIRPORT AND HARBOR DEVELOPMENT.

**ACHIEVEMENTS:** This long-term project established the use of tracer techniques by the Engineering Division of the Port of Singapore Authority. A matter of particular concern was to study the stability of beaches and shallow-water areas in the neighbourhood of the 700 hectare site for the new international airport at Changi. Four experts paid visits in connection with these studies in the period 1981-1983. Subsequently, after a review of the project in 1983, a further expert visited in 1987 to provide training in various aspects of coastal hydraulics. Some related equipment was provided, namely a unit for analysis of sediment samples and various radioactive tracers. One project-related fellowship and two visits were granted. The major results were: (a) the stability of reclaimed land at Changi was determined. Much expensive shore protection work could be omitted, resulting in savings of about US \$5 million; (b) optimum sites for

dumping of dredged spoil were identified and are being used; (c) the results of this project have made possible major decisions regarding coastal protection works and land reclamation projects in Singapore; (d) the transfer of isotope techniques and expertise in this field has made the Port of Singapore Authority to a large-extent self-reliant in such studies.

■ SPA/9/005

**ENVIRONMENTAL RADIOACTIVITY MONITORING**

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COMPLETED: 88-01-04

TOTAL COST: US \$57,053.65

OBJECTIVES:

TO ASSIST IN SETTING UP A NATIONAL RADIOLOGICAL MONITORING NETWORK WHICH SHOULD PROVIDE INFORMATION ABOUT THE POSSIBLE IMPACT OF NUCLEAR FACILITIES ON THE ENVIRONMENT AND ON THE POPULATION AT LARGE.

ACHIEVEMENTS:

With the help of two Agency experts, a research programme was initiated with the narrower objectives of determining the extent of radioactive pollution and the marine geochemistry of transuranic nuclides in the Mediterranean Sea as a first stage. Co-operation between the Instituto Oceanografico and the Junta de Energia Nuclear was established, which included collaboration on sampling, sample preparation and radiochemical analysis. As a result of the project, a better understanding has been obtained of the distribution of transuranic elements in the water environment around southeastern Spain. Two project-related fellowships were granted.

■ SRL/5/018

**RADIOISOTOPES IN ANIMAL SCIENCE**

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COMPLETED: 88-12-31

TOTAL COST: US \$75,490.79

OBJECTIVES:

IMPROVEMENT OF DOMESTIC BUFFALO PRODUCTION THROUGH THE CONTROL OF A PARASITE (TOXOCARA VITULORUM), KNOWN TO INCREASE MORBIDITY AND MORTALITY OF BUFFALO CALVES.

ACHIEVEMENTS:

The project has successfully achieved the development of an effective control strategy for Neoscaris vitulorum infection in buffalo and the determination of the route of migration of N. vitulorum larvae from muscles to milk. In addition, new knowledge of the pathogenesis of N. vitulorum in buffalo calves has been gained. The project has served to upgrade equipment available for related work and has helped to train staff in laboratory techniques which were also being applied in Agency Research Contract related studies. This project was partly funded by an extrabudgetary contribution from the United Kingdom Government and partly from the Agency's Technical Assistance and Co-operation Fund.

■ SRL/8/008

**NON-DESTRUCTIVE TESTING**

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COMPLETED: 88-12-20

TOTAL COST: US \$49,116.98

OBJECTIVES:

IMPROVEMENT OF INSPECTION AND NON-DESTRUCTIVE TESTING OF REFINERY INSTALLATIONS.

ACHIEVEMENTS:

The Ceylon Petroleum Corporation's Inspection Department is responsible for keeping petroleum refinery installations operating safely. The Agency was requested to assist in expanding the range of non-destructive testing available so

that unplanned shutdowns due to plant failures could be reduced, as well as decreasing the risk of fire and other hazards. A programme of fellowship training was set up funded from the general fellowship allocation, while experts provided on the job training on use of radioactive tracers and radiography. Some related test equipment was provided. The Department is now able to maintain high inspection standards, the staff are competent to undertake various types of testing, and this has led to improved reliability and control, as well as to appropriate quality assurance for the refinery installations and equipment.

■ SUD/6/013

**NUCLEAR MEDICINE SERVICES**

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COMPLETED: 88-04-21

TOTAL COST: US \$3,779.61

OBJECTIVES:

TO ASSESS THE REQUIREMENTS FOR THE ESTABLISHMENT OF A NUCLEAR MEDICINE UNIT.

ACHIEVEMENTS:

Short-term expert services were provided to assess the feasibility of establishing (a) a nuclear medicine laboratory in the Faculty of Medicine of Gezira University and (b) a programme for training of nuclear medicine technicians at the High Institute of Radiography and Radiotherapy. The assessment and the recommendations made by the expert were fully utilized to formulate two new TC projects, one in "Nuclear medicine" (SUD/6/014) and one in "Advanced training for nuclear medicine technicians" (SUD/6/015).

■ SUD/6/016

**INTRACAVITARY RADIATION THERAPY FOR CANCER**

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CANCELLED: 88-09-09

OBJECTIVES:

TO PROVIDE AN AFTER-LOADING SYSTEM WHICH WILL ENABLE THE RADIATION AND ISOTOPES CENTRE TO PROVIDE TREATMENT TO A LARGER NUMBER OF CANCER PATIENTS.

REASON FOR CANCELLATION:

The Government of Sudan, by letter dated 21 August 1988, requested cancellation of this project in order to utilize the funds allocated to support the related project SUD/6/012 (Use of a gamma camera), which was considered to be of higher priority.

■ THA/1/007

**ACCELERATOR-BASED RESEARCH**

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COMPLETED: 88-08-02

TOTAL COST: US \$15,943.57

OBJECTIVES:

TO REVIEW ACADEMIC TRAINING IN NUCLEAR SCIENCES WITH A VIEW TO ACHIEVING GREATER CO-ORDINATION BETWEEN UNIVERSITIES. TO EXAMINE THE FEASIBILITY AND ADVISABILITY OF ACQUIRING A PARTICLE ACCELERATOR.

ACHIEVEMENTS:

Three Agency experts undertook an advisory mission to examine both the feasibility and advisability of Thailand's acquiring a particle accelerator. They visited three universities and the Office of Atomic Energy for Peace. The principal recommendations were: (a) the Chulalongkorn proposal should be kept pending until such time as an appropriate infrastructure was in place and re-

search areas expanded; (b) the Chiang Mai University proposal should be declined. Instead, an alternative, multi-purpose and interdisciplinary accelerator should be considered; and (c) the Government of Thailand should promote the use of major nuclear facilities by national institutions through the establishment of formal programmes with appropriate support.

■ **THA/5/026**

**RADIOISOTOPES IN AGRICULTURE**

COMPLETED: **88-11-18**

TOTAL COST: **US \$140,903.63**

OBJECTIVES:

STUDY OF THE IMPACT OF VARIOUS SOIL AND FERTILIZER MANAGEMENT PRACTICES ON THE EFFICIENCY OF FERTILIZER AND SOIL NUTRIENT UTILIZATION BY CROPS.

ACHIEVEMENTS:

The principal aims of this project were to evaluate zero tillage methods for soybeans, and to quantify nitrogen fixation. Both were accomplished and considerable information was obtained that is of immediate value to agriculture in Thailand. Locally developed soybean varieties were equal to or better than several imported varieties in use or on trial. Soybeans were found to be well adapted to zero tillage. Inoculation with Brady rhizobium japonicum gave significant increases in nitrogen fixation and hence yield. Using nitrogen-15 isotope dilution studies, it was found that nitrogen fixation averaged over 100 kg of nitrogen per hectare and provided over 50% of the nitrogen found in soybeans. In addition to five project-related fellowships and five scientific visits, five man months of expert services provided training on fertilizer-uptake and soil-fertility studies. An expert also assisted with installation of the UV spectrometer and instructed on its use and maintenance. A nitrogen-15 analyser and sample preparation line, as well as miscellaneous items of laboratory equipment and supplies and nitrogen-15 labelled fertilizer, were provided. The Isotope Laboratory is now able to perform nitrogen-15 analysis and is continuing with similar experiments independently as a result of the equipment and training provided by the Agency. This project was partly funded by an extrabudgetary contribution from the Government of Saudi Arabia.

■ **THA/5/028**

**ISOTOPES IN ANIMAL SCIENCE**

COMPLETED: **88-11-07**

TOTAL COST: **US \$89,600.12**

OBJECTIVES:

TO DEVELOP A RESEARCH PROGRAMME ON ANIMAL PRODUCTION USING NUCLEAR TECHNIQUES, INCLUDING SETTING UP OF THE NECESSARY LABORATORY FACILITIES.

ACHIEVEMENTS:

With the equipment and expert services provided, a radioimmunoassay (RIA) laboratory for milk progesterone assay was established in 1985 which has been functioning satisfactorily since then. The laboratory at the Department of Animal Science, Khon Kaen University, is now fully equipped to handle RIA work which does not involve solvent extraction of samples. A field study on the reproductive status of village buffaloes, planned and initiated with expert assistance, commenced in November 1985. To support the field studies, excellent animal handling facilities have been constructed. Two project-funded fellowships were granted, and two project-related IAEA Research Contracts were awarded, of which one has been completed and one extended.

■ **THA/6/016**

**NUCLEAR MEDICINE**

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COMPLETED: **88-08-02**

TOTAL COST: **US \$151,560.36**

OBJECTIVES:

TO UPGRADE THE GAMMA CAMERA FACILITY FOR RADIONUCLIDE IMAGING ON CANCER PATIENTS.

ACHIEVEMENTS:

The gamma camera facility at the Chang Mai University Faculty of Medicine (Northern Thailand) has been upgraded, and improved diagnostic services are now being provided. Following installation of the ADAC computer system and video-image formatter, two experts assisted with training and programme development. Cardiac, renal, hepatobiliary, bone, liver and brain scans are now use routinely. Other research work (for instance on congenital, cardiomyopathic and coronary heart diseases) is being undertaken. This project was funded by an extrabudgetary contribution from the United States of America.

■ **THA/6/018**

**NUCLEAR CARDIOLOGY**

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COMPLETED: **88-05-02**

TOTAL COST: **US \$120,765.21**

OBJECTIVES:

TO INTRODUCE NUCLEAR CARDIOLOGY TECHNIQUES FOR ROUTINE USE AT THE DIVISION OF NUCLEAR MEDICINE OF THE SIRIRAJ HOSPITAL.

ACHIEVEMENTS:

Cardiovascular nuclear medicine studies at the Siriraj Hospital (Bangkok, central Thailand) have played an active role in improving diagnostic capabilities for heart patients. This has been supported by upgrading the gamma camera by provision of an ADAC computer system. Three experts served variously to introduce new clinical techniques and install the equipment. A project-related fellowship was awarded. During the last two years of the project, approximately 250 cases of technetium-99m gated blood pool and thallium-201 myocardial perfusion studies have been carried out on a weekly basis. There is a continuing great demand for such studies, and the counterpart institution is fully able to carry them out.

■ **THA/6/020**

**RADIOIMMUNOASSAY CONTROL LABORATORY**

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COMPLETED: **88-07-12**

TOTAL COST: **US \$46,550.55**

OBJECTIVES:

TO ESTABLISH A LABORATORY FACILITY FOR THE LOCAL PRODUCTION, QUALITY CONTROL, AND DISTRIBUTION OF RIA REAGENTS.

ACHIEVEMENTS:

The Radioisotope Production Division of the Office of Atomic Energy for Peace requested Agency assistance to set up a laboratory for preparing radioimmunoassay kits locally using imported bulk reagents, and for establishing quality control procedures and a distribution network. With just three months of training by an Agency expert and provision of a modest amount of equipment (US \$30,000) that included a liquid scintillation and a beta/gamma counter, a centrifuge and a computer support system, such a laboratory was established as a functional entity in less than two years. Tracers for thyroid hormone diagnostics with acceptable quality are being distributed to 12 institutions (hospitals, research institutes and universities). The resulting cost savings have permitted routine use of the techniques by clinicians, giving improved diagnosis.

Studies are under way to develop other such reagents in high demand. The laboratory is already accepting trainees from various institutions in the country for basic training in RIA techniques.

■ TUN/5/006

**STUDIES OF PLANT WATER USE IN ARID AND SEMI-ARID REGIONS**

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COMPLETED: 88-02-26

TOTAL COST: US \$41,144.65

OBJECTIVES:

STRENGTHENING OF THE RESEARCH PROGRAMME ON SOIL/WATER RELATIONSHIPS.

ACHIEVEMENTS:

The Centre de Recherche du Gnie Rural, which is responsible for water management research relating to cultivation of crops, initiated research into soil/water relationships, supported by the present project. Funding was assured by an extrabudgetary contribution from the Government of France in addition to support from the Agency's Technical Assistance and Co-operation Fund. Three research stations were equipped with soil-moisture probes which are being used on a routine basis for soil/water while, in one of the stations, a data treatment and compilation system was installed, and applications were demonstrated by an Agency expert. A second expert provided selected staff with on-the-job training in the use of the neutron moisture probes. Useful data were obtained and, as a practical application of the results, more efficient irrigation methods are being introduced to farmers for the cultivation of olive trees, wheat and certain legumes.

■ TUN/5/007

**NUCLEAR TECHNIQUES IN AGRICULTURE**

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COMPLETED: 88-02-26

TOTAL COST: US \$17,221.90

OBJECTIVES:

STUDIES IN SOIL/WATER/PLANT RELATIONSHIPS.

ACHIEVEMENTS:

The Bioclimatology Laboratory of the Centre de Recherche du Gnie Rural at Ariana sought to upgrade its facilities to undertake studies that would elaborate a water-balance model for determining the requirements for optimum and rational utilization of water. The model already devised is being tested and compared with other available models. As part of these studies, and to support the continuation of these studies in the future, close co-operation has been established between the laboratory and other national as well as foreign laboratories. The project was funded by an extrabudgetary contribution from the United States of America.

■ UGA/5/009

**ANIMAL SCIENCE**

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COMPLETED: 88-12-30

TOTAL COST: US \$120,710.82

OBJECTIVES:

TO ESTABLISH A RADIOIMMUNOASSAY LABORATORY; TO INTRODUCE HORMONE MEASUREMENTS IN LIVESTOCK BREEDING AND APPROPRIATE MANAGEMENT SCHEMES.

ACHIEVEMENTS:

An Agency mission visited the Livestock Experimental Station of the Department of Veterinary Services and the Veterinary School of Makerere University and assisted in formulating a composite plan of work for investigations on the reproductive efficiency of dairy cattle. The substantial amount of equipment and supplies delivered between 1984 and 1988 has ensured establishment of a

functional laboratory for radioimmunoassay (RIA) and enzyme-linked immunosorbent assay (ELISA) investigations at Makerere University. Further expert missions assisted with training on the use of RIA for progesterone studies in blood and milk of cattle, and ELISA for rinderpest diagnosis, as well as with analysis and interpretation of data. Two project-related fellowships and one scientific visit were awarded. Adequately trained staff are now available for continuing the work begun under this project. In this context, two project-related research contracts have been completed, and one extended.

■ URT/6/003

**EPIDEMIOLOGY OF MALARIA**

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COMPLETED: 88-10-24

TOTAL COST: US \$100,610.33

OBJECTIVES:

INTRODUCTION OF RADIOIMMUNOASSAY TECHNIQUES FOR EPIDEMIOLOGICAL INVESTIGATIONS TO DETECT MALARIA SPOOROZITES IN MOSQUITOES.

ACHIEVEMENTS:

Following the recommendations of an Agency mission in 1984, facilities were established at the Amani Medical Research Centre for detecting malaria sporozoites in mosquitoes by means of a sensitive radioimmunoassay technique. Equipment to a value of US \$50,000 was provided by Finland, and equipment and reagents for US \$30,000 from the Agency's Technical Assistance and Co-operation Fund. A team of scientists were trained for two months in the use of the assay technique by an IAEA expert, and teaching included topics such as personal safety precautions and appropriate forms of disposal for the low-level liquid and solid radioactive wastes. With this technique, useful information was obtained on the epidemiology of malaria in the "malaria belt" in the Amani region in northeast Tanzania. To ensure that work can continue efficiently, a technician from the Amani Medical Research Centre is being trained under a fellowship at the Agency's Seibersdorf Laboratory to undertake maintenance, trouble-shooting and repair.

■ URU/1/003

**MOESSBAUER SPECTROSCOPY**

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COMPLETED: 88-12-20

TOTAL COST: US \$83,375.16

OBJECTIVES:

ESTABLISHMENT OF MOESSBAUER SPECTROSCOPY TECHNIQUES FOR MATERIALS ANALYSIS.

ACHIEVEMENTS:

In the course of this project funded by an extrabudgetary contribution from the United States of America, a complete Moessbauer spectrometry system and supporting computer system were provided to the counterpart organization at a cost of US \$66390 to enable the laboratory to apply such spectrometry techniques for materials analysis. The two missions undertaken by an Agency expert were sufficient to train the local personnel and to leave the equipment in good working condition. However, the achievements have been compromised by the fact that trained personnel have left the laboratory and are now involved in other activities.



■ URU/5/016

**NITROGEN FIXATION STUDIES**

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COMPLETED: 88-12-21

TOTAL COST: US \$45,612.51

OBJECTIVES:

INTRODUCTION OF NUCLEAR TECHNIQUES IN THE QUALITATIVE DETERMINATION OF SYMBIOTICALLY FIXED NITROGEN IN GRASSES.

ACHIEVEMENTS:

High-quality grazing land is needed for production of meat and dairy products, but the fodder available from natural pastures in Uruguay does not meet national demand, with serious shortages in winter. A multidisciplinary group to use nitrogen-15 techniques for the solution of specific agricultural research problems affecting biological nitrogen fixation in pastures was established under this project. It is undertaking quantification of biological nitrogen fixation with a view to application by farmers of improved nitrogenous fertilizer practices (including use of commercial mixtures). Studies of persistence and of the productivity of forage legumes are also being made. Some research results have already been published in internationally recognized specialist journals.

■ VEN/9/004

**RESEARCH REACTOR SAFETY**

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COMPLETED: 88-12-30

TOTAL COST: US \$13,733.67

OBJECTIVES:

TO ASSIST IN THE PREPARATION OF A REACTOR SAFETY REPORT. DEVELOPMENT OF PERSONNEL RADIATION MONITORING AND ENVIRONMENTAL MONITORING AT THE REACTOR SITE.

ACHIEVEMENTS:

Focus was on the safe operation of a 3 MW swimming-pool-type research reactor being operated by the Venezuelan Institute for Scientific Research in Caracas. Agency experts analysed the existing situation in each of the following areas: (a) improvement and upgrading of the Safety Analysis Report (SAR) taking into account environmental and seismological data; (b) operational procedures for area monitoring at the reactor site and environmental monitoring; and (c) operational procedures to ensure a correct personnel radiation monitoring at the reactor site. They also made recommendations for personnel training and equipment needed to fulfil the requirements for the safe operation of the reactor. At the present time, the research reactor is shut down.

■ YUG/3/008

**GEOCHEMICAL FLUORIMETRIC LABORATORY**

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COMPLETED: 88-11-25

TOTAL COST: US \$47,558.12

OBJECTIVES:

TO SUPPORT GEOCHEMICAL EXPLORATION FOR URANIUM IN SLOVENIA.

ACHIEVEMENTS:

The Agency, through an extrabudgetary contribution provided by the Federal Republic of Germany, assisted the Geological Survey Department in Ljubljana to establish a geochemical fluorimetric laboratory for the analysis of uranium in samples collected from different locations in the Republic of Slovenia. An expert helped with project planning, but no further assistance was required, as the local geologists and field engineers were sufficiently experienced. There is strong collaboration between the Department and the Jozef Stefan Institute in pursuance of the project objectives. The laboratory is now fully functional.

■ YUG/4/021

**PREVLAKA NUCLEAR POWER PLANT**

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COMPLETED: 88-07-12

TOTAL COST: US \$303,423.46

OBJECTIVES:

TO ASSIST SEVERAL INSTITUTIONS TO ESTABLISH AND/OR STRENGTHEN THEIR PROJECT PLANNING AND MANAGEMENT CAPABILITIES (DURING PRE-PROJECT ACTIVITIES).

ACHIEVEMENTS:

The capability of the Institute for Electricity Generation Development and Research in Zagreb has been increased with respect to assessment of nuclear power plant pre-project planning requirements and bid evaluation. About 60 expert missions were sent to the country, some of these supporting courses or workshops on quality assurance, nuclear power plant management and civil engineering considerations. Detailed bid specifications were prepared for PWR, BWR, WWER and CANDU reactors. Such document preparation has proved to be a valuable form of technology transfer for the various Yugoslavian groups participating in the project. Other topics considered were domestic participation and site licensing.

■ YUG/9/015

**COMPUTATIONAL REACTOR SAFETY EVALUATION I**

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COMPLETED: 88-05-09

TOTAL COST: US \$110,573.79

OBJECTIVES:

TO STRENGTHEN THE COMPUTATIONAL CAPABILITIES OF THE INSTITUTE.

ACHIEVEMENTS:

Computer equipment was provided through an extrabudgetary contribution from the Federal Republic of Germany. The main objective of the project – to strengthen the computational capabilities of the Reactor Engineering Department of the Jozef Stefan Institute – has been achieved, providing very much needed support to the local regulatory body reviewing safe operation of the Krsko Nuclear Power Plant.

■ YUG/9/019

**COMPUTER-AIDED SAFETY ANALYSIS**

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COMPLETED: 88-05-31

TOTAL COST: US \$35,175.94

OBJECTIVES:

STRENGTHENING OF THE COMPUTATIONAL CAPABILITIES OF THE FACULTY.

ACHIEVEMENTS:

Computation capabilities of the Electrical Engineering Faculty of the University of Zagreb in connection with nuclear power plant safety analysis have been strengthened through provision of a computer system and peripheral equipment (Hesoclust master with accessories). The project was funded from an extrabudgetary contribution by the United States of America and from the Agency's Technical Assistance and Co-operation Fund. One fellowship was awarded, a Yugoslavian expert visited the Agency for training and an expert mission concerned with PWR transient analysis was organized. The Faculty can now offer much improved support to the local regulatory body which reviews operational safety of the Krsko Nuclear Power Plant.

■ YUG/9/021

**FAILED FUEL DETECTION**

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COMPLETED: 88-06-15

TOTAL COST: US \$66,228.79

OBJECTIVES:

TO STRENGTHEN THE COMPUTATIONAL CAPABILITY OF THE INSTITUTE.

ACHIEVEMENTS:

This project was supported by an extrabudgetary contribution from the United States of America and funds in trust. The project was planned to assist the Jozef Stefan Institute to implement newer techniques for analysing isotopes in fission gases released from nuclear fuel, thus improving its ability to assess fuel defects in reactor cores. An expert provided guidance on experimental and analytical techniques in connection with the computer hardware and software (including programmes such as CAMAC and CRATE) supplied. Other items of equipment and supplies included a hyperpure semi-conductor detector, two surface-barrier semi-conductor detectors and alpha-emitting radioisotope-containing foils.

■ ZAI/5/006

**RADIOISOTOPES IN AGRICULTURE**

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COMPLETED: 88-10-24

TOTAL COST: US \$194,718.21

OBJECTIVES:

TO STUDY INOCULATION TECHNIQUES AS RELATED TO NITROGEN FIXATION.

ACHIEVEMENTS:

The Kinshasa Regional Nuclear Research Centre was carrying out rhizobium bacteria inoculation experiments to improve nitrogen fixation by cereals. Studies of such biological fixation were being extended to other crops such as soybean, sugarcane, and, lately, legumes. In the period 1980-88, the Agency assisted the research by supplying an emission spectrometer and Kjeldahl apparatus for nitrogen determinations, a gas chromatograph and various supplementary items such as nitrogen-15 labelled fertilizer. Experts assisted with installation of the emission spectrometer and with training in nitrogen fixation study techniques. Six counterpart staff were given training abroad, supported by project related fellowships. The project has resulted in a well equipped and operational nuclear agricultural laboratory. This enables the Centre to be self-reliant in sample analysis and interpretation of results. Inoculation of various leguminous crops of interest to Zaire has led to the identification of promising varieties with improved biological nitrogen fixation capacity and, thus, higher protein yield.

■ ZAI/8/005

**RADIOISOTOPES IN HYDROLOGY**

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COMPLETED: 88-08-17

TOTAL COST: US \$44,570.60

OBJECTIVES:

STUDY OF LOWER ZAIRE AND BATEKE PLATEAU TO MEASURE RIVER DISCHARGE AND DETERMINE SEDIMENT MOVEMENT OF RIVERS.

ACHIEVEMENTS:

The Nuclear Chemistry and Physics Division of the Kinshasa Regional Nuclear Research Centre, in collaboration with other institutions in the country responsible for water resources, established a unit able to use radioisotopes in hydrological and hydrogeological studies. Of particular interest were the hydrogeology of Lower Zaire and the Bateke plateau, and the movements of sediments in rivers. A sedimentological analysing unit was provided by the

Agency and experts assisted with nuclear gauge installation and training in application of related techniques. One staff member was granted a fellowship for training in France on practical aspects of the use of the equipment. Radioisotope techniques are now being used in combination with non-nuclear methods for the measurement of river discharges, and sediment deposits in the largest dam in the country are being regularly monitored using the equipment provided under the project.

# IMPLEMENTATION SUMMARY I

## ALL FUNDS\*

Description	Adjusted programme (\$)	Share of total programme (%)	New obligations (\$)	Implementation rate (%)	Ear-markings (\$)
<b>CURRENT YEAR</b>					
<b>AREA BREAKDOWN</b>					
Africa	9,870,218	16.4	5,569,612	56.4	4,300,606
Asia & Pacific	15,349,856	25.5	9,148,043	59.6	6,201,813
Latin America	12,975,691	21.5	8,035,259	61.9	4,940,432
Middle East & Europe	12,416,635	20.6	8,763,694	70.6	3,652,941
Interregional	4,869,677	8.1	3,097,426	63.6	1,772,251
Global	4,766,182	7.9	4,007,861	84.1	758,321
<b>Total</b>	<b>60,248,259</b>	<b>100.0</b>	<b>38,621,895</b>	<b>64.1</b>	<b>21,626,364</b>
<b>COMPONENT BREAKDOWN</b>					
Experts	14,284,295	23.7	7,721,291	54.1	6,563,004
Equipment	29,815,797	49.5	19,945,496	66.9	9,870,301
Fellowships	7,723,566	12.8	5,275,441	68.3	2,448,125
Training courses	6,890,420	11.4	4,476,777	65.0	2,413,643
Sub-contracts	933,023	1.6	756,598	81.1	176,425
Miscellaneous	601,158	1.0	446,292	74.2	154,866
<b>Total</b>	<b>60,248,259</b>	<b>100.0</b>	<b>38,621,895</b>	<b>64.1</b>	<b>21,626,364</b>
<b>FUND BREAKDOWN</b>					
TACF	43,652,306	72.5	28,383,470	65.0	15,268,836
UNDP	3,682,121	6.1	3,050,530	82.8	631,591
Extrabudgetary	12,570,119	20.8	7,100,068	56.5	5,470,051
Funds in trust	343,713	0.6	87,827	25.6	255,886
<b>Total</b>	<b>60,248,259</b>	<b>100.0</b>	<b>38,621,895</b>	<b>64.1</b>	<b>21,626,364</b>
<b>CURRENT AND FUTURE YEARS</b>					
Current	60,248,259	73.1	38,621,895	64.1	21,626,364
Future	22,127,548	26.9	2,470,897	11.2	19,656,651
<b>Total</b>	<b>82,375,807</b>	<b>100.0</b>	<b>41,092,792</b>		<b>41,283,015</b>

\* As at 31 December 1988.

**IMPLEMENTATION SUMMARY II**  
**TECHNICAL ASSISTANCE AND CO-OPERATION FUND\***

Description	Adjusted programme (\$)	Share of total programme (%)	New obligations (\$)	Implementation rate (%)	Ear-markings (\$)
<b>CURRENT YEAR</b>					
<b>AREA BREAKDOWN</b>					
Africa	7,782,823	17.8	4,636,637	59.6	3,146,186
Asia & Pacific	9,980,182	22.9	5,785,183	58.0	4,194,999
Latin America	8,132,265	18.6	5,217,240	64.2	2,915,025
Middle East & Europe	8,615,434	19.7	5,791,348	67.2	2,824,086
Interregional	4,353,447	10.0	2,850,939	65.5	1,502,508
Global	4,788,155	11.0	4,102,123	85.7	686,032
<b>Total</b>	<b>43,652,306</b>	<b>100.0</b>	<b>28,383,470</b>	<b>65.0</b>	<b>15,268,836</b>
<b>COMPONENT BREAKDOWN</b>					
Experts	9,846,429	22.6	5,742,909	58.3	4,103,520
Equipment	20,785,476	47.6	13,652,798	65.7	7,132,678
Fellowships	6,530,692	15.0	4,691,562	71.8	1,839,130
Training courses	5,639,542	12.9	3,613,719	64.1	2,025,823
Sub-contracts	328,172	0.7	278,444	84.8	49,728
Miscellaneous	521,995	1.2	404,038	77.4	117,957
<b>Total</b>	<b>43,652,306</b>	<b>100.0</b>	<b>28,383,470</b>	<b>65.0</b>	<b>15,268,836</b>
<b>CURRENCY TYPE BREAKDOWN</b>					
Convertible	34,005,935	77.9	22,514,462	66.2	11,491,473
Non-convertible	9,646,371	22.1	5,869,008	60.8	3,777,363
<b>Total</b>	<b>43,652,306</b>	<b>100.0</b>	<b>28,383,470</b>	<b>65.0</b>	<b>15,268,836</b>
<b>CURRENT AND FUTURE YEARS</b>					
Current	43,652,306	66.7	28,383,470	65.0	15,268,836
Future	21,775,948	33.3	2,470,897	11.3	19,305,051
<b>Total</b>	<b>65,428,254</b>	<b>100.0</b>	<b>30,854,367</b>		<b>34,573,887</b>

\* As at 31 December 1988.

**IMPLEMENTATION SUMMARY IIIA**  
**ALL FUNDS BY DEPARTMENT AND DIVISION\***

Description	Adjusted programme (\$)	Share of total programme (%)	New obligations (\$)	Implementation rate (%)	Ear-markings (\$)
<b>Department of Research and Isotopes</b>					
Joint FAO/IAEA Division	10,980,425	18.2	7,276,403	66.3	3,704,022
Division of Life Sciences	6,435,199	10.7	3,442,545	53.5	2,992,654
Division of Physical and Chemical Sciences	19,874,860	33.0	13,462,779	67.7	6,412,081
The Agency's Laboratories	2,489,646	4.1	1,576,299	63.3	913,347
<b>Sub-total</b>	<b>39,780,130</b>	<b>66.0</b>	<b>25,758,026</b>	<b>64.8</b>	<b>14,022,104</b>
<b>Department of Nuclear Energy and Safety</b>					
Division of Nuclear Safety	8,464,182	14.1	4,705,147	55.6	3,759,035
Division of Nuclear Power	2,901,626	4.8	1,770,598	61.0	1,131,028
Division of Scientific and Technical Information	282,529	0.5	99,095	35.1	183,434
Division of Nuclear Fuel Cycle	2,977,560	4.9	1,759,206	59.1	1,218,354
<b>Sub-total</b>	<b>14,625,897</b>	<b>24.3</b>	<b>8,334,046</b>	<b>57.0</b>	<b>6,291,851</b>
<b>Department of Administration</b>					
Legal Division	26,865	0.0	9,818	36.5	17,047
<b>Sub-total</b>	<b>26,865</b>	<b>0.0</b>	<b>9,818</b>	<b>36.5</b>	<b>17,047</b>
<b>Department of Safeguards</b>					
Division for Standardization, Training and Admin. Support	39,159	0.1	31,680	80.9	7,479
<b>Sub-total</b>	<b>39,159</b>	<b>0.1</b>	<b>31,680</b>	<b>80.9</b>	<b>7,479</b>
<b>Department of Technical Co-operation</b>					
Division of Technical Assistance and Co-operation	1,010,025	1.7	480,463	47.6	529,562
<b>Sub-total</b>	<b>1,010,025</b>	<b>1.7</b>	<b>480,463</b>	<b>47.6</b>	<b>529,562</b>
<b>TOTAL</b>	<b>55,482,076</b>	<b>92.1</b>	<b>34,614,033</b>	<b>62.4</b>	<b>20,868,043</b>
<b>Global</b>					
Not distributed by Department	4,766,183	7.9	4,007,862	84.1	758,321
<b>Sub-total</b>	<b>4,766,183</b>	<b>7.9</b>	<b>4,007,862</b>	<b>84.1</b>	<b>758,321</b>
<b>GRAND TOTAL</b>	<b>60,248,259</b>	<b>100.0</b>	<b>38,621,895</b>	<b>64.1</b>	<b>21,626,364</b>

\* As at 31 December 1988.

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

Description	Adjusted programme (\$)	Share of total programme (%)	New obligations (\$)	Implementation rate (%)	Ear-markings (\$)
<b>Department of Research and Isotopes</b>					
Joint FAO/IAEA Division	4,445,775	20.1	281,794	6.3	4,163,981
Division of Life Sciences	2,544,967	11.5	268,350	10.5	2,276,617
Division of Physical and Chemical Sciences	7,434,705	33.6	1,616,985	21.7	5,817,720
The Agency's Laboratories	1,155,829	5.2	19,356	1.7	1,136,473
<b>Sub-total</b>	<b>15,581,276</b>	<b>70.4</b>	<b>2,186,485</b>	<b>14.0</b>	<b>13,394,791</b>
<b>Department of Nuclear Energy and Safety</b>					
Division of Nuclear Safety	4,076,494	18.4	104,809	2.6	3,971,685
Division of Nuclear Power	742,900	3.4	0	0.0	742,900
Division of Scientific and Technical Information	91,300	0.4	0	0.0	91,300
Division of Nuclear Fuel Cycle	1,428,217	6.5	104,662	7.3	1,323,555
<b>Sub-total</b>	<b>6,338,911</b>	<b>28.7</b>	<b>209,471</b>	<b>3.3</b>	<b>6,129,440</b>
<b>Department of Technical Co-operation</b>					
Division of Technical Assistance and Co-operation	207,361	0.9	74,941	36.1	132,420
<b>Sub-total</b>	<b>207,361</b>	<b>0.9</b>	<b>74,941</b>	<b>36.1</b>	<b>132,420</b>
<b>GRAND TOTAL</b>	<b>22,127,548</b>	<b>100.0</b>	<b>2,470,897</b>	<b>11.2</b>	<b>19,656,651</b>

\* As at 31 December 1988.



## Explanatory Notes to Figures

### **Figure 1A. Resources available for Agency technical co-operation programmes: 1982-1988**

This figure shows all resources made available to the Agency for technical co-operation activities from all funds for the programme years 1982-88. 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 1982-88 include resources made available by the UNDP-administered United Nations Financing System 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 1A do not include resources made available for future years.

### **Figure 1B. Disbursements by field of activity: 1988**

This figure shows, by component and by major field of activity, the distribution of all assistance provided in 1988, irrespective of the source of funds.

### **Figure 1C. Disbursements by programme component: 1979-1988**

The total assistance provided during the period 1979-1988 is broken down by year and type of input (training, experts and equipment), irrespective of the source of funds.

### **Figure 2A. Technical co-operation personnel services by field of activity: 1988**

This figure shows the number of assignments carried out by training course lecturers, experts and other project personnel in each of the Agency's ten major fields of activity, together with the total man-months provided.

### **Figure 2B. Technical co-operation personnel services by region: 1988**

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 3A. Distribution of equipment disbursements by field of activity: 1988**

This figure shows the total amount of equipment provided in the ten major fields of activity.

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**Figure 3B. Distribution of equipment disbursements by region: 1988**

---

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.

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**Figure 4A. Distribution of trainees by field of activity: 1988**

---

The number of training course participants and fellowship holders are shown in this figure, together with the total man-months of training provided in each of the Agency's major fields of activity.

---

**Figure 4B. Summary data on training programmes: 1988**

---

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 5A. Distribution of disbursements by type and field of activity**

---

In this figure, percentages (obtained by averaging over the past five years) are shown for equipment, expert services and training in the ten major fields of activity.

---

**Figure 5B. Technical Assistance and Co-operation Fund disbursements by type of currency and region: 1988**

---

This figure, which refers only to the Technical Assistance and Co-operation Fund, gives total disbursements for 1988 broken down by region and for convertible and non-convertible currencies.

---

**Figure 5C. Distribution of technical co-operation disbursements by field and region: 1988**

---

The bar charts indicate graphically the shares of each field per region, while the table below the figure gives actual amounts.

---

**Figure 5D. Distribution of technical co-operation disbursements by source and region: 1988**

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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.

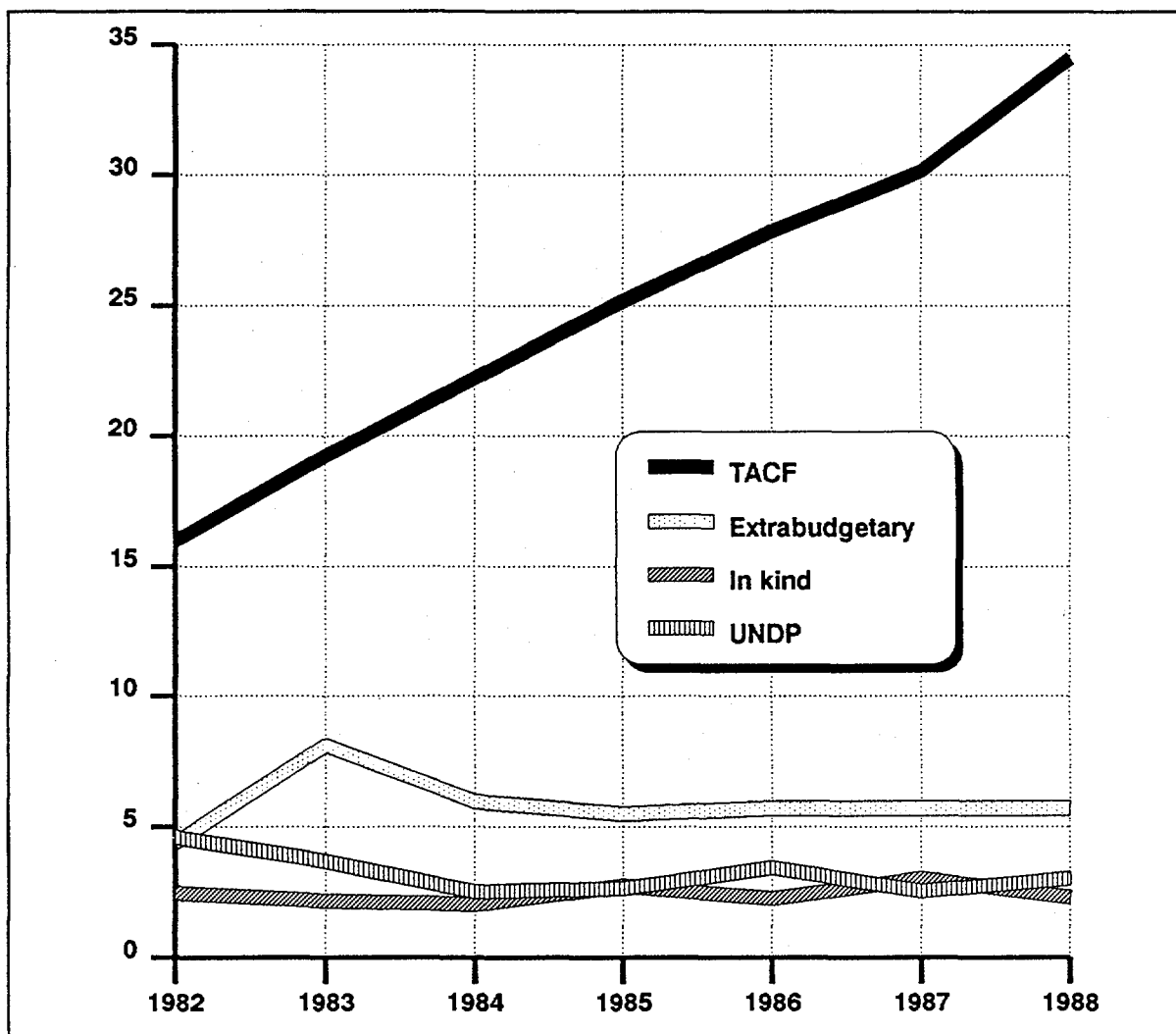
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**Figure 6. Utilization of the Technical Assistance and Co-operation Fund**

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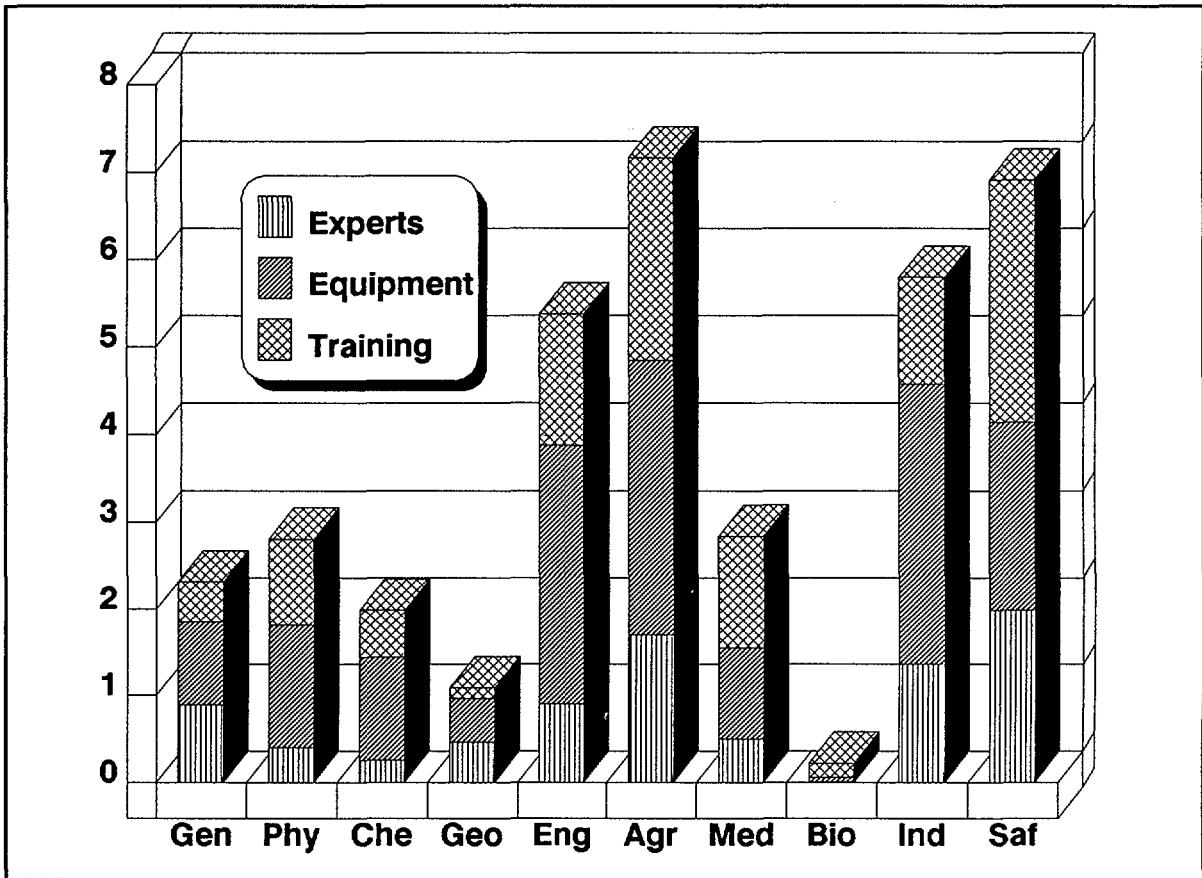
The bar chart shows, over a ten-year period, the total resources available to the Technical Assistance and Co-operation Fund year by year - each year including the unobligated and unspent funds of prior years - as well as the disbursements and obligations incurred against these resources as at 31 December of each year. Obligations incurred against future years for approved multi-year projects are shown separately, reflecting the status at the end of 1988. The graph below it shows, in per cent, the unobligated balance, unliquidated obligations and disbursements for the same ten-year period.

**FIGURE 1A**  
**RESOURCES AVAILABLE FOR AGENCY**  
**TECHNICAL CO-OPERATION PROGRAMMES: 1982 - 1988**  
(in millions of dollars)



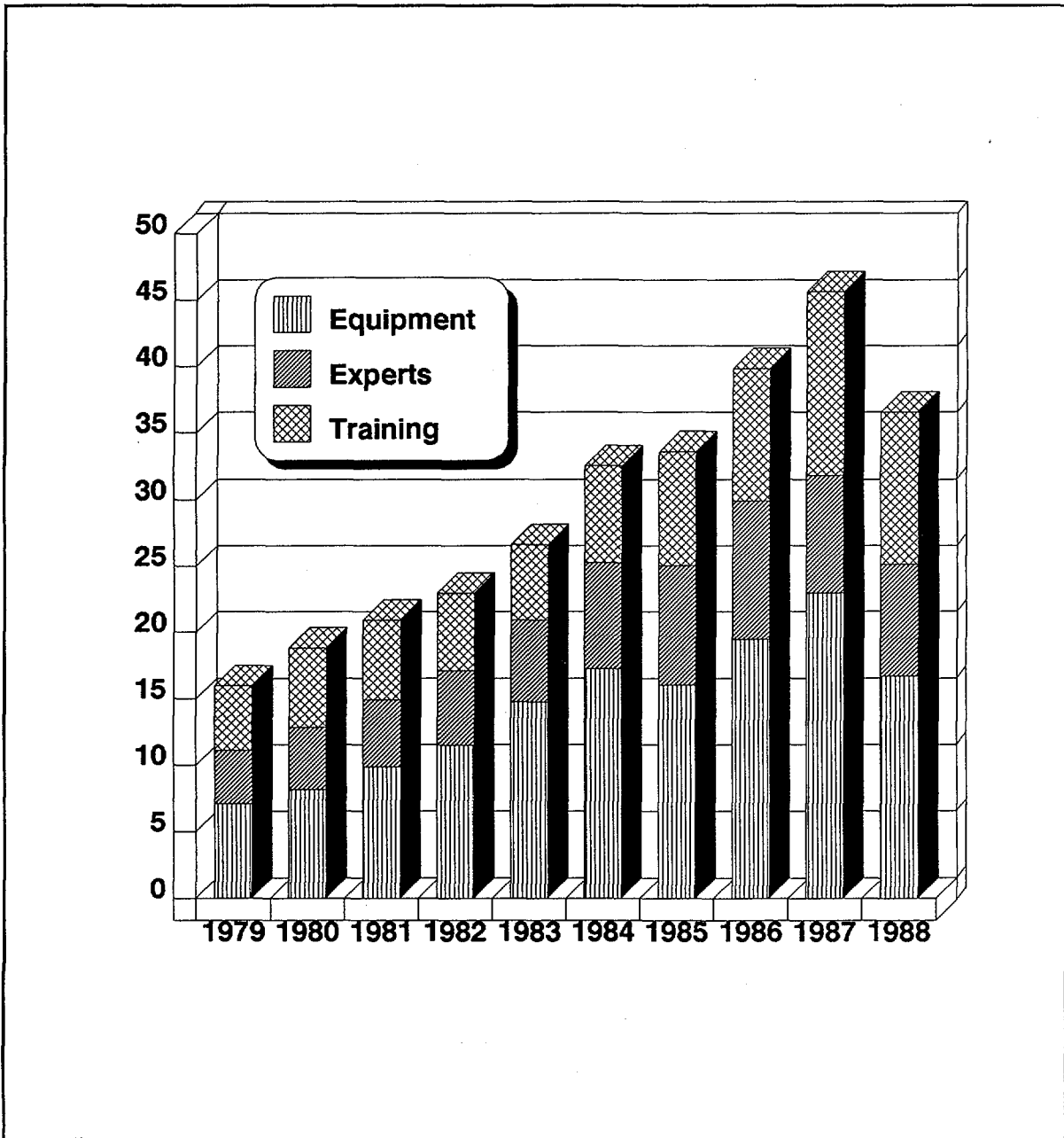
TACF	16.003	19.241	22.232	25.197	27.860	30.153	34.510
Extra-budgetary funds	4.413	8.101	5.964	5.484	5.702	5.700	5.710
Assistance in kind	2.493	2.172	2.066	2.765	2.282	3.066	2.322
UNDP	4.631	3.706	2.541	2.654	3.480	2.568	3.051
<b>TOTAL</b>	<b>27.540</b>	<b>33.220</b>	<b>32.803</b>	<b>36.100</b>	<b>39.324</b>	<b>41.487</b>	<b>45.593</b>

**FIGURE 1B**  
**DISBURSEMENTS BY FIELD OF ACTIVITY: 1988**  
(in millions of dollars)

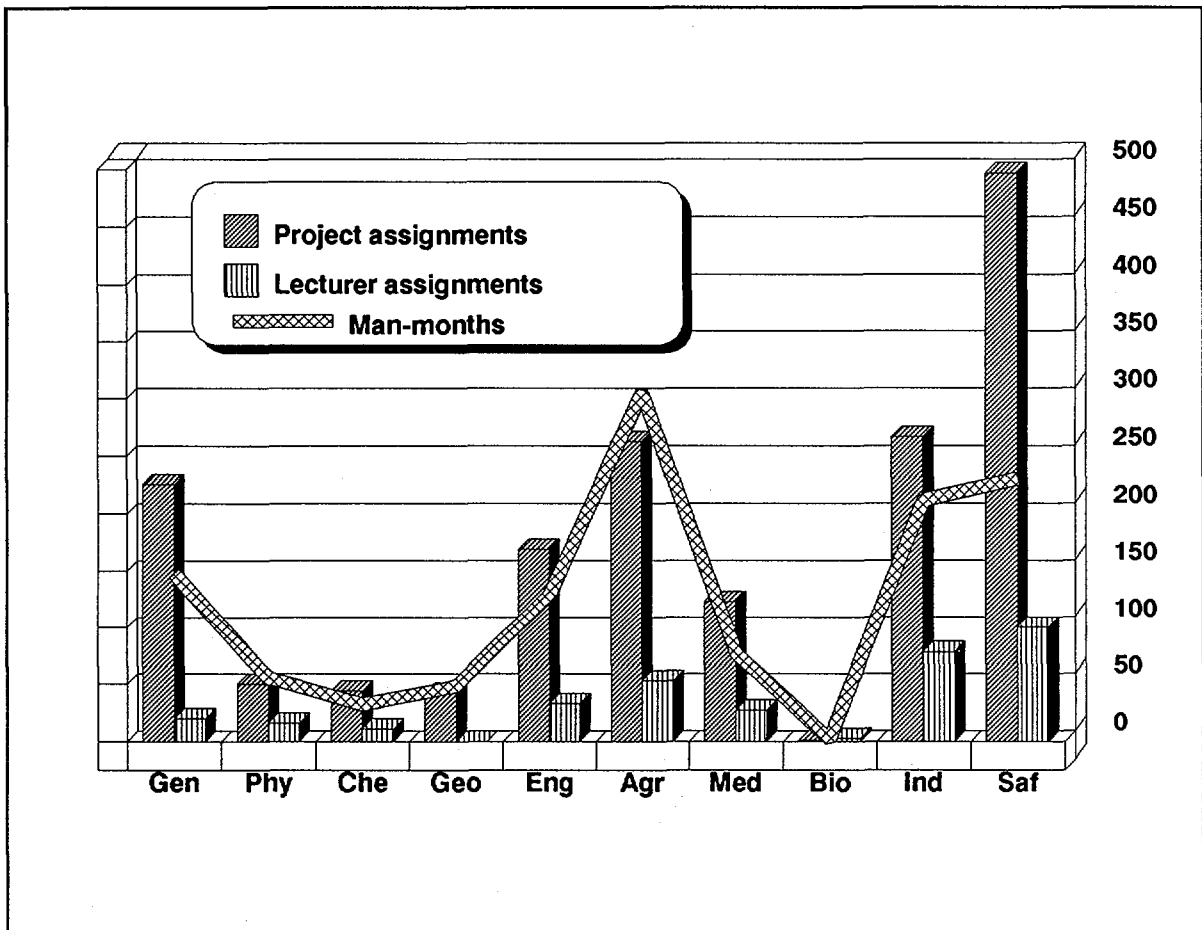


<b>Gen</b>	<b>=</b>	<b>General atomic energy development</b>
<b>Phy</b>	<b>=</b>	<b>Nuclear physics</b>
<b>Che</b>	<b>=</b>	<b>Nuclear chemistry</b>
<b>Geo</b>	<b>=</b>	<b>Prospecting, mining and processing of nuclear materials</b>
<b>Eng</b>	<b>=</b>	<b>Nuclear engineering and technology</b>
<b>Agr</b>	<b>=</b>	<b>Application of isotopes and radiation in agriculture</b>
<b>Med</b>	<b>=</b>	<b>Application of isotopes and radiation in medicine</b>
<b>Bio</b>	<b>=</b>	<b>Application of isotopes and radiation in biology</b>
<b>Ind</b>	<b>=</b>	<b>Application of isotopes and radiation in industry and hydrology</b>
<b>Saf</b>	<b>=</b>	<b>Safety in nuclear energy</b>

**FIGURE 1C**  
**DISBURSEMENTS BY COMPONENT: 1979-1988**  
(in millions of dollars)



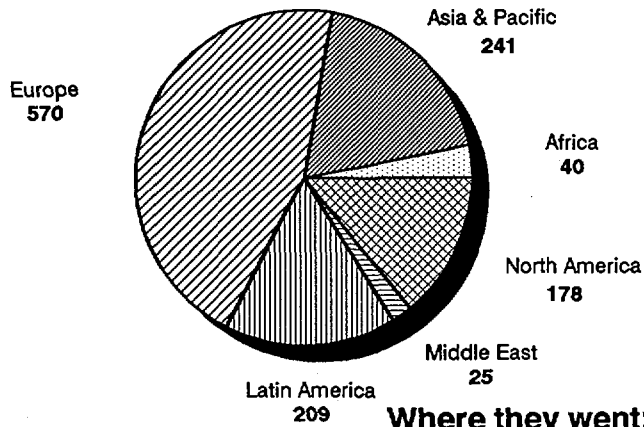
**FIGURE 2A**  
**TECHNICAL CO-OPERATION**  
**PERSONNEL SERVICES BY FIELD OF ACTIVITY: 1988**



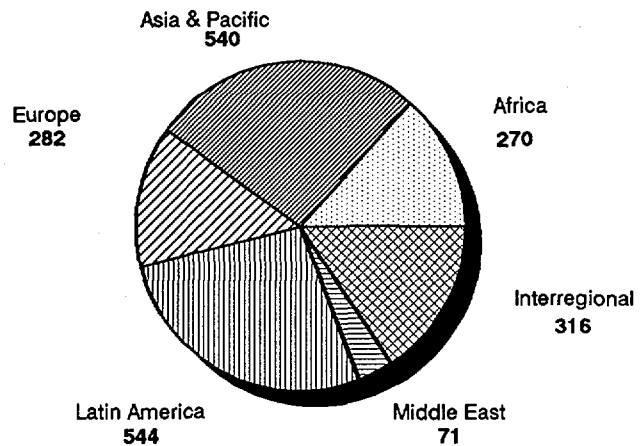
<b>Gen</b>	<b>=</b>	<b>General atomic energy development</b>
<b>Phy</b>	<b>=</b>	<b>Nuclear physics</b>
<b>Che</b>	<b>=</b>	<b>Nuclear chemistry</b>
<b>Geo</b>	<b>=</b>	<b>Prospecting, mining and processing of nuclear materials</b>
<b>Eng</b>	<b>=</b>	<b>Nuclear engineering and technology</b>
<b>Agr</b>	<b>=</b>	<b>Application of isotopes and radiation in agriculture</b>
<b>Med</b>	<b>=</b>	<b>Application of isotopes and radiation in medicine</b>
<b>Bio</b>	<b>=</b>	<b>Application of isotopes and radiation in biology</b>
<b>Ind</b>	<b>=</b>	<b>Application of isotopes and radiation in industry and hydrology</b>
<b>Saf</b>	<b>=</b>	<b>Safety in nuclear energy</b>

**FIGURE 2B**  
**TECHNICAL CO-OPERATION**  
**PERSONNEL SERVICES BY REGION: 1988**

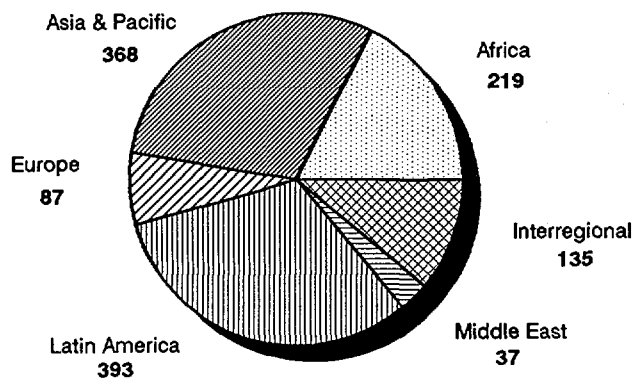
**Where they came from: 1263**



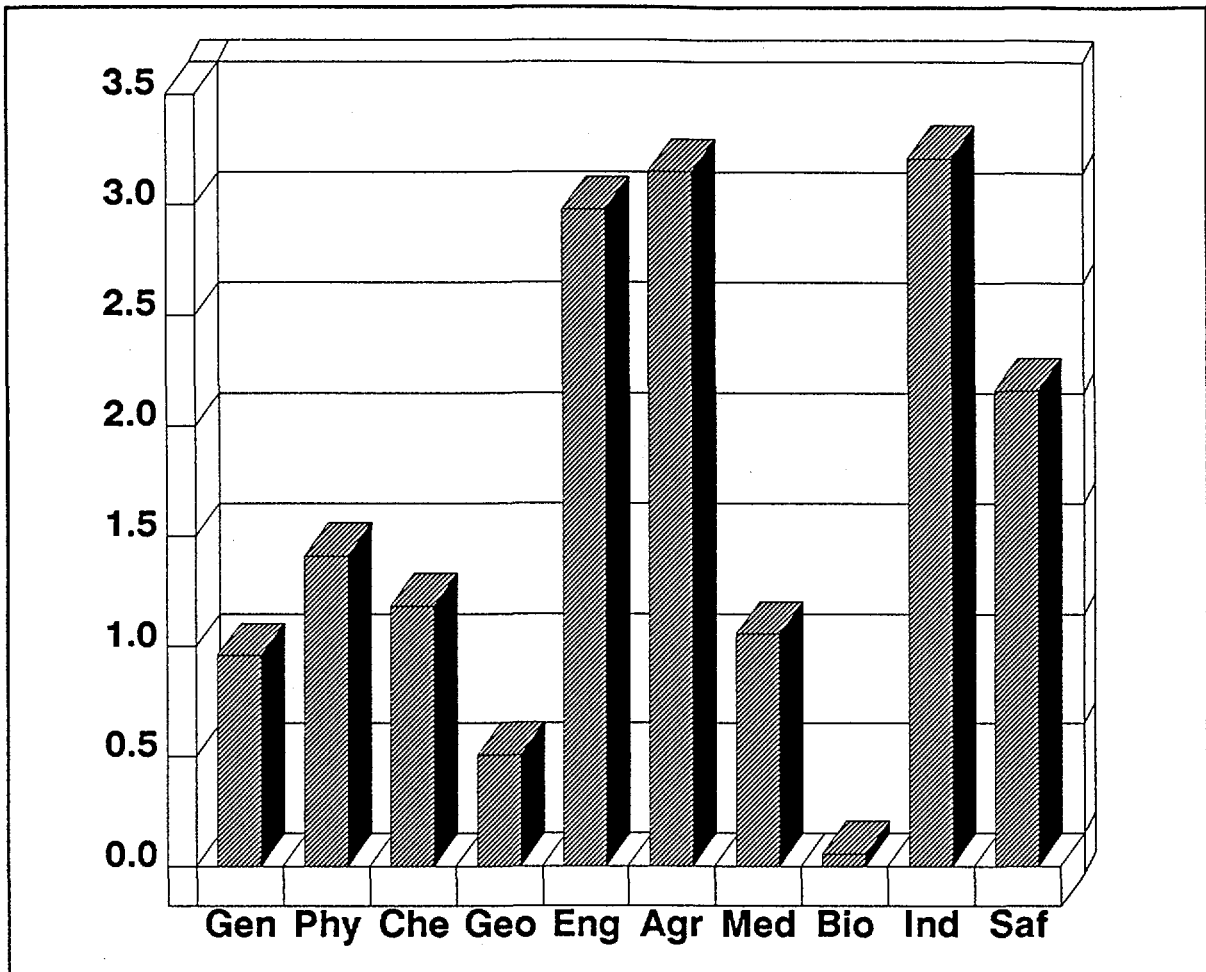
**Where they went: 2023 assignments**



**For how long: 1239 man-months**



**FIGURE 3A**  
**DISTRIBUTION OF EQUIPMENT DISBURSEMENTS**  
**BY FIELD OF ACTIVITY: 1988**  
(in millions of dollars)

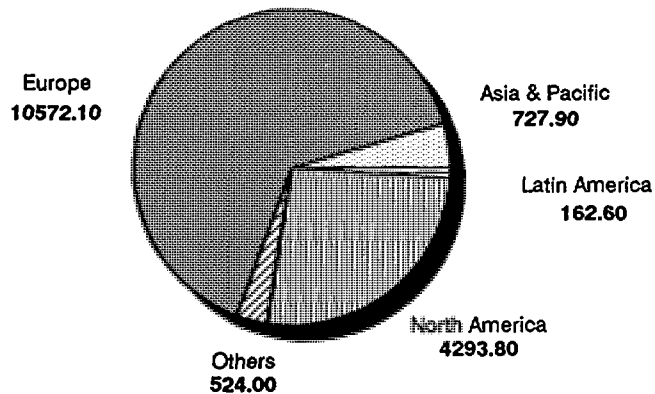


- |            |          |  |
|------------|----------|--|
| <b>Gen</b> | <b>=</b> | <b>General atomic energy development</b>                               |
| <b>Phy</b> | <b>=</b> | <b>Nuclear physics</b>   |
| <b>Che</b> | <b>=</b> | <b>Nuclear chemistry</b>   |
| <b>Geo</b> | <b>=</b> | <b>Prospecting, mining and processing of nuclear materials</b>         |
| <b>Eng</b> | <b>=</b> | <b>Nuclear engineering and technology</b>                              |
| <b>Agr</b> | <b>=</b> | <b>Application of isotopes and radiation in agriculture</b>            |
| <b>Med</b> | <b>=</b> | <b>Application of isotopes and radiation in medicine</b>               |
| <b>Bio</b> | <b>=</b> | <b>Application of isotopes and radiation in biology</b>                |
| <b>Ind</b> | <b>=</b> | <b>Application of isotopes and radiation in industry and hydrology</b> |
| <b>Saf</b> | <b>=</b> | <b>Safety in nuclear energy</b>  |

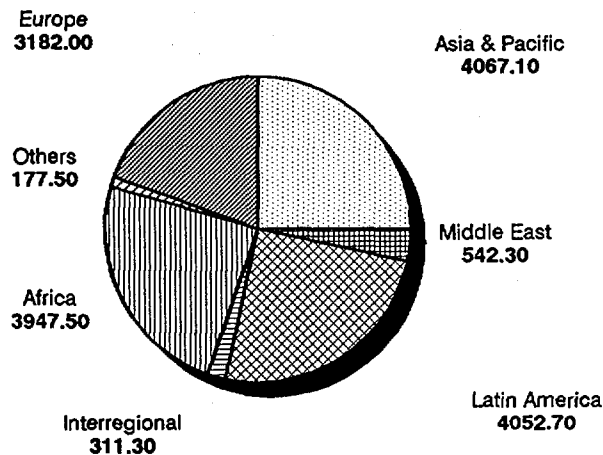


**FIGURE 3B**  
**DISTRIBUTION OF EQUIPMENT DISBURSEMENTS**  
**BY REGION: 1988**  
**(in thousands of dollars)**

**Where it came from: \$16.3 million**



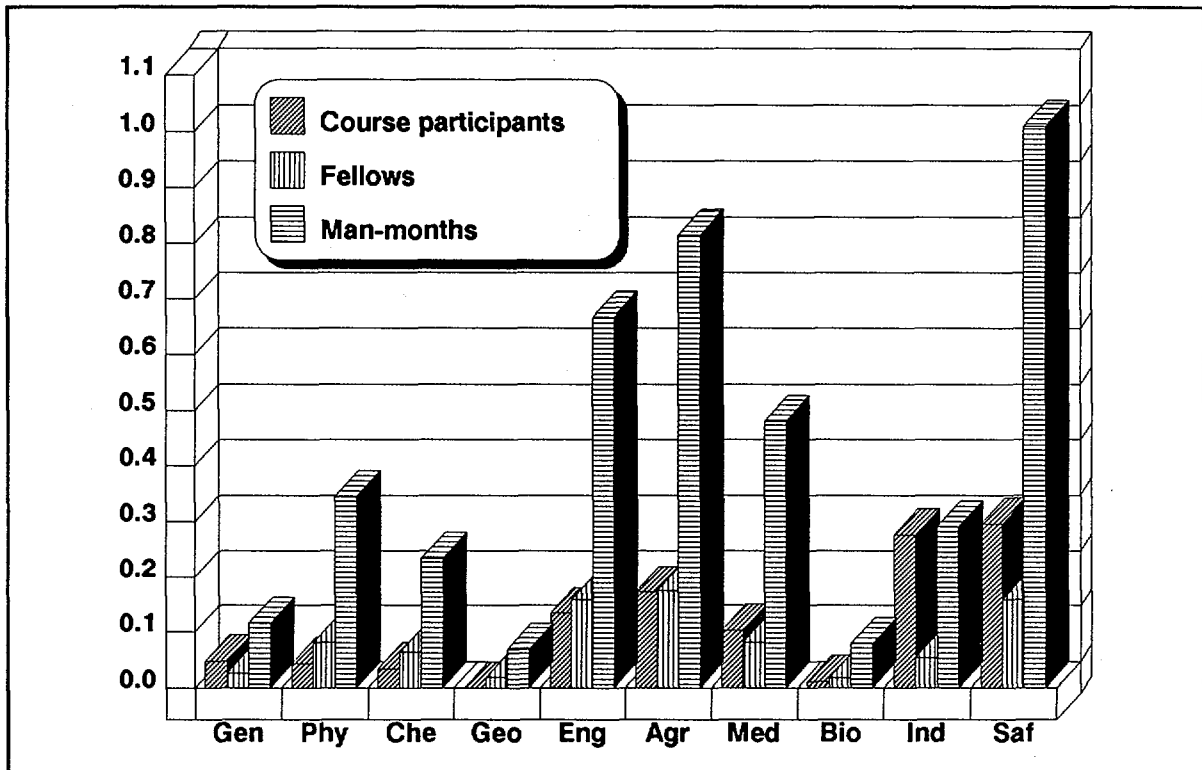
**Where it went: \$16.3 million**



**Where equipment was purchased:**

Australia	87	Finland	63	Netherlands	264
Austria	1,028	German D.R.	674	Poland	168
Brazil	59	Germany, F.R.	553	Switzerland	203
Canada	468	France	2,079	Thailand	75
Colombia	53	Hungary	217	Taiwan	96
China	138	Italy	118	USSR	3,027
Czechoslovakia	161	Japan	265	UK	1,654
Denmark	61	Luxembourg	138	USA	3,826

**FIGURE 4A**  
**DISTRIBUTION OF TRAINEES**  
**BY FIELD OF ACTIVITY: 1988**  
**(in thousands)**

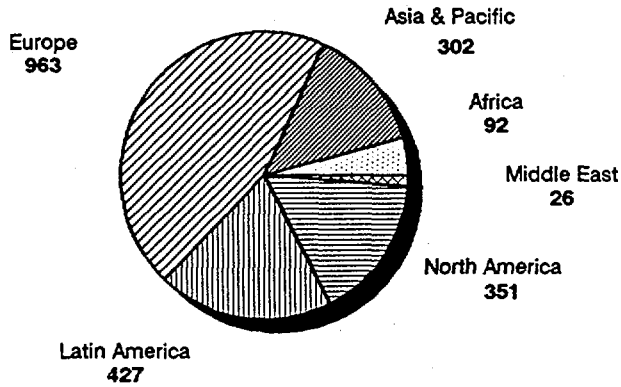


- |            |          |  |
|------------|----------|--|
| <b>Gen</b> | <b>=</b> | <b>General atomic energy development</b>                               |
| <b>Phy</b> | <b>=</b> | <b>Nuclear physics</b>   |
| <b>Che</b> | <b>=</b> | <b>Nuclear chemistry</b>   |
| <b>Geo</b> | <b>=</b> | <b>Prospecting, mining and processing of nuclear materials</b>         |
| <b>Eng</b> | <b>=</b> | <b>Nuclear engineering and technology</b>                              |
| <b>Agr</b> | <b>=</b> | <b>Application of isotopes and radiation in agriculture</b>            |
| <b>Med</b> | <b>=</b> | <b>Application of isotopes and radiation in medicine</b>               |
| <b>Bio</b> | <b>=</b> | <b>Application of isotopes and radiation in biology</b>                |
| <b>Ind</b> | <b>=</b> | <b>Application of isotopes and radiation in industry and hydrology</b> |
| <b>Saf</b> | <b>=</b> | <b>Safety in nuclear energy</b>  |

**FIGURE 4B**  
**SUMMARY DATA ON TRAINING PROGRAMMES: 1988**

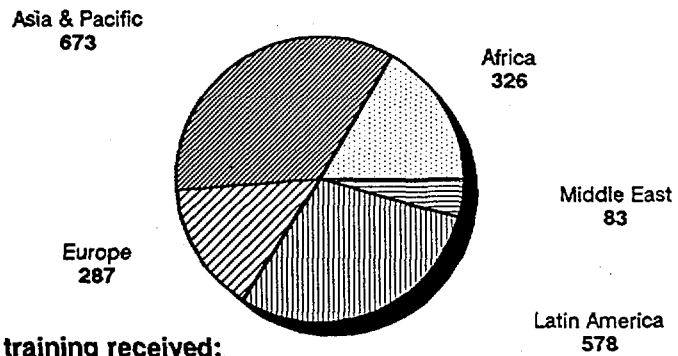
**Where training was given:**

2161 places of study



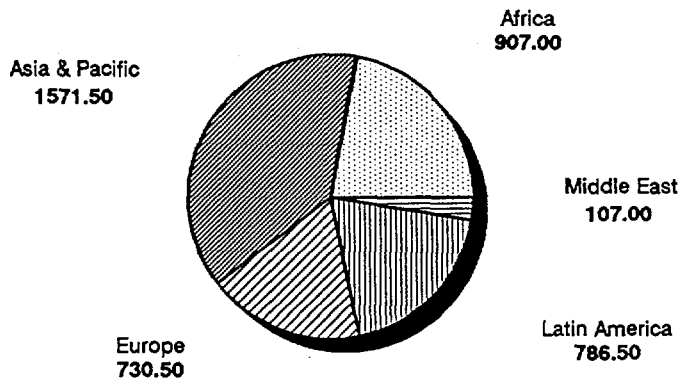
**Where trainees came from:**

1947 persons

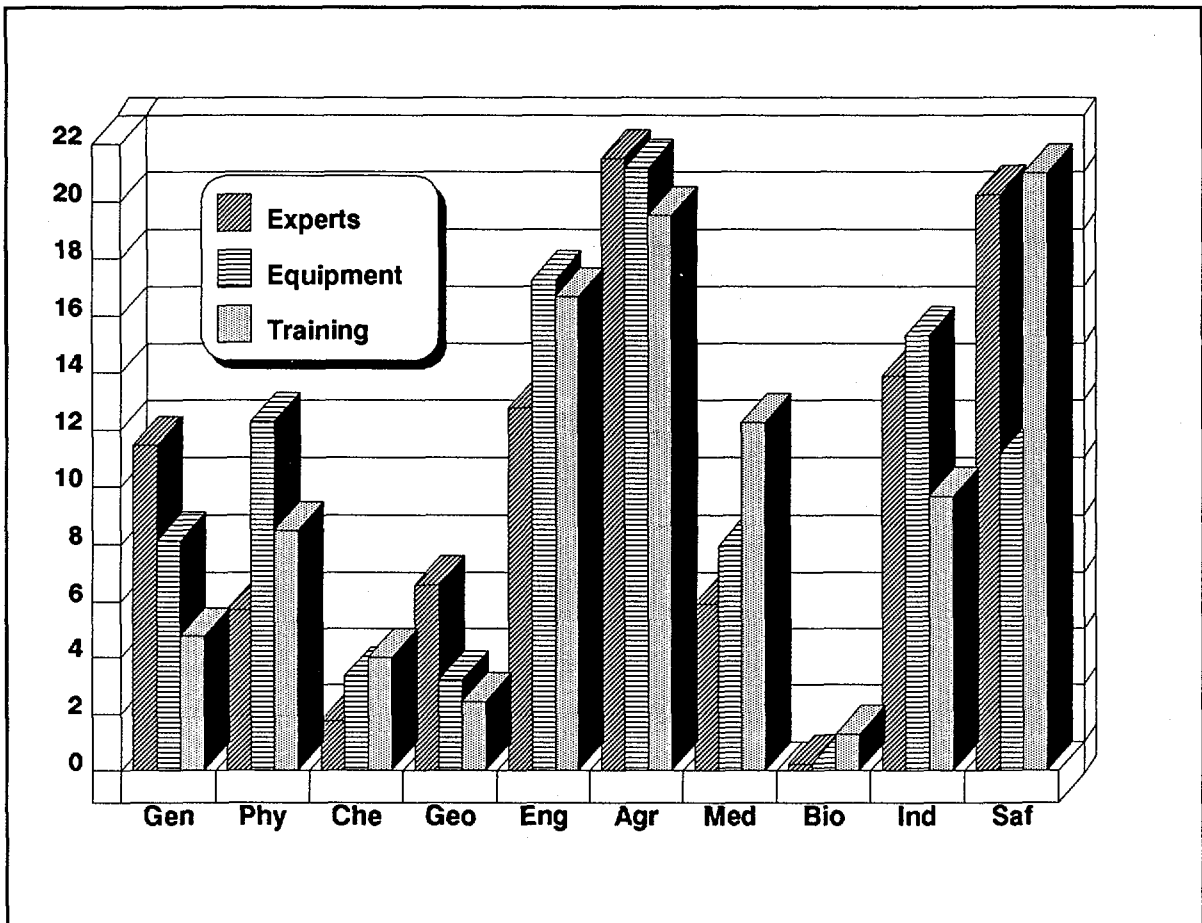


**Amount of training received:**

4102.5 man-months

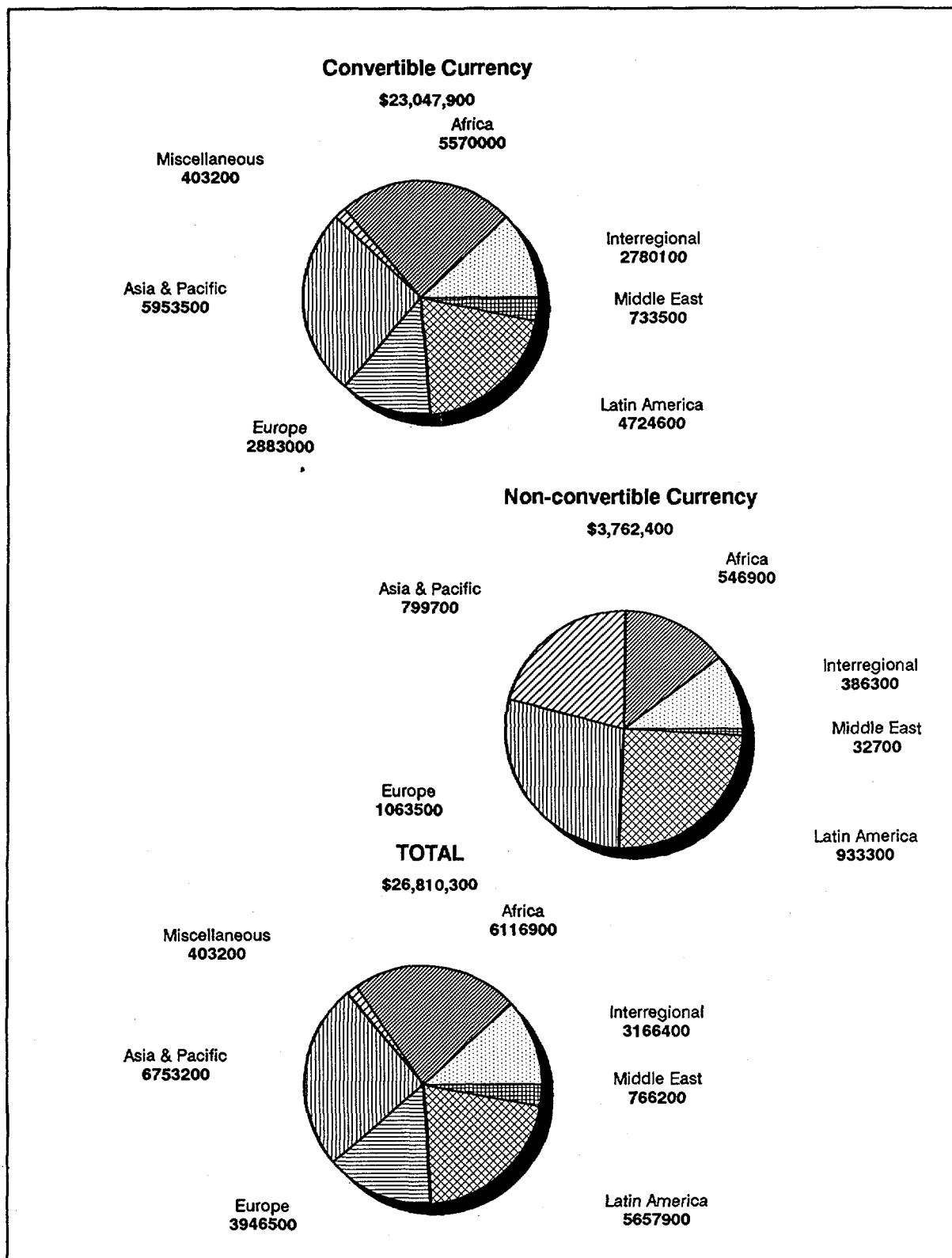


**FIGURE 5A**  
**DISTRIBUTION OF DISBURSEMENTS**  
**BY TYPE AND FIELD OF ACTIVITY**  
 (in per cent, averaged over the period 1984-1988)

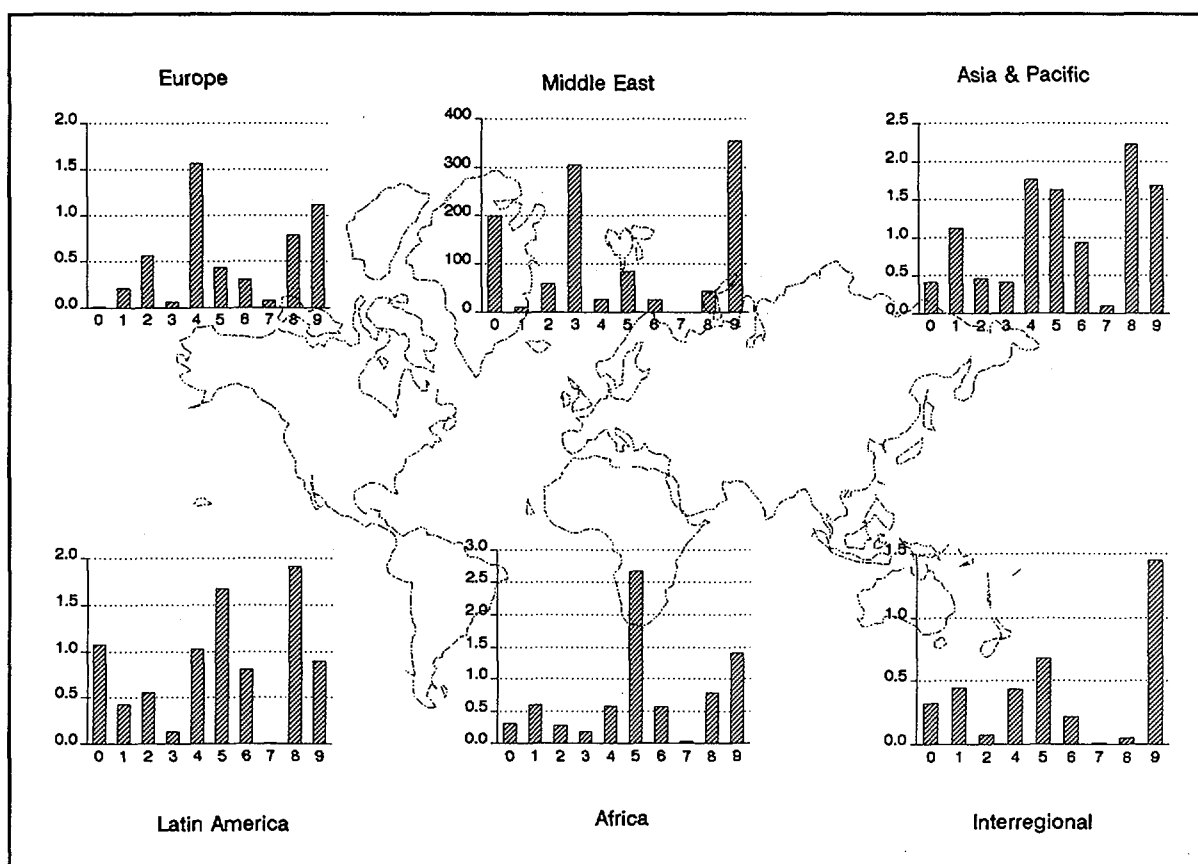


- Gen** = General atomic energy development
- Phy** = Nuclear physics
- Che** = Nuclear chemistry
- Geo** = Prospecting, mining and processing of nuclear materials
- Eng** = Nuclear engineering and technology
- Agr** = Application of isotopes and radiation in agriculture
- Med** = Application of isotopes and radiation in medicine
- Bio** = Application of isotopes and radiation in biology
- Ind** = Application of isotopes and radiation in industry and hydrology
- Saf** = Safety in nuclear energy

**FIGURE 5B**  
**TECHNICAL ASSISTANCE AND CO-OPERATION FUND**  
**DISBURSEMENTS BY TYPE OF CURRENCY AND REGION: 1988**



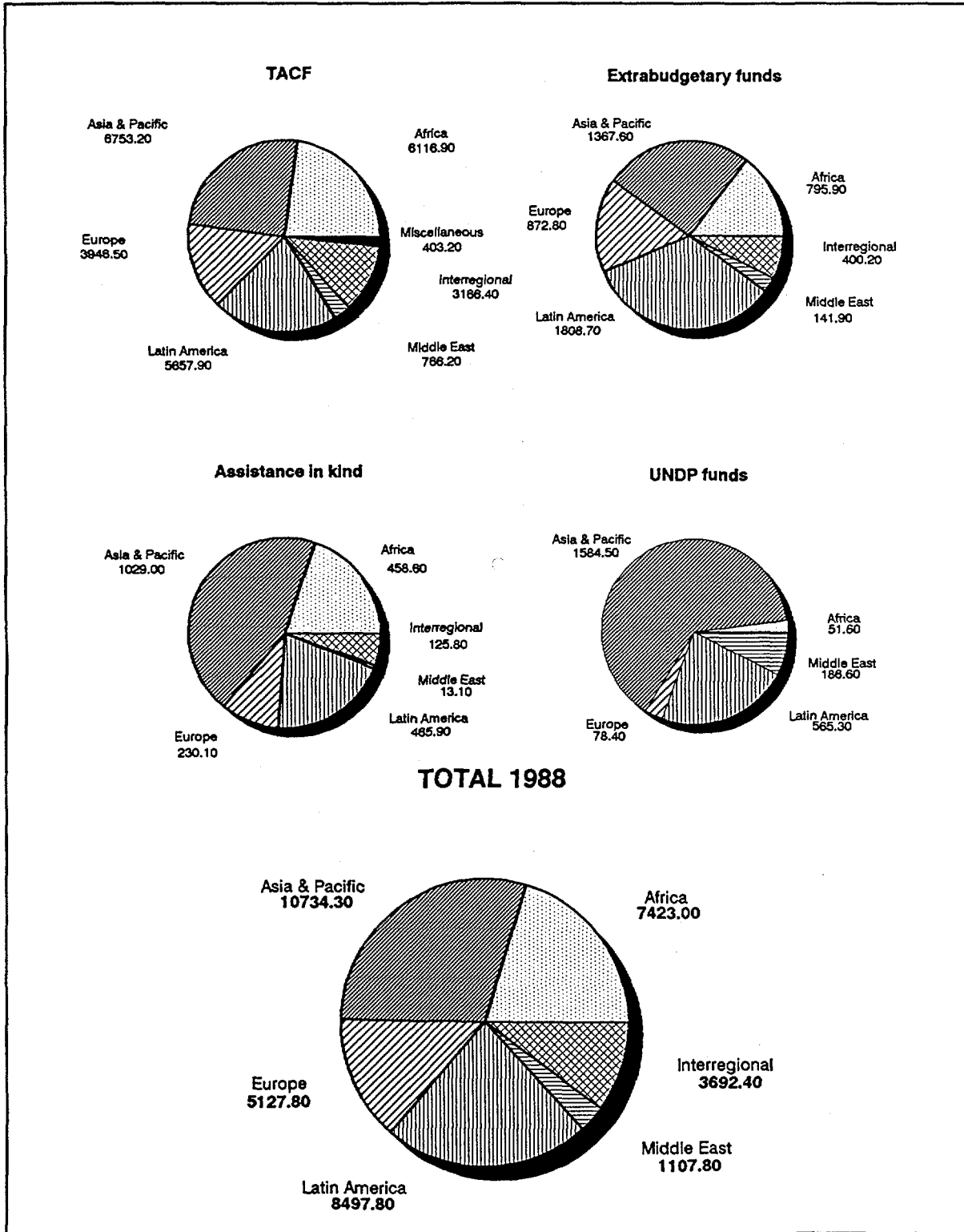
**FIGURE 5C**  
**DISTRIBUTION OF TECHNICAL CO-OPERATION**  
**DISBURSEMENTS BY FIELD AND REGION: 1988**



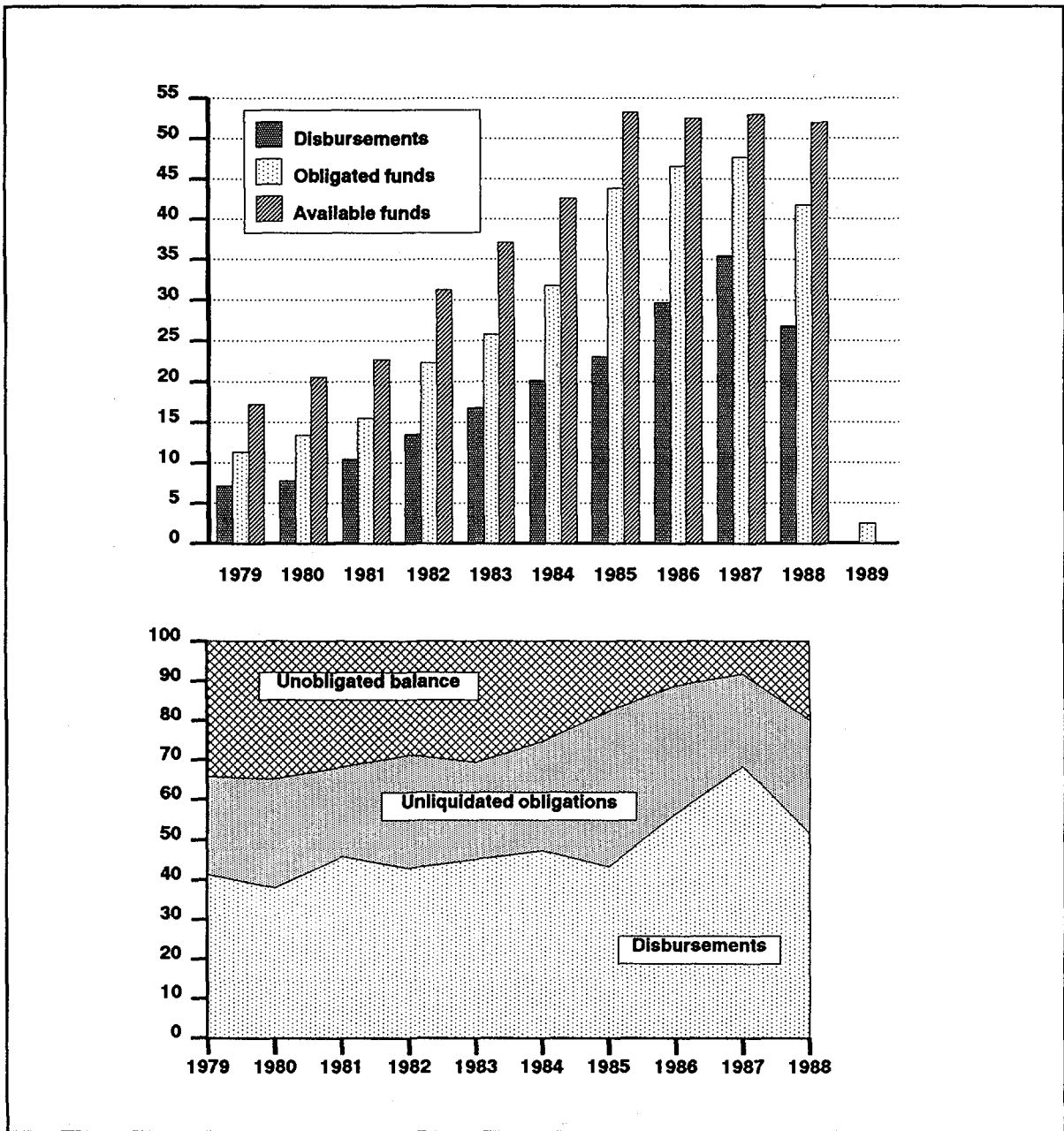
**Summary in thousands of dollars**

Field of activity	Africa \$	Asia & Pacific \$	Europe \$	Latin America \$	Middle East \$	Inter- regional \$	All regions \$
0 - General atomic energy development	309.3	411.9	8.8	1,072.8	199.0	321.5	2323.3
1 - Nuclear physics	595.1	1,126.6	209.9	429.6	10.8	447.2	2819.2
2 - Nuclear chemistry	285.6	458.7	563.5	548.3	59.7	78.0	1993.8
3 - Prospecting, mining and processing of nuclear materials	184.4	408.4	62.3	129.7	305.6	0.0	1090.4
4 - Nuclear engineering and technology	576.0	1,762.0	1,561.5	1,025.6	25.6	435.3	5386.0
Application of isotopes and radiation in							
5 - Agriculture	2,673.2	1,626.6	437.1	1,674.7	84.9	679.8	7176.3
6 - Medicine	571.7	927.1	301.4	801.0	25.1	219.9	2846.2
7 - Biology	38.9	95.6	76.7	8.0	0.0	12.3	231.5
8 - Industry and hydrology	783.7	2,228.4	784.5	1,913.4	43.6	51.2	5804.8
9 - Safety in nuclear energy	1,405.1	1,689.0	1,122.1	894.7	353.5	1447.2	6911.6
<b>Sub-total</b>	<b>7,423.0</b>	<b>10,734.3</b>	<b>5,127.8</b>	<b>8,497.8</b>	<b>1,107.8</b>	<b>3692.4</b>	<b>36583.1</b>
Miscellaneous	0.0	0.0	0.0	0.0	0.0	403.2	403.2
<b>GRAND TOTAL</b>	<b>7,423.0</b>	<b>10,734.3</b>	<b>5,127.8</b>	<b>8,497.8</b>	<b>1,107.8</b>	<b>4095.6</b>	<b>36986.3</b>

**FIGURE 5D**  
**DISTRIBUTION OF TECHNICAL CO-OPERATION**  
**DISBURSEMENTS BY SOURCE AND REGION: 1988**  
(in thousands of dollars)



**FIGURE 6**  
**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: 1979-1988**

This table is directly related to Figure 1A, 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.

### **Table 2. Technical Assistance and Co-operation Fund: 1979-1988**

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 1988). 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: 1988**

This table shows the number of individuals who undertook technical co-operation assignments during 1988. 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 grouped at the end under their respective headings and are not listed by nationality.

### **Table 3B. Trainees in the field by place of study: 1988**

A breakdown is given for trainees (fellows, training course participants and visiting scientists) based on the place of study.

### **Table 4. Distribution of technical co-operation disbursements by type: 1984-1988**

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 1988 for fellows who had already started their studies in 1988. "Miscellaneous" refers to disbursements in all components for telex charges, health insurance, copying fees and for other minor items or services. In 1988, it also included a charge of \$189,780 for radiation protection services.

**Table 5. Extrabudgetary funds for technical co-operation activities by donor as at 31 December 1988**

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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.

**Table 6A. Technical co-operation personnel services: 1988**

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A list is given of 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: 1988**

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The list shows, by recipient country, the number of trainees and the total man-months of training received in 1988.

**Table 7. Financial summary: 1988**

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This major table shows, by type of assistance and by source, the total technical assistance furnished to each recipient country as well as to intercountry projects and training courses.

**Table 8. Financial summary: 1958-1988**

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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**

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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 1987 and 1988.

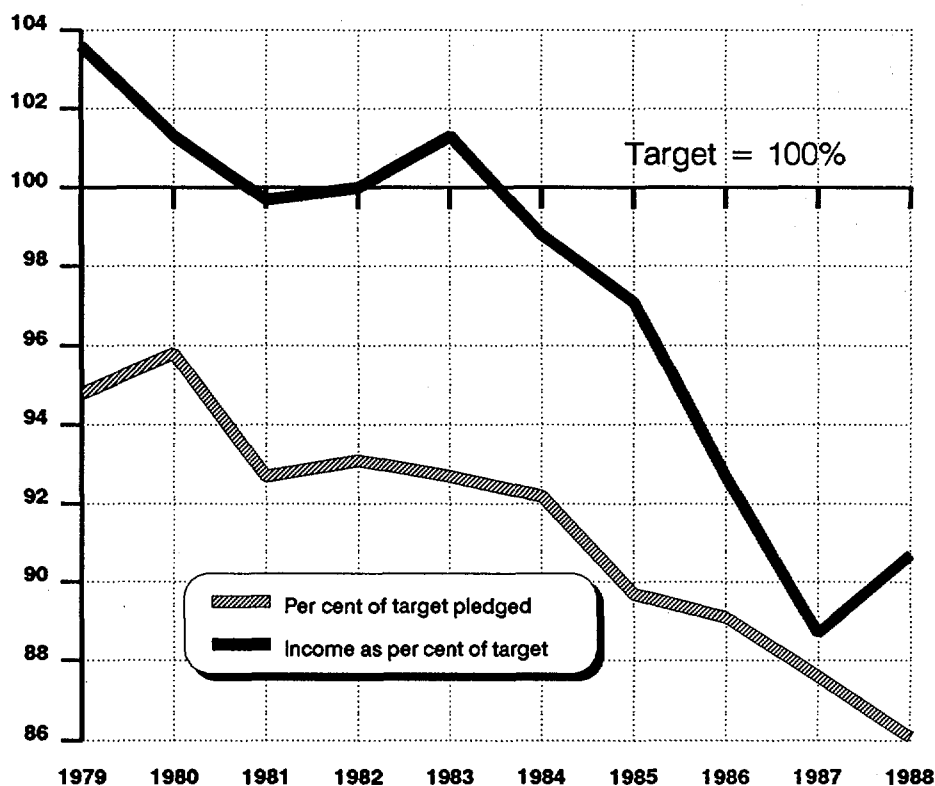
**TABLE 1**  
**AVAILABLE RESOURCES: 1979-1988**  
(in thousands of dollars)

Year	Technical Assistance and Co-operation Fund				Other resources				Grand total (1 + 5) (6)
	Voluntary contributions		Miscellaneous	Sub-total	Extrabudgetary funds	Assistance In kind	UNDP	Sub-total	
	Convertible currency	Non-convertible currency	Income						
	(1a)	(1b)	(1c)	(1)	(2)	(3)	(4)	(5)	
1979	6,448	1,614	740	8,802	2,635	2,015	6,066	10,716	19,518
1980	7,977	2,083	572	10,632	2,669	2,628	5,018	10,315	20,947
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	11,083	45,593
<b>1978-1987</b>	<b>159,882</b>	<b>36,077</b>	<b>11,627</b>	<b>207,586</b>	<b>49,897</b>	<b>24,597</b>	<b>38,901</b>	<b>113,395</b>	<b>320,981</b>

**TABLE 2**  
**TECHNICAL ASSISTANCE AND CO-OPERATION FUND: 1979-1988**

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 by programme year	Income as per cent of target
1979	8,500,000	8,062,513	94.9	8,802,221	103.6
1980	10,500,000	10,059,733	95.8	10,632,033	101.3
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

**PLEDGES AND INCOME TO THE TACF: 1979 -1988**  
**(in per cent)**



**TABLE 3A**  
**PROJECT PERSONNEL BY PLACE OF ORIGIN: 1988**

Place of origin	Total individuals	Assignments				Total
		International experts	National experts	Lecturers	Other project personnel	
Algeria	1	1	-	-	-	1
Argentina	51	44	-	24	3	71
Australia	24	18	-	8	-	26
Austria	21	24	-	5	6	35
Bangladesh	10	11	-	1	-	12
Barbados	1	1	-	-	-	1
Belgium	13	14	-	3	-	17
Bolivia	5	5	1	-	-	6
Brazil	33	18	3	25	5	51
Bulgaria	17	8	20	2	-	30
Canada	26	34	-	7	-	41
Chile	12	11	1	4	-	16
China	13	12	1	-	-	13
Colombia	6	6	-	2	-	8
Costa Rica	2	2	-	-	-	2
Cuba	2	2	-	-	-	2
Czechoslovakia	19	13	16	2	-	31
Denmark	7	20	-	-	-	20
Dominican Republic	1	1	-	-	-	1
Ecuador	6	6	1	-	-	7
Egypt	10	2	8	1	-	11
El Salvador	2	1	-	1	-	2
Ethiopia	2	2	-	-	-	2
Finland	11	13	-	2	-	15
France	53	54	-	9	-	63
German D.R.	9	14	-	2	-	16
Germany F.R.	71	76	-	12	-	88
Ghana	1	2	-	-	-	2
Greece	6	8	1	-	-	9
Guatemala	6	5	1	1	-	7
Guyana	1	2	-	-	-	2
Hungary	38	39	24	4	-	67
India	38	64	-	6	-	70
Indonesia	14	12	-	1	1	14
Iran Islamic Rep.	3	5	2	-	-	7
Iraq	6	2	6	-	-	8
Israel	4	4	-	1	-	5
Italy	16	23	-	1	-	24
Jamaica	3	2	-	1	-	3
Japan	28	22	-	12	-	34

Place of origin	Assignments					Total
	Total individuals	International experts	National experts	Lecturers	Other project personnel	
Jordan	5	3	-	2	-	5
Korea Rep.	11	9	-	2	-	11
Libyan A.J.	1	1	-	-	-	1
Malaysia	20	17	6	1	-	24
Mali	1	-	-	1	-	1
Mexico	24	17	1	10	-	28
Morocco	2	2	-	-	-	2
Netherlands	7	9	-	2	-	11
New Zealand	3	3	-	1	-	4
Nigeria	5	5	-	-	-	5
Norway	2	2	-	-	-	2
Pakistan	9	10	-	-	-	10
Panama	3	1	2	-	-	3
Paraguay	7	7	1	1	-	9
Peru	11	9	4	-	4	17
Philippines	8	7	-	1	-	8
Poland	27	36	20	1	-	57
Portugal	5	2	2	1	-	5
Romania	3	-	3	-	-	3
Saudi Arabia	1	1	-	-	-	1
Senegal	1	1	-	-	-	1
Singapore	2	2	-	-	-	2
Spain	29	35	-	6	-	41
Sri Lanka	11	37	1	2	-	40
Sudan	1	-	-	1	-	1
Sweden	9	6	-	5	1	12
Switzerland	2	-	-	2	-	2
Syrian Arab Rep.	3	3	-	1	-	4
Thailand	21	19	4	2	2	27
Trinidad and Tobago	2	2	-	1	-	3
Tunisia	4	1	3	-	-	4
Turkey	10	37	4	1	-	42
USSR	10	13	-	1	-	14
United Arab Emirates	3	4	-	-	-	4
UK	64	100	-	17	-	117
USA	131	132	-	22	-	154
Uruguay	8	7	1	2	-	10
Venezuela	8	4	5	-	-	9
Viet Nam	9	9	1	-	-	10
Yugoslavia	25	35	-	5	-	40
IAEA	154	324	-	106	-	430
Other international organizations	9	2	-	7	-	9
<b>TOTAL</b>	<b>1263</b>	<b>1517</b>	<b>143</b>	<b>341</b>	<b>22</b>	<b>2023</b>

**TABLE 3B**  
**TRAINEES IN THE FIELD BY PLACE OF STUDY: 1988**

Place of study	Fellows	Training course participants	Visiting scientists	TOTAL <sup>a)</sup>
Argentina	15	81	3	99
Australia	9	40	3	52
Austria	10	-	8	18
Belgium	18	-	2	20
Brazil	13	68	4	85
Bulgaria	5	-	3	8
Canada	18	30	8	56
Chile	2	46	2	50
China	3	56	1	60
Colombia	1	32	1	34
Costa Rica	2	8	-	10
Côte d'Ivoire	1	-	-	1
Cuba	-	14	3	17
Cyprus	1	-	-	1
Czechoslovakia	3	-	3	6
Denmark	4	-	3	7
Dominican Rep.	-	16	-	16
Ecuador	2	3	-	5
Egypt	-	15	-	15
Ethiopia	-	18	-	18
Finland	3	-	-	3
France	47	30	25	102
German D.R.	15	14	3	32
Germany, F.R.	68	82	30	180
Ghana	-	20	-	20
Greece	2	-	-	2
Guatemala	1	6	-	7
Hungary	27	28	2	57
India	12	26	5	43
Indonesia	-	-	6	6
Ireland	1	20	-	21
Italy	15	-	11	26
Jamaica	-	7	-	7
Japan	10	23	6	39
Jordan	-	9	-	9
Kenya	2	8	-	10
Korea, Republic of	-	26	5	31
Kuwait	-	11	-	11
Malaysia	1	15	5	21
Mali	1	-	-	1

Place of study	Fellows	Training course participants	Visiting scientists	TOTAL <sup>a)</sup>
Mexico	3	-	1	4
Morocco	1	-	-	1
Netherlands	12	-	14	26
New Zealand	-	-	1	1
Niger	-	8	-	8
Nigeria	-	14	1	15
Norway	3	-	-	3
Pakistan	1	12	3	16
Paraguay	-	5	-	5
Peru	1	54	-	55
Philippines	1	-	-	1
Poland	9	9	8	26
Singapore	2	-	-	2
Spain	26	-	11	37
Sri Lanka	-	9	-	9
Sudan	-	-	1	1
Sweden	6	-	5	11
Switzerland	7	-	5	12
Syrian Arab Republic	-	6	-	6
Thailand	-	12	9	21
Trinidad and Tobago	-	12	-	12
Turkey	-	10	-	10
USSR	15	29	52	96
UK	79	20	15	114
USA	135	151	7	293
Uruguay	2	7	-	9
Venezuela	-	14	-	14
Yugoslavia	8	-	-	8
Zambia	1	-	-	1
Zimbabwe	1	-	-	1
IAEA	71	44	21	136
European Nuclear Res. Center	1	-	-	1
<b>TOTAL</b>	<b>697</b>	<b>1,168</b>	<b>296</b>	<b>2,161</b>

a) The difference between the number of trainees (1,947) and the number of places of study (2,161) 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: 1984-1988

Year and source	Experts		Equipment		Fellowships		Scientific visits		Training courses		Sub-contracts		Miscellaneous		Total	Assistance outstanding as at 31 December '88		Total (8 + 9 + 10)	
													Unliquidated In-kind obligations balance						
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)								
	\$	%	\$	%	\$	%	\$	%	\$	%	\$	%	\$	%	\$	\$	\$		
<b>1984</b>																			
UNDP funds	935.4	24.0	2,145.2	55.0	197.8	5.1	0.0	0.0	263.5	6.7	291.5	7.5	65.3	1.7	3,898.7	100.0	0.0	0.0	3,898.7
Agency funds	4,118.2	20.5	10,010.1	49.7	2,739.8	13.6	364.8	1.8	2,530.9	12.6	241.8	1.2	118.8	0.6	20,124.0	100.0	0.0	0.0	20,124.0
Extrabudgetary funds	1,538.3	23.7	3,802.5	58.6	243.4	3.7	8.0	0.1	209.9	3.2	692.8	10.7	0.0	0.0	6,492.7	100.0	0.0	0.0	6,492.7
Assistance in kind	285.4	13.8	53.0	2.6	1,491.1	72.2	0.0	0.0	238.6	11.4	0.0	0.0	0.0	0.0	2,066.1	100.0	0.0	0.0	2,066.1
TOTAL	6,877.3	21.1	18,010.8	49.1	4,671.9	14.3	370.6	1.1	3,240.9	10.0	1,225.9	3.8	184.1	0.6	32,581.5	100.0	0.0	0.0	32,581.5
<b>1985</b>																			
UNDP funds	877.2	34.2	1,101.9	43.0	141.2	5.5	91.1	3.6	218.3	8.5	99.9	3.9	32.8	1.3	2,562.5	100.0	0.0	0.0	2,562.5
Agency funds	5,032.7	21.8	10,448.2	45.3	3,153.9	13.7	448.1	1.9	3,447.2	15.0	370.8	1.6	181.4	0.7	23,082.3	100.0	0.0	0.0	23,082.3
Extrabudgetary funds	1,581.2	29.7	2,887.5	54.2	125.6	2.3	2.4	0.1	158.1	3.0	570.9	10.7	0.0	0.0	5,325.7	100.0	0.0	0.0	5,325.7
Assistance in kind	501.9	18.1	0.0	0.0	1,484.7	53.7	2.7	0.1	778.1	28.1	0.0	0.0	0.0	0.0	2,765.4	100.0	0.0	0.0	2,765.4
TOTAL	7,993.0	23.7	14,437.6	42.8	4,905.4	14.5	544.3	1.8	4,599.7	13.6	1,041.8	3.1	194.3	0.6	33,715.9	100.0	0.0	0.0	33,715.9
<b>1986</b>																			
UNDP funds	840.7	31.4	1,285.1	43.0	190.7	5.4	49.0	1.6	428.4	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	3,631.9	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	28.1	2,759.1	54.9	131.6	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	4,948.8	12.4	818.9	2.0	203.6	0.5	39,980.3	100.0	0.0	0.0	39,980.3
<b>1987</b>																			
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	6,748.7	19.0	18,518.5	52.2	5,904.3	16.7	389.6	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	2,514.7	82.0	0.0	0.0	378.6	12.3	2.8	0.1	0.0	0.0	3,065.6	100.0	0.0	0.0	3,065.6
TOTAL	8,858.8	19.1	22,985.6	49.6	8,828.3	19.0	505.2	1.1	4,498.6	9.7	498.7	1.1	173.6	0.4	48,345.0	100.0	0.0	0.0	48,345.0
<b>1988</b>																			
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	1,530.8	0.0	3,997.2
Agency funds	6,077.3	22.7	11,948.8	44.6	4,049.2	15.1	405.2	1.5	3,663.9	13.8	262.7	1.0	403.2	1.5	28,810.3	100.0	17,250.8	0.0	44,060.9
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	4,968.8	0.0	10,355.9
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	349.4	2,671.9
TOTAL	8,300.3	22.4	16,060.8	43.4	5,880.7	15.9	543.9	1.5	4,977.8	13.5	777.5	2.1	445.5	1.2	38,988.3	100.0	23,750.2	349.4	61,085.9
<b>1984-1988</b>																			
UNDP funds	4,592.8	30.1	6,820.2	43.4	1,146.5	7.5	396.1	2.8	1,525.3	10.0	787.5	5.1	201.6	1.3	15,250.0	100.0	1,530.8	0.0	16,780.8
Agency funds	28,411.9	21.0	64,994.5	48.1	19,907.1	14.7	2,315.5	1.7	17,012.9	12.6	1,498.0	1.1	899.5	0.8	135,139.4	100.0	17,250.8	0.0	152,390.0
Extrabudgetary funds	6,811.0	24.4	15,884.3	58.6	552.3	2.0	423.5	1.6	1,549.9	5.7	2,092.3	7.7	0.0	0.0	27,113.3	100.0	4,968.8	0.0	32,082.1
Assistance in kind	1,678.1	13.4	108.7	0.9	8,537.4	68.3	2.7	0.0	2,173.9	17.4	2.9	0.0	0.0	0.0	12,501.7	100.0	0.0	349.4	12,851.1
TOTAL	41,291.8	21.7	87,607.7	48.1	30,143.3	15.9	3,137.8	1.7	22,262.0	11.7	4,360.7	2.3	1,201.1	0.6	190,004.4	100.0	23,750.2	349.4	214,104.0

**TABLE 5**  
**EXTRABUDGETARY FUNDS FOR**  
**TECHNICAL CO-OPERATION ACTIVITIES BY DONOR**  
**(as at 31 December 1988)**

Donor	Funds available 1 January 1988	New funds in 1988	Total funds available	Disbursements in 1988	Unliquidated obligations at year-end	Unobligated balance
<b>A. Funds for activities where donor is not recipient</b>						
Australia	0	143,695	143,695	126,083	0	17,612
Belgium	74,473	56,657	131,130	15,118	0	116,012
Canada	2,689	0	2,689	1,179	0	1,510
Chile	766	8,150	8,916	8,916	0	0
CEC	107,381	91,799	199,180	92,527	87,987	18,666
Finland	5,225	0	5,225	4,950	0	275
Germany, F.R.	2,108,798	1,222,069 <sup>a</sup>	3,330,867	1,347,336	525,714	1,457,817
Italy	1,244,623	-21,000 <sup>b</sup>	1,223,623	593,390	220,163	410,070
Japan	302,622	338,900	641,522	248,876	83,311	309,335
Korea, R.	0	70,000	70,000	0	0	70,000
Kuwait	227,782	0	227,782	131,274	33,230	63,278
Norway	15,263	0	15,263	0	0	15,263
Saudi Arabia	4,229	0	4,229	0	0	4,229
Sweden	297,263	288,136	585,399	257,917	45,654	281,828
USSR	2,427,550	1,336,137	3,763,687	638,185	2,251,556	873,946
UK	1,171,812	885,303 <sup>c</sup>	2,057,115	347,135	633,258	1,076,722
USA	3,327,677	1,500,000	4,827,677	1,458,026	1,015,624	2,354,027
<b>Sub-total</b>	<b>11,318,153</b>	<b>5,919,846</b>	<b>17,237,999</b>	<b>5,270,912</b>	<b>4,896,497</b>	<b>7,070,590</b>
<b>B. Funds for activities where donor is recipient</b>						
Chile	3,000	21,850	24,850	2,611	0	22,239
Colombia	3,284	0	3,284	0	3,111	173
Ecuador	5,010	-131	4,879	0	0	4,879
Hungary	0	17,700	17,700	10,067	4,417	3,216
Iceland	0	8,500	8,500	0	0	8,500
Iran, I. R.	9,162	0	9,162	5,339	0	3,823
Libyan Arab J.	-333	14,348	14,015	5,739	0	8,276
Malaysia	20,480	0	20,480	19,910	0	570
Mexico	0	8,483	8,483	0	8,483	0
Nigeria	4,730	0	4,730	0	4,729	1
Pakistan	54,000	0	54,000	54,120	0	-120
Panama	2,480	0	2,480	0	0	2,480
Poland	15,000	15,000	30,000	3,719	0	26,281
Portugal	0	20,000	20,000	0	19,454	546
Syrian A.R.	115,814	0	115,814	10,195	25,951	79,668
Thailand	1,983	0	1,983	0	0	1,983
Yugoslavia	71,026	33,404	104,430	4,461	6,132	93,837
<b>Sub-total</b>	<b>305,636</b>	<b>139,154</b>	<b>444,790</b>	<b>116,161</b>	<b>72,277</b>	<b>256,352</b>
<b>TOTAL</b>	<b>11,623,789</b>	<b>6,059,000</b>	<b>17,682,789</b>	<b>5,387,073</b>	<b>4,968,774</b>	<b>7,326,942</b>

<sup>a</sup> Includes \$193,440 as future-year project provisions.

<sup>b</sup> Fund reduction owing to termination of Egyptian Misr-Med project.

<sup>c</sup> Includes receivable of \$374,445, \$155,400 of which is against future-years.

**TABLE 6A**  
**TECHNICAL CO-OPERATION PERSONNEL SERVICES: 1988**

Recipient	Number of assignments	Number of man-months	Recipient	Number of assignments	Number of man-months
Afghanistan	2	0.5	Niger	6	4.0
Albania	6	2.5	Nigeria	12	26.0
Algeria	9	7.0	Pakistan	7	7.5
Argentina	5	16.0	Panama	5	2.0
Bangladesh	11	8.0	Paraguay	7	4.0
Bolivia	5	5.0	Peru	27	63.0
Brazil	52	55.5	Philippines	8	8.0
Burma	3	2.0	Poland	10	3.0
Cameroon	6	5.0	Portugal	22	7.5
Chile	11	6.5	Romania	39	10.5
China	53	28.5	Senegal	6	3.0
Colombia	12	8.0	Sierra Leone	2	2.0
Costa Rica	2	1.0	Singapore	5	3.5
Côte d'Ivoire	6	4.0	Sri Lanka	10	6.5
Cuba	14	14.5	Sudan	5	4.0
Cyprus	1	0.5	Syrian Arab Rep.	23	14.0
Dem. P.R. Korea	7	8.5	Thailand	50	67.5
Dominican Republic	5	3.0	Tunisia	16	5.0
Ecuador	19	13.0	Turkey	32	10.0
Egypt	41	18.0	Uganda	4	2.0
El Salvador	4	1.5	United Arab Emirates	2	1.0
Ethiopia	7	6.5	UK (Hong Kong)	2	0.5
Ghana	12	5.0	United Rep. Tanzania	6	14.0
Greece	9	5.0	Uruguay	10	6.0
Guatemala	10	7.0	Venezuela	15	10.0
Haiti	3	2.0	Viet Nam	7	3.5
Indonesia	44	50.0	Yugoslavia	7	3.5
Iran, Islamic Rep.	9	3.0	Zaire	11	7.5
Iraq	32	11.5	Zambia	17	18.0
Jamaica	2	2.5	Zimbabwe	1	0.5
Jordan	14	10.0			
Kenya	6	8.0	<i>Sub-total</i>	<i>945</i>	<i>732.0</i>
Korea, Rep.	36	24.5	Intercountry projects	737	403.0
Libyan Arab J.	4	5.0	Training courses	341	103.5
Madagascar	3	2.0			
Malaysia	31	19.5	<i>Sub-total</i>	<i>1078</i>	<i>506.5</i>
Mali	7	4.5			
Mauritius	1	0.5			
Mexico	39	23.0	<b>GRAND TOTAL</b>	<b>2023</b>	<b>1238.5</b>
Mongolia	7	9.5			
Morocco	18	6.0			
Nicaragua	3	1.0			

**TABLE 6B**  
**RECIPIENTS OF TRAINING ABROAD: 1988**

Recipient	Fellows		Visiting scientists		Training course participants		TOTAL	
	(1)	(2)	(1)	(2)	(1)	(2)	(1)	(2)
Afghanistan	-	-	1	0.5	2	1.5	3	2.0
Albania	2	13.5	-	-	-	-	2	13.5
Algeria	11	47.5	2	1.0	7	8.0	20	56.5
Angola	-	-	-	-	1	1.0	1	1.0
Argentina	2	6.0	2	1.0	49	36.0	53	43.0
Bangladesh	16	79.5	6	3.5	19	13.0	41	96.0
Barbados	-	-	-	-	7	3.5	7	3.5
Bolivia	4	21.5	2	1.0	25	29.0	31	51.5
Brazil	7	17.0	-	-	55	55.5	62	72.5
Bulgaria	34	146.0	5	3.5	27	25.5	66	175.0
Burkina Faso	-	-	-	-	1	0.5	1	0.5
Burma	1	4.0	-	-	-	-	1	4.0
Burundi	-	-	-	-	1	0.5	1	0.5
Cameroon	-	-	-	-	3	3.0	3	3.0
Central African Rep.	-	-	-	-	1	0.5	1	0.5
Chile	11	54.5	2	1.5	35	25.0	48	81.0
China	50	194.5	27	21.5	42	37.5	119	253.5
Colombia	14	54.0	2	1.0	26	17.0	42	72.0
Costa Rica	4	9.5	-	-	16	9.0	20	18.5
Côte d'Ivoire	8	27.5	-	-	3	2.5	11	30.0
Cuba	7	22.0	2	1.5	22	30.0	31	53.5
Czechoslovakia	8	39.5	2	0.5	22	22.5	32	62.5
Dem. P.R. Korea	8	25.0	7	4.0	2	2.5	17	31.5
Dominican Republic	3	12.0	-	-	10	5.0	13	17.0
Ecuador	9	51.0	1	0.5	24	18.0	34	69.5
Egypt	29	153.5	4	1.5	9	8.0	42	163.0
El Salvador	2	2.5	-	-	2	2.5	4	5.0
Ethiopia	3	23.0	1	1.0	2	2.0	6	26.0
Gabon	1	3.5	-	-	-	-	1	3.5
Gambia	-	-	-	-	1	0.5	1	0.5
Ghana	13	59.0	2	1.5	7	8.0	22	68.5
Greece	-	-	4	2.0	1	1.0	5	3.0
Guatemala	3	19.5	-	-	17	12.0	20	31.5
Guinea	-	-	-	-	1	1.0	1	1.0
Guyana	-	-	-	-	4	2.0	4	2.0

Recipient	Fellows		Visiting scientists		Training course participants		TOTAL	
	(1)	(2)	(1)	(2)	(1)	(2)	(1)	(2)
Haiti	1	6.0	-	-	-	-	1	6.0
Hungary	11	43.0	6	2.0	15	15.0	32	60.0
Iceland	-	-	-	-	1	1.0	1	1.0
India	-	-	4	1.0	41	39.5	45	40.5
Indonesia	14	47.5	7	2.5	34	28.0	55	78.0
Iran, Islamic Rep.	16	66.5	4	1.5	6	4.0	26	72.0
Iraq	9	25.0	4	3.0	15	8.0	28	36.0
Jamaica	-	-	-	-	10	4.5	10	4.5
Jordan	4	10.5	2	1.0	13	10.0	19	21.5
Kenya	8	30.5	-	-	5	5.0	13	35.5
Korea, Republic of	31	199.5	9	5.0	35	32.0	75	236.5
Kuwait	-	-	-	-	1	0.5	1	0.5
Liberia	-	-	-	-	1	1.0	1	1.0
Libyan Arab J.	21	114.5	-	-	2	2.0	23	116.5
Madagascar	2	6.5	-	-	2	3.5	4	10.0
Malaysia	12	38.5	2	1.0	30	24.0	44	63.5
Malawi	-	-	-	-	2	2.0	2	2.0
Mali	3	6.0	-	-	7	3.0	10	9.0
Mauritius	-	-	-	-	3	3.0	3	3.0
Mexico	11	29.0	3	1.0	45	62.0	59	92.0
Mongolia	1	2.5	-	-	-	-	1	2.5
Morocco	10	24.0	5	3.0	12	11.0	27	38.0
Nicaragua	2	17.5	1	0.5	-	-	3	18.0
Niger	5	20.0	-	-	1	0.5	6	20.5
Nigeria	16	83.5	2	1.0	14	12.0	32	96.5
Pakistan	18	114.0	3	1.5	24	20.0	45	135.5
Panama	1	3.0	-	-	4	3.0	5	6.0
Paraguay	6	17.5	1	0.5	17	7.5	24	25.5
Peru	5	27.5	-	-	26	15.0	31	42.5
Philippines	14	38.5	-	-	23	27.5	37	66.0
Poland	42	193.5	7	4.5	15	15.5	64	213.5
Portugal	6	12.0	-	-	4	3.5	10	15.5
Romania	2	6.0	2	1.5	4	4.0	8	11.5
Rwanda	-	-	-	-	1	0.5	1	0.5
Saudi Arabia	-	-	-	-	4	2.5	4	2.5

Recipient	Fellows		Visiting scientists		Training course participants		TOTAL	
	(1)	(2)	(1)	(2)	(1)	(2)	(1)	(2)
Senegal	1	3.0	-	-	6	2.0	7	5.0
Sierra Leone	3	27.0	1	0.5	3	3.0	7	30.5
Singapore	-	-	-	-	10	6.0	10	6.0
Somalia	-	-	-	-	3	2.5	3	2.5
Spain	-	-	-	-	3	3.5	3	3.5
Sri Lanka	14	67.5	3	2.0	13	10.5	30	80.0
Sudan	9	59.5	1	0.5	8	6.5	18	66.5
Syrian Arab Rep.	6	28.0	1	0.5	17	11.0	24	39.5
Thailand	37	181.0	5	2.5	38	29.5	80	213.0
Trinidad and Tobago	-	-	-	-	8	3.0	8	3.0
Tunisia	1	3.0	-	-	2	2.0	3	5.0
Turkey	12	61.0	4	1.5	15	15.0	31	77.5
Uganda	2	11.0	-	-	7	6.0	9	17.0
U. Arab Emirates	1	4.5	-	-	6	3.5	7	8.0
United Kingdom	-	-	-	-	1	0.5	1	0.5
U.R. Tanzania	5	24.0	-	-	8	7.5	13	31.5
Uruguay	3	7.5	2	1.5	28	18.5	33	27.5
Venezuela	2	5.0	-	-	33	36.5	35	41.5
Viet Nam	32	182.5	1	0.5	11	8.0	44	191.0
Yugoslavia	18	80.0	4	1.5	10	11.5	32	93.0
Zaire	9	25.0	-	-	4	4.5	13	29.5
Zambia	6	18.5	-	-	6	5.0	12	23.5
Zimbabwe	-	-	-	-	8	8.0	8	8.0
<b>TOTAL</b>	<b>682</b>	<b>3056.0</b>	<b>156</b>	<b>88.5</b>	<b>1109</b>	<b>958.0</b>	<b>1947</b>	<b>4102.5</b>

(1) Number of trainees. (2) Number of man-months of training received.

**TABLE 7**  
**FINANCIAL SUMMARY: 1988**  
(in thousands of dollars)

Recipient	Assistance provided, by type						Assistance provided, by source					Unliquid.		TOTAL (12) + (13) (14)
	Experts	Equip- ment	Fellow- ships	Group training	Sub- contracts	Total	UNDP	TACF CC	TACF NCC	Extra- bud.	In kind	Total	oblig.	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	
AFGHANISTAN	5.4	0.0	(1.2)	0.0	0.0	4.2	0.0	4.2	0.0	0.0	0.0	4.2	0.0	4.2
ALBANIA	15.9	106.6	23.4	0.0	0.0	145.9	0.0	113.4	32.5	0.0	0.0	145.9	118.2	264.1
ALGERIA	97.8	299.6	97.8	0.0	0.0	495.2	0.0	436.0	23.1	0.0	36.1	495.2	7.9	503.1
ARGENTINA	39.7	162.7	28.9	0.0	0.0	231.3	212.4	18.9	0.0	0.0	0.0	231.3	76.2	307.5
BANGLADESH	49.4	387.3	181.5	0.0	0.0	618.2	0.0	492.1	70.0	24.4	31.7	618.2	777.3	1,395.5
BOLIVIA	36.1	91.7	41.7	0.4	0.0	169.9	0.0	57.4	11.2	89.2	12.1	169.9	12.1	182.0
BRAZIL	419.3	631.8	45.6	0.0	0.0	1,096.7	0.0	602.4	8.7	464.7	20.9	1,096.7	247.0	1,343.7
BULGARIA	(2.0)	1,110.0	253.6	0.0	0.0	1,361.6	0.0	426.3	769.3	161.0	5.0	1,361.6	1,307.1	2,668.7
BURMA	13.9	86.4	10.5	0.0	0.0	92.8	0.0	92.8	0.0	0.0	0.0	92.8	54.7	147.5
CAMEROON	53.5	32.5	1.4	0.0	0.0	87.4	0.0	57.6	0.0	29.8	0.0	87.4	18.5	105.9
CAPE VERDE	0.4	0.0	0.0	0.0	0.0	0.4	0.4	0.0	0.0	0.0	0.0	0.4	0.0	0.4
CHILE	79.8	76.0	107.4	0.0	0.0	263.2	0.0	238.3	0.0	2.6	22.3	263.2	432.6	695.8
CHINA	291.7	531.0	447.7	0.0	8.1	1,278.5	414.7	598.2	10.6	223.1	31.9	1,278.5	1,085.0	2,363.5
COLOMBIA	54.9	206.3	78.5	0.0	0.0	339.7	0.0	311.5	0.0	0.0	28.2	339.7	251.9	591.6
COSTA RICA	14.5	43.0	20.0	0.0	0.0	77.5	17.1	48.6	7.0	0.0	4.8	77.5	37.8	115.3
COTE D'IVOIRE	42.5	64.2	40.6	0.0	0.0	147.3	0.0	107.2	17.0	23.1	0.0	147.3	34.1	181.4
CUBA	99.7	281.6	51.2	0.0	0.0	432.5	86.0	283.7	62.8	0.0	0.0	432.5	320.5	753.0
CYPRUS	1.2	21.2	0.0	0.0	0.0	22.4	0.0	22.4	0.0	0.0	0.0	22.4	33.9	56.3
CZECHOSLOVAKIA	0.0	0.0	48.5	0.0	0.0	48.5	0.0	48.5	0.0	0.0	0.0	48.5	25.0	73.5
DEM. P.R. KOREA	61.1	146.2	44.6	0.0	0.0	251.9	0.0	218.4	25.5	(1.1)	9.1	251.9	1,386.0	1,637.9
DOMINICAN REPUBLIC	29.6	64.0	28.2	0.0	0.0	121.8	0.0	114.8	2.2	0.0	4.8	121.8	7.2	129.0
ECUADOR	104.4	363.1	84.9	0.0	0.0	552.4	0.0	255.8	178.5	96.9	21.2	552.4	379.4	931.8
EGYPT	139.6	959.6	330.2	0.0	57.5	1,488.9	51.1	436.9	331.7	471.5	195.7	1,486.9	713.6	2,200.5
EL SALVADOR	30.1	58.3	1.7	0.0	0.0	90.1	0.0	57.4	0.0	32.7	0.0	90.1	74.8	164.9
ETHIOPIA	49.5	129.4	71.9	0.0	0.0	250.8	0.0	224.3	3.8	0.0	22.7	250.8	43.8	294.6
GABON	0.8	27.7	3.9	0.0	0.0	32.4	0.0	32.4	0.0	0.0	0.0	32.4	0.0	32.4
GHANA	51.1	218.7	162.5	0.0	0.0	432.3	0.1	400.9	2.3	0.1	28.9	432.3	307.8	740.1
GREECE	35.6	273.2	5.4	0.0	0.0	314.2	0.0	216.5	0.0	97.7	0.0	314.2	90.8	405.0
GUATEMALA	65.5	84.8	15.3	0.0	20.0	185.6	0.0	148.8	11.9	24.9	0.0	185.6	329.5	515.1
HAITI	5.3	43.9	11.6	0.0	0.0	60.8	0.0	59.2	1.6	0.0	0.0	60.8	12.5	73.3
HUNGARY	2.9	572.8	44.3	0.0	0.0	620.0	0.5	102.1	19.9	492.0	5.5	620.0	301.0	921.0
ICELAND	0.0	35.2	0.0	0.0	0.0	35.2	0.0	35.2	0.0	0.0	0.0	35.2	45.1	80.3
INDIA	0.0	0.0	3.8	0.0	0.0	3.8	0.0	3.8	0.0	0.0	0.0	3.8	0.0	3.8
INDONESIA	316.2	540.1	165.6	0.0	25.0	1,046.9	73.3	408.4	343.3	186.6	35.3	1,046.9	244.2	1,291.1
IRAN, I.R.	28.2	222.7	131.5	0.0	0.0	382.4	84.0	268.0	24.6	5.3	0.5	382.4	168.7	551.1
IRAQ	115.0	89.8	54.2	0.0	18.3	277.3	0.0	247.9	16.3	0.0	13.1	277.3	3.5	280.8
JAMAICA	20.3	45.8	0.0	0.0	55.0	121.1	0.0	66.1	0.0	55.0	0.0	121.1	15.1	136.2
JORDAN	88.2	162.2	23.3	0.0	0.0	271.7	0.0	258.5	13.2	0.0	0.0	271.7	158.0	429.7
KENYA	41.7	145.9	70.1	0.0	0.0	257.7	0.0	202.0	0.0	41.9	13.8	257.7	77.7	335.4
KOREA, R.	220.8	80.1	557.0	0.0	0.0	857.9	125.8	429.5	0.0	116.6	186.0	857.9	213.1	1,071.0
LIBYAN A.J.	37.0	107.6	65.0	0.0	0.0	209.6	0.0	221.3	41.2	(52.9)	0.0	209.6	183.5	393.1
MADAGASCAR	20.5	42.9	16.8	0.0	0.0	80.2	0.0	68.0	3.8	0.0	8.4	80.2	72.1	152.3
MALAYSIA	176.6	488.3	108.8	0.0	0.0	775.7	0.0	536.4	119.6	73.6	48.1	775.7	450.3	1,226.0
MALI	39.6	102.4	13.3	0.0	0.0	155.3	0.0	155.3	0.0	0.0	0.0	155.3	107.4	262.7
MAURITIUS	22.8	6.5	6.3	0.0	0.0	35.6	0.0	30.4	5.2	0.0	0.0	35.6	6.2	41.8

Recipient	Assistance provided, by type					Total	Assistance provided, by source					Unliquid.		TOTAL (12) + (13) (14)
	Experts	Equip- ment	Fellow- ships	Group training	Sub- contracts		UNDP	TACF CC	TACF NCC	Extra- bud.	In kind	Total	oblig.	
	(1)	(2)	(3)	(4)	(5)		(6)	(7)	(8)	(9)	(10)	(11)	(12)	
MEXICO	181.1	65.2	70.7	0.0	127.6	444.6	0.0	254.4	0.0	150.9	39.3	444.6	288.8	733.4
MONGOLIA	49.2	82.7	8.6	0.0	0.0	140.5	0.0	116.3	24.2	0.0	0.0	140.5	98.1	238.6
MOROCCO	58.6	215.5	53.5	0.0	0.0	327.6	0.0	209.6	0.0	112.7	5.3	327.6	86.6	414.2
NICARAGUA	28.5	75.2	22.0	0.0	0.0	125.7	0.0	115.7	10.0	0.0	0.0	125.7	227.6	353.3
NIGER	38.3	79.7	29.1	0.0	0.0	147.1	0.0	136.9	0.5	0.0	9.7	147.1	119.6	266.7
NIGERIA	89.5	142.4	190.1	0.0	0.0	422.0	0.0	244.6	35.6	91.5	50.3	422.0	321.6	743.6
PAKISTAN	63.1	167.8	182.0	0.0	0.0	412.9	0.0	318.1	(14.9)	54.1	55.6	412.9	190.0	602.9
PANAMA	10.5	118.6	7.4	0.0	0.0	136.5	0.0	100.5	0.4	30.0	5.6	136.5	59.0	195.5
PARAGUAY	26.6	100.2	28.1	0.0	0.0	154.9	0.0	151.6	3.3	0.0	0.0	154.9	96.4	251.3
PERU	201.8	737.9	50.9	0.0	47.6	1,038.2	108.3	301.2	555.3	67.9	5.5	1,038.2	511.7	1,549.9
PHILIPPINES	43.4	252.5	107.5	0.0	7.6	411.0	0.0	300.3	0.0	58.0	52.7	411.0	276.3	687.3
POLAND	27.1	258.3	335.2	0.0	0.0	620.6	0.0	550.7	57.3	3.8	8.8	620.6	1,494.5	2,115.1
PORTUGAL	66.7	169.3	19.4	0.0	0.0	255.4	0.0	199.3	2.2	46.8	7.1	255.4	1,095.6	1,351.0
ROMANIA	129.9	214.7	14.3	0.0	0.0	358.9	5.5	304.2	42.2	0.0	7.0	358.9	427.6	786.5
SENEGAL	27.8	135.8	8.0	0.0	0.0	171.6	0.0	133.4	31.4	0.0	6.8	171.6	49.2	220.8
SIERRA LEONE	9.1	3.4	34.5	0.0	0.0	47.0	0.0	47.0	0.0	0.0	0.0	47.0	13.5	60.5
SINGAPORE	34.0	26.0	0.0	0.0	0.0	60.0	0.0	60.0	0.0	0.0	0.0	60.0	9.0	69.0
SRI LANKA	49.4	394.8	129.8	0.0	0.0	574.0	0.0	536.5	9.8	13.1	14.6	574.0	159.3	733.3
SUDAN	41.3	80.0	123.2	0.0	0.2	244.7	0.0	186.3	0.0	9.8	48.6	244.7	175.6	420.3
SYRIAN A.R.	126.1	275.5	67.2	0.0	58.4	527.2	186.6	195.5	3.2	141.9	0.0	527.2	140.7	667.9
THAILAND	345.4	334.5	470.4	8.4	0.0	1,158.7	259.3	396.3	6.2	258.7	238.2	1,158.7	376.6	1,535.3
TUNISIA	33.2	75.1	6.4	0.0	0.0	114.7	0.0	114.7	0.0	0.0	0.0	114.7	301.0	415.7
TURKEY	98.8	173.8	166.2	0.0	0.0	438.8	72.4	270.3	1.5	0.0	94.6	438.8	112.1	550.9
UGANDA	18.9	75.1	20.7	0.0	0.0	114.7	0.0	114.7	0.0	0.0	0.0	114.7	81.5	196.2
U.A. EMIRATES	6.2	14.8	10.6	0.0	0.0	31.6	0.0	31.6	0.0	0.0	0.0	31.6	52.0	83.6
UK (HONG KONG)	5.6	0.6	0.0	0.0	0.0	6.2	0.0	6.2	0.0	0.0	0.0	6.2	23.3	29.5
U.R. TANZANIA	78.3	90.1	47.6	0.0	0.0	216.0	0.0	195.5	0.0	4.9	15.6	216.0	61.5	277.5
URUGUAY	65.0	128.8	25.6	0.0	0.0	219.4	0.0	161.2	0.0	53.7	4.5	219.4	66.7	286.1
VENEZUELA	68.8	77.5	21.4	0.9	0.0	168.6	40.7	128.2	1.7	0.0	0.0	168.6	156.7	325.3
VIETNAM	36.3	263.6	245.9	0.0	0.0	545.8	0.0	317.1	153.3	(19.8)	95.2	545.8	1,281.4	1,827.2
YUGOSLAVIA	40.9	134.9	152.8	0.0	0.0	328.6	0.0	189.5	0.0	61.5	77.6	328.6	3,162.6	3,491.2
ZAIRE	91.1	254.1	81.1	0.0	0.0	426.3	0.0	376.4	38.6	0.0	11.3	426.3	17.7	444.0
ZAMBIA	170.5	410.1	36.8	0.0	0.0	617.4	0.0	593.7	12.7	8.5	2.5	617.4	161.6	779.0
ZIMBABWE	3.9	57.0	1.9	0.0	0.0	62.8	0.0	62.8	0.0	0.0	0.0	62.8	28.8	91.6
<b>SUB-TOTAL</b>	<b>5,381.0</b>	<b>14,810.6</b>	<b>6,266.2</b>	<b>9.7</b>	<b>425.3</b>	<b>26,892.8</b>	<b>1,738.2</b>	<b>16,576.1</b>	<b>3,131.3</b>	<b>3,806.7</b>	<b>1,640.5</b>	<b>26,892.8</b>	<b>21,955.3</b>	<b>48,848.1</b>

### INTERCOUNTRY PROJECTS

INTERREGIONAL	926.6	311.3	47.2	2,316.5	90.8	3,692.4	0.0	2,780.1	386.3	400.2	125.8	3,692.4	488.9	4,181.3
AFRICA	401.7	192.2	17.5	228.6	0.0	840.0	0.0	782.1	0.0	55.0	2.9	840.0	427.0	1,267.0
ASIA & PACIFIC	788.5	80.5	46.5	1,197.4	0.0	2,112.9	627.4	850.9	27.5	375	232.1	2,112.9	390.3	2,503.2
EUROPE	184.8	112.0	42.7	61.5	176.7	577.7	0.0	404.6	138.6	10.0	24.5	577.7	100.9	678.6
LATIN AMERICA	617.7	598.3	4.5	1,164.1	84.7	2,467.3	100.8	1,250.9	78.7	740.2	296.7	2,467.3	386.5	2,853.8
<b>SUB-TOTAL</b>	<b>2,919.3</b>	<b>1,292.3</b>	<b>158.4</b>	<b>4,968.1</b>	<b>352.2</b>	<b>9,890.3</b>	<b>728.2</b>	<b>6,068.6</b>	<b>631.1</b>	<b>1,580.4</b>	<b>682.0</b>	<b>9,890.3</b>	<b>1,793.6</b>	<b>11,483.9</b>
MISCELLANEOUS	91.5	177.5	70.8	54.8	8.6	403.2	0.0	403.2	0.0	0.0	0.0	403.2	1.3	404.5
<b>GRAND TOTAL</b>	<b>8,391.8</b>	<b>16,280.4</b>	<b>6,495.4</b>	<b>5,032.6</b>	<b>786.1</b>	<b>36,986.3</b>	<b>2,466.4</b>	<b>23,047.9</b>	<b>3,762.4</b>	<b>5,387.1</b>	<b>2,322.5</b>	<b>36,986.3</b>	<b>23,750.2</b>	<b>60,736.5</b>



**TABLE 8**  
**FINANCIAL SUMMARY: 1958-1988**  
(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 funds	Extra- budgetary funds <sup>a)</sup>	In kind	Total
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)
Afghanistan	384.0	441.5	132.6	0.0	0.0	958.1	92.9	783.4	0.0	81.8	958.1
Albania	121.3	1,589.8	161.6	0.0	0.0	1,872.7	119.2	1,724.2	0.0	29.3	1,872.7
Algeria	471.7	1,429.9	328.6	0.0	0.0	2,230.2	21.7	2,117.3	0.0	91.2	2,230.2
Argentina	3,358.9	2,452.2	1,248.7	0.0	0.0	7,059.8	4,832.9	1,671.3	17.5	538.1	7,059.8
Bangladesh	1,024.1	4,266.9	2,593.8	0.0	0.0	7,884.8	63.8	5,202.1	1,180.2	1,438.7	7,884.8
Bolivia	580.7	1,617.8	435.4	5.7	0.0	2,639.6	159.5	1,884.5	419.8	175.8	2,639.6
Brazil	5,567.7	5,878.6	2,298.0	0.0	0.0	13,744.3	5,660.4	5,967.8	1,373.4	742.7	13,744.3
Bulgaria	139.5	3,606.5	2,445.6	0.0	0.0	6,191.8	543.9	4,854.3	161.0	632.4	6,191.8
Burma	804.6	1,505.8	238.4	0.0	0.0	2,548.8	537.0	1,908.2	0.0	103.6	2,548.8
Cameroon	435.9	271.6	45.6	0.0	0.0	753.1	297.3	396.8	52.2	6.8	753.1
Cape Verde	3.5	0.1	0.0	0.0	0.0	3.6	3.6	0.0	0.0	0.0	3.6
Chad	116.3	30.6	0.0	0.0	0.0	146.9	146.9	0.0	0.0	0.0	146.9
Chile	2,729.0	2,688.2	1,564.6	0.0	0.0	6,981.8	3,615.1	2,882.0	2.6	482.1	6,981.8
China	982.3	848.6	1,202.1	0.0	8.1	3,041.1	861.2	1,827.8	230.0	122.1	3,041.1
Colombia	1,374.5	2,685.1	1,004.3	0.0	0.0	5,063.9	1,693.6	2,465.7	223.6	681.0	5,063.9
Costa Rica	899.5	1,132.2	285.1	0.0	7.0	2,323.8	618.1	1,281.9	234.3	169.5	2,323.8
Côte d'Ivoire	427.4	785.6	151.2	0.0	0.0	1,344.2	73.4	1,187.9	56.1	26.8	1,344.2
Cuba	582.7	5,126.7	364.6	0.0	0.0	6,074.0	1,734.9	4,159.0	39.2	140.9	6,074.0
Cyprus	122.8	643.2	202.3	0.0	0.0	968.3	24.1	743.9	34.6	165.7	968.3
Czechoslovakia	0.5	104.8	1,071.5	0.0	0.0	1,176.8	6.2	786.1	12.9	371.6	1,176.8
Dem. P.R. Korea	160.7	2,775.7	645.4	0.0	0.0	3,581.8	0.0	3,054.3	52.6	474.9	3,581.8
Dominican Rep.	168.8	619.1	172.4	0.0	0.0	960.3	0.0	924.2	3.9	32.2	960.3
Ecuador	1,357.1	3,287.9	572.2	0.0	0.0	5,217.2	547.5	3,612.0	694.0	363.7	5,217.2
Egypt	3,457.9	10,405.7	3,828.1	0.0	1,032.8	18,724.5	1,677.2	7,325.9	7,229.6	2,491.8	18,724.5
El Salvador	189.2	489.3	177.9	0.0	0.0	856.4	14.1	574.1	93.6	174.6	856.4
Ethiopia	525.3	769.3	389.8	0.0	0.0	1,684.4	437.5	1,173.4	0.0	73.5	1,684.4
Gabon	57.0	85.7	29.3	0.0	0.0	172.0	0.0	159.4	0.0	12.6	172.0
Ghana	706.3	2,025.3	2,333.3	0.0	0.0	5,064.9	354.5	2,990.8	353.0	1,366.6	5,064.9
Greece	1,943.4	1,690.7	1,218.8	0.0	0.0	4,852.9	1,561.9	2,203.3	443.0	644.7	4,852.9
Guatemala	343.0	1,096.9	193.6	0.0	20.0	1,653.5	56.2	1,355.6	133.2	108.5	1,653.5
Haiti	9.9	44.1	11.6	0.0	0.9	66.5	0.9	65.6	0.0	0.0	66.5
Honduras	0.0	0.0	0.7	0.0	0.0	0.7	0.0	0.7	0.0	0.0	0.7
Hungary	109.8	7,633.2	1,800.3	0.0	0.0	9,543.3	693.4	7,780.5	759.2	310.2	9,543.3
Iceland	66.9	675.8	152.3	0.0	0.0	895.0	0.0	767.9	0.0	127.1	895.0
India	1,015.8	3,801.6	2,681.5	0.0	0.0	7,498.9	2,920.3	1,284.5	2,131.9	1,162.2	7,498.9
Indonesia	2,914.9	3,707.0	2,020.0	0.0	25.0	8,666.9	2,083.5	4,731.5	951.0	900.9	8,666.9
Iran, I.R.	883.9	2,089.0	1,155.0	0.0	131.5	4,259.4	2,077.3	1,520.0	351.3	310.8	4,259.4
Iraq	694.0	1,229.3	919.2	0.0	18.3	2,860.8	242.5	2,160.5	25.0	432.8	2,860.8
Ireland	0.0	0.0	9.7	0.0	0.0	9.7	0.0	9.7	0.0	0.0	9.7
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	231.7	650.6	61.4	0.0	55.0	998.7	15.3	809.4	103.2	70.8	998.7
Jordan	480.9	842.7	239.7	0.0	0.0	1,563.3	89.3	1,268.8	100.6	104.6	1,563.3
Kenya	837.7	1,373.3	887.1	0.0	0.0	3,098.1	33.2	1,976.1	675.2	413.6	3,098.1
Korea, Rep.	3,025.1	2,007.8	3,662.0	0.0	0.0	8,694.9	866.2	4,444.5	1,254.6	2,129.6	8,694.9
Kuwait	12.0	0.0	3.9	0.0	0.0	15.9	0.0	15.9	0.0	0.0	15.9
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.	337.0	515.5	586.9	0.0	0.0	1,439.4	7.3	1,418.0	(39.7)	53.8	1,439.4
Madagascar	1,311.2	1,497.2	198.2	0.0	0.0	3,006.6	1,436.6	1,273.7	244.2	52.1	3,006.6
Malawi	5.1	0.0	0.0	0.0	0.0	5.1	5.1	0.0	0.0	0.0	5.1
Malaysia	1,479.1	2,757.3	1,093.4	0.0	0.0	5,329.8	1.6	3,946.2	832.2	549.8	5,329.8
Mali	733.6	991.1	274.8	0.0	0.0	1,999.5	13.4	1,788.3	128.7	69.1	1,999.5
Mauritius	109.1	204.0	32.7	0.0	0.0	345.8	0.0	342.0	3.8	0.0	345.8
Mexico	2,675.9	1,207.9	1,324.6	0.0	497.1	5,705.5	419.3	3,613.3	902.3	770.6	5,705.5
Mongolia	345.5	1,125.8	37.0	0.0	0.0	1,508.3	0.0	1,484.1	10.6	13.6	1,508.3

Recipient	Assistance provided, by type						Assistance provided, by source				
	Experts	Equip- ment	Fellow- ships	Group training	Sub- contracts	Total	UNDP	Agency funds	Extra- budgetary funds <sup>a)</sup>	In kind	Total
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)
Morocco	1,746.1	1,516.7	445.9	0.0	18.0	3,726.7	909.6	2,253.0	316.1	248.0	3,726.7
Nicaragua	81.0	280.8	78.5	0.0	0.0	450.3	0.0	450.3	0.0	0.0	450.3
Niger	332.7	558.9	92.6	0.0	0.0	984.2	0.0	941.2	0.0	43.0	984.2
Nigeria	2,939.9	2,448.1	1,146.1	0.0	30.4	6,565.5	980.9	1,804.3	3,057.2	723.1	6,565.5
Niue	7.8	6.9	0.0	0.0	0.0	14.7	14.7	0.0	0.0	0.0	14.7
Pakistan	1,828.3	3,302.4	3,598.1	0.0	5.2	8,734.0	1,842.0	5,344.0	144.7	1,403.3	8,734.0
Panama	361.3	995.9	233.3	0.0	0.0	1,590.5	4.1	1,291.8	174.7	119.9	1,590.5
Paraguay	243.7	962.5	286.0	0.0	0.0	1,492.2	0.0	1,293.4	94.1	104.7	1,492.2
Peru	3,533.7	6,109.5	1,380.0	2.7	47.6	11,073.5	3,897.9	3,680.4	2,697.2	818.0	11,073.5
Philippines	2,356.1	3,432.2	3,564.1	0.0	90.8	9,443.2	1,964.4	4,064.1	1,248.0	2,166.7	9,443.2
Poland	142.0	3,047.1	2,895.8	0.0	0.0	6,084.9	202.9	5,091.3	240.3	550.4	6,084.9
Portugal	344.1	2,447.5	391.9	0.0	0.0	3,183.5	0.0	2,330.0	677.9	175.6	3,183.5
Romania	891.8	4,376.3	917.8	0.0	134.5	6,320.4	2,762.2	3,252.7	52.2	253.3	6,320.4
St. Christopher	0.0	0.0	8.5	0.0	0.0	8.5	0.0	0.0	8.5	0.0	8.5
Saudi Arabia	66.8	11.9	12.8	0.0	0.0	91.5	0.0	84.5	0.0	7.0	91.5
Senegal	446.2	1,183.3	219.8	0.0	0.0	1,849.4	345.8	1,276.6	154.7	72.3	1,849.4
Sierra Leone	429.8	262.7	186.8	0.0	0.0	879.3	174.5	576.1	12.4	116.3	879.3
Singapore	424.4	1,030.8	120.0	0.0	0.0	1,575.3	0.0	1,405.5	103.3	66.5	1,575.3
Spain	382.3	0.0	98.4	0.0	0.0	480.7	0.0	401.6	56.0	23.1	480.7
Sri Lanka	1,018.6	2,730.6	1,681.3	0.0	0.0	5,430.5	307.9	3,963.0	558.0	601.6	5,430.5
Sudan	816.6	2,039.7	1,804.9	0.0	10.9	4,672.1	296.7	3,241.1	518.8	615.5	4,672.1
Syrian A.R.	685.3	1,669.5	589.5	0.0	208.8	3,153.2	589.8	2,087.8	389.7	85.9	3,153.2
Thailand	2,373.7	4,350.6	4,703.3	8.4	3.8	11,439.8	1,416.3	5,534.4	1,854.5	2,634.6	11,439.8
Tunisia	709.7	1,007.3	343.2	0.0	0.0	2,060.2	141.2	1,522.6	262.6	133.8	2,060.2
Turkey	2,084.9	2,509.5	3,202.7	0.0	22.2	7,829.3	1,707.9	4,135.5	130.8	1,855.1	7,829.3
Uganda	326.0	353.1	397.1	0.0	0.0	1,076.2	131.0	890.0	0.0	55.2	1,076.2
U.A. Emirates	42.4	56.7	15.9	0.0	0.0	115.0	0.0	115.0	0.0	0.0	115.0
UK (Hong Kong)	74.3	114.6	26.1	0.0	0.0	215.0	0.0	206.0	0.0	9.0	215.0
U.R. Tanzania	530.3	1,277.7	675.9	0.0	0.0	2,483.9	9.6	2,283.3	59.1	131.9	2,483.9
Uruguay	789.2	2,247.6	459.7	0.0	0.0	3,496.5	183.1	2,237.4	744.7	321.3	3,496.5
Venezuela	1,163.1	977.1	368.6	0.9	0.0	2,509.7	175.9	2,053.6	97.8	182.4	2,509.7
Viet Nam	395.5	3,365.3	1,525.2	0.0	0.0	5,286.0	31.4	4,476.0	139.5	639.1	5,286.0
Yugoslavia	1,325.9	5,160.0	2,567.6	0.0	37.3	9,090.8	3,061.7	4,031.6	1,172.5	824.8	9,090.8
Zaire	699.1	1,729.8	801.5	0.0	0.0	3,230.4	578.8	2,083.2	192.2	376.2	3,230.4
Zambia	1,266.6	2,390.1	708.1	0.0	0.0	4,364.8	152.5	3,759.2	180.9	272.2	4,364.8
Zimbabwe	3.9	57.0	19.7	0.0	0.0	80.6	0.0	80.6	0.0	0.0	80.6
Other countries b)	457.7	228.7	1,455.9	0.0	0.0	2,142.3	403.9	886.5	0.0	851.9	2,142.3
Sub-total	78,279.1	158,071.2	80,077.9	17.7	2,405.3	318,851.2	59,326.9	186,439.3	36,862.2	36,222.8	318,851.2
Intercountry projects											
Africa	1,335.3	1,114.9	295.0	465.6	20.0	3,230.8	332.8	2,719.4	114.4	64.2	3,230.8
Arab States	22.9	0.0	33.8	7.0	0.0	63.7	63.7	0.0	0.0	0.0	63.7
Asia & Pacific	5,016.9	3,569.6	2,330.3	1,948.9	81.1	12,948.8	6,363.0	3,683.3	1,727.4	1,175.1	12,948.8
Europe	472.4	154.6	68.8	70.6	984.5	1,731.1	59.5	1,635.5	10.0	26.1	1,731.1
Latin America	4,323.6	3,557.7	1,304.5	1,767.3	437.4	11,390.5	2,982.0	5,427.8	1,392.4	1,588.3	11,390.5
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	11,000.8	4,945.2	17,031.1	5,197.5	452.4	38,627.0	1,790.5	30,543.4	3,639.8	2,653.3	38,627.0
Sub-total	22,179.7	13,343.4	21,068.8	9,456.9	1,955.4	68,004.2	11,603.8	44,009.4	6,884.0	5,507.0	68,004.2
Miscellaneous	444.8	619.0	252.5	74.3	16.4	1,407.0	23.2	1,383.8	0.0	0.0	1,407.0
TOTAL	100,903.6	172,033.6	101,399.2	9,548.9	4,377.1	388,262.4	70,953.9	231,832.5	43,746.2	41,729.8	388,262.4

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, Democratic Kampuchea, Denmark, Finland, France, the Federal Republic of Germany, Italy, Japan, Monaco, the Netherlands, New Zealand, Norway, Somalia, South Africa, Sweden, Switzerland, and the United States of America.

**TABLE 9**  
**WOMEN'S PARTICIPATION IN TECHNICAL CO-OPERATION**

	1981			1987			1988		
	Total	of which women	% of women	Total	of which women	% of women	Total	of which women	% of women
Fellows	570	97	17.0	870	173	19.9	682	146	21.4
Visiting scientists	65	7	10.8	160	12	7.5	156	12	7.7
Training course participants	519	64	12.3	945	151	16.0	1109	179	16.1
Project counterparts	511	46	9.0	1152	126	10.9	1119	124	11.1
International experts	319	7	2.2	793	42	5.3	938	56	6.0
National experts	12	0	0.0	51	4	7.8	89	11	12.4
Lecturers	119	2	1.7	233	20	8.6	221	20	9.0
Other project personnel	11	9	81.8	23	17	73.9	15	11	73.3
TCAC P-staff*	34	5	14.7	49	13	26.5	59	16	27.1
TCAC G-staff*	54	48	88.8	77	72	93.5	81	78	96.3

\* Including the staff of the Office of the DDG and, as from 1983, the staff of the Evaluation Section.

## Explanatory Notes to Annexes

### Annex I. Disbursement of extrabudgetary and in-kind contributions

Related to Table 5, this Annex shows, by donor and by type, the technical assistance disbursements made during 1988 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: 1988

All courses organized by the Agency in 1988 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. Purely national courses are not included in this summary.

### Annex III. Published reports: 1988

Technical co-operation project reports published in 1988 are listed by country, with an indication of their distribution status.

### Annex IV. Voluntary contributions pledged and paid to the Technical Assistance and Co-operation Fund for 1988

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 1988.

### Annex V. Cost-free fellowships offered and awarded: 1988

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

This table includes two projects being implemented for the United Nations Financing System 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 1988

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 1988

Information is provided on Reserve Fund approvals for new and existing projects.

### **Annex IX. Net programme changes by recipient**

The Secretariat is obliged to furnish information on changes to approved projects under the provisions of the Revised Guiding Principles. As over five hundred 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. Net rephasings undertaken during 1988**

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 to future years project funds originally intended for use in the current year. 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 funds released as a result of rephasing are used to reduce overprogramming, as additional inputs to other projects and for the upgrading or as an extension of footnote-a/ projects. The Annex shows only net changes per country to projects rephased in 1988.

## ANNEX I

### DISBURSEMENTS OF EXTRABUDGETARY AND IN-KIND CONTRIBUTIONS

#### 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- contracts	Sub- total	Experts	Equip- ment	Fellow- ships	Group training	Sub- total	
<b>Countries</b>												
Algeria	0.0	0.0	0.0	0.0	0.0	0.0	0.8	0.0	0.0	0.0	0.8	0.8
Argentina	0.0	0.0	0.0	0.0	0.0	0.0	14.7	0.0	2.8	20.4	37.9	37.9
Australia	14.1	1.8	0.0	110.2	0.0	126.1	7.2	0.0	0.0	115.4	122.6	248.7
Austria	0.0	0.0	0.0	0.0	0.0	0.0	1.2	0.0	18.1	0.9	20.2	20.2
Bangladesh	0.0	0.0	0.0	0.0	0.0	0.0	1.2	0.0	0.0	1.3	2.5	2.5
Belgium	5.4	9.7	0.0	0.0	0.0	15.1	2.1	0.0	47.4	1.6	51.1	66.2
Brazil	0.0	0.0	0.0	0.0	0.0	0.0	7.8	0.0	0.5	50.0	58.3	58.3
Bulgaria	0.0	0.0	0.0	0.0	0.0	0.0	11.3	0.0	0.0	2.7	14.0	14.0
Canada	1.2	0.0	0.0	0.0	0.0	1.2	12.5	0.0	0.0	8.8	21.3	22.5
Chile	0.0	0.0	2.4	6.5	0.0	8.9	6.5	0.0	0.4	33.6	40.5	49.4
China	0.0	0.0	0.0	0.0	0.0	0.0	0.8	0.0	0.0	0.0	0.8	0.8
Colombia	0.0	0.0	0.0	0.0	0.0	0.0	0.0	53.0	0.0	4.1	57.1	57.1
Czechoslovakia	0.0	0.0	0.0	0.0	0.0	0.0	5.5	0.0	9.3	1.0	15.8	15.8
Denmark	0.0	0.0	0.0	0.0	0.0	0.0	0.8	0.0	12.7	0.0	13.5	13.5
Finland	0.0	5.0	0.0	0.0	0.0	5.0	7.0	0.0	0.0	1.0	8.0	13.0
France	0.0	0.0	0.0	0.0	0.0	0.0	19.7	0.0	85.7	9.4	114.8	114.8
German D.R.	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	6.8	2.4	9.2	9.2
Germany, F.R.	208.1	938.0	0.0	168.2	35.0	1,347.3	25.1	2.7	274.8	4.5	307.1	1,654.4
Greece	0.0	0.0	0.0	0.0	0.0	0.0	1.6	0.0	0.0	0.0	1.6	1.6
Guatemala	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2.0	2.0	2.0
Hungary	0.0	0.0	0.0	0.0	0.0	0.0	4.3	0.0	52.2	2.1	58.6	58.6
India	0.0	0.0	0.0	0.0	0.0	0.0	2.4	0.0	53.8	8.0	64.2	64.2
Indonesia	0.0	0.0	0.0	0.0	0.0	0.0	1.2	0.0	0.0	2.0	3.2	3.2
Italy	168.1	172.3	16.3	107.5	129.2	593.4	4.2	0.0	43.1	1.3	48.6	642.0
Japan	148.4	0.0	0.0	100.5	0.0	248.9	9.0	0.0	0.0	6.5	15.5	264.4
Jordan	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.8	0.8	0.8
Korea, R.	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	46.1	46.1	46.1
Kuwait	0.0	131.3	0.0	0.0	0.0	131.3	1.1	0.0	0.0	0.0	1.1	132.4
Malaysia	0.0	0.0	0.0	0.0	0.0	0.0	0.8	0.0	0.0	2.2	3.0	3.0
Mexico	0.0	0.0	0.0	0.0	0.0	0.0	13.7	0.0	0.0	13.0	26.7	26.7
Netherlands	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	19.4	0.8	20.2	20.2
New Zealand	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.4	1.4	1.4
Peru	0.0	0.0	0.0	0.0	0.0	0.0	3.2	0.0	0.0	0.0	3.2	3.2
Philippines	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.7	0.7	0.7
Poland	0.0	0.0	0.0	0.0	0.0	0.0	6.7	0.0	40.9	0.0	47.6	47.6
Senegal	0.0	0.0	0.0	0.0	0.0	0.0	0.8	0.0	0.0	0.0	0.8	0.8
Spain	0.0	0.0	0.0	0.0	0.0	0.0	9.2	0.0	51.1	2.8	63.1	63.1
Sri Lanka	0.0	0.0	0.0	0.0	0.0	0.0	1.0	0.0	0.0	0.0	1.0	1.0
Sweden	152.8	100.5	4.6	0.0	0.0	257.9	4.7	0.0	0.0	19.6	24.3	282.2
Switzerland	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.8	0.8	0.8

Donor	Extrabudgetary						In-kind					Total
	Experts	Equip- ment	Fellow- ships	Group training	Sub- contracts	Sub- total	Experts	Equip- ment	Fellow- ships	Group training	Sub- total	
<b>Countries (continued)</b>												
Thailand	0.0	0.0	0.0	0.0	0.0	0.0	1.7	0.0	0.0	2.5	4.2	4.2
Trinidad and Tobago	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.0	1.0	1.0
Turkey	0.0	0.0	0.0	0.0	0.0	0.0	9.2	0.0	0.0	0.8	10.0	10.0
USSR	0.0	717.8	(78.8)	0.0	0.0	638.2	8.7	0.0	0.0	5.8	14.5	652.7
UK	71.8	253.5	22.0	0.0	0.0	347.1	21.4	0.0	76.9	8.6	106.9	454.0
USA	293.5	882.7	0.0	54.2	227.6	1,458.0	45.3	0.0	746.6	18.0	809.9	2,267.9
Uruguay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2.0	2.0	2.0
Yugoslavia	0.0	0.0	0.0	0.0	0.0	0.0	13.6	0.0	0.0	0.0	13.6	13.6
<b>Organizations</b>												
EEC	14.1	70.7	0.0	7.7	0.0	92.5	0.0	0.0	0.0	0.0	0.0	92.5
FAO	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.2	1.2	1.2
IBRD	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	3.4	3.4	3.4
IFFIT	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	20.6	20.6	20.6
UNDP	0.0	0.0	0.0	0.0	0.0	0.0	2.0	0.0	0.0	0.0	2.0	2.0
WHO	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	3.2	3.2	3.2
<b>TOTAL</b>	<b>1,077.3</b>	<b>3,281.3</b>	<b>(34.3)</b>	<b>554.8</b>	<b>391.8</b>	<b>5,270.9</b>	<b>290.0</b>	<b>55.7</b>	<b>1,542.5</b>	<b>434.3</b>	<b>2,322.5</b>	<b>7,593.4</b>

**B. Assistance for activities where donor is recipient  
(in thousands of dollars)**

Donor	Project title	Project code	Equipment	Other	Total
Chile	Impurities in uranium compounds	CHI/3/008	2.6	0.0	2.6
Hungary	Procurement assistance for Hungary	HUN/4/008	0.1	0.0	0.1
	Computer-aided safety analysis	RER/9/002	10.0	0.0	10.0
Iran, I.R.	Radioisotope production	IRA/2/004	5.3	0.0	5.3
Libyan A.J.	Eradication of Mediterranean Fruit Fly	LIB/5/003	0.0	5.8	5.8
Malaysia	Nitrogen-15 fertilizer studies	MAL/5/018	19.9	0.0	19.9
Pakistan	Control and instrumentation	PAK/4/027	54.1	0.0	54.1
Poland	Procurement assistance	POL/4/007	3.7	0.0	3.7
Syrian A.R.	Procurement assistance	SYR/0/005	10.2	0.0	10.2
Yugoslavia	Failed fuel detection	YUG/9/021	3.9	0.0	3.9
	Radiation protection	YUG/9/022	0.8	0.0	0.6
<b>TOTAL</b>			<b>110.4</b>	<b>5.8</b>	<b>116.2</b>

## ANNEX II

### TRAINING COURSES: 1988

Project title and code	Place(s) and dates	Source of funds	Participation <sup>a)</sup>			Amount(s) expended <sup>b)</sup> (\$)
			(1)	(2)	(3)	
INTERREGIONAL TRAINING COURSE ON ELECTRICITY DEMAND FORECASTING FOR NUCLEAR POWER PLANNING (MAED), INT/0/046/001	ARGONNE, IL, USA 12 SEPTEMBER - 14 OCTOBER	AGENCY	27	0	0	85,223 (CC)
INTERREGIONAL SEMINAR AND WORKSHOP ON CALIBRATION PROCEDURES IN SECONDARY STANDARD DOSIMETRY LABORATORY, INT/1/014/002	ISTANBUL, TURKEY 17 OCTOBER - 5 NOVEMBER	AGENCY	10	0	14	27,843 (CC)
INTERREGIONAL TRAINING COURSE AND GROUP TRAINING IN X-RAY ANALYSIS, INT/1/042/001	ARGONNE, IL, USA 25 JANUARY - 13 MAY	AGENCY	0	18	0	58,538 (CC)
INTERREGIONAL TRAINING COURSE ON APPLIED NUCLEAR PHYSICS AND DATA MEASUREMENTS AT NEUTRON GENERATORS, INT/1/044/001	DRESDEN, GERMAN D.R. 28 NOVEMBER - 9 DECEMBER	AGENCY	14	0	0	10,616 (CC)
INTERREGIONAL TRAINING COURSE ON WATER CHEMISTRY IN NUCLEAR POWER PLANTS, INT/2/005/001	KARLSRUHE, GERMANY, F.R. 6 JUNE - 1 JULY	AGENCY	21	0	0	75,064 (CC) 214 (NCC)
ADVANCED INTERREGIONAL TRAINING COURSE ON NUCLEAR ELECTRONICS, INT/4/095/001	ARGONNE, IL, USA 19 SEPTEMBER - 9 DECEMBER	AGENCY	17	0	0	75,577 (CC)
INTERREGIONAL TRAINING COURSE ON ADVANCED INTERFACING IN NUCLEAR EXPERIMENTS, INT/4/096/001	SANTO DOMINGO, DOMINICAN R. 8 AUGUST - 23 SEPTEMBER	AGENCY	16	0	0	124,083 (CC)
INTERREGIONAL TRAINING COURSE ON RADIATION TECHNOLOGY AND ENGINEERING, INT/4/097/001	BUDAPEST, HUNGARY 16 MAY - 10 JUNE	AGENCY	20	2	0	50,376 (CC) 21,010 (NCC)
INTERREGIONAL TRAINING COURSE ON RESEARCH REACTOR OPERATION, UTILIZATION AND SAFETY, INT/4/099/001	GIF-SUR-YVETTE, FRANCE 14 NOVEMBER - 8 DECEMBER	AGENCY	19	1	0	23,373 (CC) 456 (NCC)
INTERREGIONAL TRAINING COURSE ON THE INDUCTION AND USE OF MUTATIONS IN PLANT BREEDING, INT/5/112/001	SEIBERSDORF, AUSTRIA 5 APRIL - 19 MAY	AGENCY	18	2	0	123,543 (CC) 9 (NCC)



Project title and code	Place(s) and dates	Source of funds	Participation <sup>a)</sup>			Amount(s) expended <sup>b)</sup> (\$)
			(1)	(2)	(3)	
INTERREGIONAL TRAINING COURSE ON THE USE OF RADIATION AND ISOTOPES IN INSECT CONTROL AND ENTOMOLOGY, INT/5/113/001	GAINESVILLE, FL, USA 16 MAY - 24 JUNE	AGENCY	18	0	0	99,935 (CC)
INTERREGIONAL TRAINING COURSE ON THE USE OF ISOTOPE AND RADIATION TECHNIQUES IN STUDIES ON SOIL/PLANT PRODUCTIVITY WITH EMPHASIS ON ROOT STUDIES, INT/5/114/001	SEIBERSDORF, AUSTRIA 24 MAY - 1 JULY	AGENCY	18	2	0	120,410 (CC)
INTERREGIONAL TRAINING COURSE ON NUCLEAR MEDICINE, INT/6/036/001	MOSCOW, USSR 1 SEPTEMBER - 7 OCTOBER	AGENCY	29	0	0	76,354 (CC)
INTERREGIONAL WORKSHOP ON EVALUATION OF NPP SURVEILLANCE TEST INTERVALS AND LIMITING CONDITIONS OF OPERATION USING PSA, INT/9/063/001	VIENNA, AUSTRIA 2 MAY - 6 MAY	AGENCY	8	0	0	2,991 (CC)
INTERREGIONAL TRAINING COURSE ON PROBABILISTIC SAFETY ASSESSMENT IN NUCLEAR POWER PLANT OPERATION, INT/9/084/001	ARGONNE, IL, USA 22 FEBRUARY - 8 APRIL	AGENCY	31	0	0	156,217 (CC)
INTERREGIONAL TRAINING COURSE ON THE QUALIFICATION OF NUCLEAR POWER PLANT OPERATIONS PERSONNEL, INT/9/085/001	KARLSRUHE, GERMANY, F.R. 11 APRIL - 19 MAY	AGENCY	25	0	0	117,837 (CC) 210 (NCC)
INTERREGIONAL TRAINING COURSE ON SAFETY IN NUCLEAR POWER PLANT OPERATION, INT/9/086/001	ARGONNE, IL, USA MISSISSAUGA, ONTARIO, CANADA 18 APRIL - 20 MAY	AGENCY	30	0	0	154,194 (CC)
INTERREGIONAL TRAINING COURSE ON PROBABILISTIC SAFETY ASSESSMENT (PSA) IN SAFETY DECISION - MANAGERIAL PERSPECTIVES, INT/9/087/001	OLDBURY-ON-SEVERN, UK 14 JUNE - 1 JULY	AGENCY	20	0	0	36,360 (CC)
INTERREGIONAL TRAINING COURSE ON RADIOLOGICAL ACCIDENT CONSEQUENCE ASSESSMENT, INT/9/088/001	DUBLIN, IRELAND 25 JUNE - 22 JULY	AGENCY	20	1	2	56,663 (CC)
INTERREGIONAL TRAINING COURSE ON THE PHYSICAL PROTECTION OF NUCLEAR FACILITIES AND MATERIALS, INT/9/089/001	ALBUQUERQUE, NM, USA 24 OCTOBER - 17 NOVEMBER	USA	21	9	0	44,948 (CC)

Project title and code	Place(s) and dates	Source of funds	Participation <sup>a)</sup>			Amount(s) expended <sup>b)</sup> (\$)
			(1)	(2)	(3)	
INTERREGIONAL TRAINING COURSE ON THE DETERMINATION OF RADIONUCLIDES IN FOOD AND ENVIRONMENTAL SAMPLES, INT/9/090/001	KARLSRUHE, GERMANY, F.R. 17 OCTOBER - 11 NOVEMBER	AGENCY	21	0	0	31,942 (CC)
INTERREGIONAL TRAINING COURSE ON RADIATION PROTECTION AND NUCLEAR SAFETY, INT/9/091/001	BUENOS AIRES, ARGENTINA 4 APRIL - 30 NOVEMBER	AGENCY	13	0	15	97,297 (CC)
INTERNATIONAL TRAINING COURSE ON OPERATIONAL SAFETY IN NUCLEAR POWER PLANTS, INT/9/092/001	GIF-SUR-YVETTE, FRANCE 6 JUNE - 1 JULY	AGENCY	11	0	0	37,828 (CC) 1,707 (NCC)
REGIONAL TRAINING COURSE ON INTEGRATED CONTROL OF TSETSE WITH EMPHASIS ON THE STERILE INSECT TECHNIQUE, RAF/5/009/001	VOM, PLATEAU STATE, NIGERIA 23 MAY - 17 JUNE	AGENCY	14	0	0	49,247 (CC)
REGIONAL TRAINING COURSE ON THE DIAGNOSIS OF RINDERPEST, RAF/5/011/002	DEBRE ZEIT, ETHIOPIA 26 SEPTEMBER - 14 OCTOBER	AGENCY	18	0	2	37,084 (CC)
REGIONAL TRAINING COURSE ON THE USE OF ISOTOPES AND RADIATION TECHNIQUES IN STUDIES OF BIOLOGICAL NITROGEN FIXATION AND SOIL/PLANT NUTRITION, RAF/5/012/001	LEGON-ACCRA, GHANA 22 AUGUST - 16 SEPTEMBER	AGENCY	20	0	5	82,059 (CC)
REGIONAL WORKSHOP ON THE DEVELOPMENT OF ISOTOPE TECHNIQUES IN HYDROLOGY AND HYDROGEOLOGY, RAF/8/012/001	NIAMEY, NIGER 21 NOVEMBER - 25 NOVEMBER	AGENCY	8	0	15	4,926 (CC)
REGIONAL TRAINING COURSE ON RADIATION PROTECTION, RAF/9/004/001	CAIRO, EGYPT 11 JUNE - 9 JULY	AGENCY	15	0	0	37,332 (CC)
REGIONAL TRAINING COURSE FOR RADIATION PROTECTION OFFICERS, RAF/9/005/001	NAIROBI, KENYA 8 AUGUST - 2 SEPTEMBER	AGENCY	8	0	5	623 (CC)
REGIONAL TRAINING COURSE ON NUCLEAR POWER PROJECT PLANNING AND IMPLEMENTATION, RAS/0/013/001	TAEJEON, CHUNG-NAM, KOREA, R. 7 NOVEMBER - 25 NOVEMBER	AGENCY	15	0	2	15,289 (CC)
ADVANCED REGIONAL TRAINING COURSE ON GAMMA-RAY SPECTROSCOPY, RAS/1/009/001	CHIANG MAI, THAILAND 31 OCTOBER - 18 NOVEMBER	AGENCY	12	0	2	53,423 (CC)

Project title and code	Place(s) and dates	Source of funds	Participation <sup>a)</sup>			Amount(s) expended <sup>b)</sup> (\$)
			(1)	(2)	(3)	
REGIONAL TRAINING COURSE ON HOSPITAL RADIOPHARMACY, RAS/6/014/001	LUCAS HEIGHTS, AUSTRALIA 28 SEPTEMBER - 26 OCTOBER	AGENCY	19	0	0	110,128 (CC)
REGIONAL TRAINING COURSE ON RADIATION STERILIZATION OF TISSUE GRAFTS FOR SAFE CLINICAL USE IN HEALTH CARE, RAS/7/003/001	BEIJING, CHINA 7 NOVEMBER - 18 NOVEMBER	AGENCY	11	0	2	17,416 (CC)
THIRD REGIONAL TRAINING DEMONSTRATION ON THE USE OF TRACER TECHNOLOGY IN INDUSTRY, RAS/8/061/019	BEIJING, CHINA 21 MARCH - 9 APRIL	UNDP	12	2	2	37,180 (CC)
REGIONAL TRAINING COURSE ON RADIATION ENGINEERING - GAMMA RADIATION FACILITIES, RAS/8/061/020	BOMBAY, INDIA 21 NOVEMBER - 2 DECEMBER	UNDP	8	0	1	11,145 (CC)
REGIONAL TRAINING COURSE ON NON-DESTRUCTIVE TESTING OF RADIOGRAPHY (LEVEL II), RAS/8/061/021	HYDERABAD, INDIA 18 JULY - 6 AUGUST	UNDP	10	0	2	22,417 (CC)
REGIONAL TRAINING COURSE ON NON-DESTRUCTIVE TESTING OF SURFACE METHODS (LEVEL II), RAS/8/061/022	SHANGHAI, CHINA 13 JUNE - 8 JULY	UNDP	11	0	3	44,574 (CC)
REGIONAL TRAINING COURSE ON NON-DESTRUCTIVE TESTING OF ULTRASONICS (LEVEL II), RAS/8/061/023	LAHORE, PAKISTAN 12 SEPTEMBER - 29 SEPTEMBER	UNDP	12	0	2	27,211 (CC)
REGIONAL TRAINING COURSE ON RADIATION CROSSLINKING APPLICATIONS IN THE WIRE AND CABLE INDUSTRY, RAS/8/061/025	SHANGHAI, CHINA 5 SEPTEMBER - 23 SEPTEMBER	UNDP	9	0	4	35,972 (CC)
REGIONAL TRAINING COURSE ON NON-DESTRUCTIVE TESTING OF EDDY CURRENTS (LEVEL II), RAS/8/061/026	TAEJEON, CHUNG-NAM, KOREA, R. 17 OCTOBER - 4 NOVEMBER	UNDP	11	0	1	33,971 (CC)
REGIONAL TRAINING COURSE ON INDUSTRIAL RADIATION STERILIZATION SELECTION AND COMPATIBILITY OF MATERIALS, RAS/8/061/027	BOMBAY, INDIA 5 DECEMBER - 16 DECEMBER	UNDP	9	0	2	8,693 (CC)

Project title and code	Place(s) and dates	Source of funds	Participation <sup>a)</sup>			Amount(s) expended <sup>b)</sup> (\$)
			(1)	(2)	(3)	
REGIONAL EXECUTIVE MANAGEMENT SEMINAR ON THE USE OF NUCLEONIC INSTRUMENTAL TECHNIQUES IN CIVIL ENGINEERING, RAS/8/061/029	TOKYO, JAPAN 24 MAY - 1 JUNE	JAPAN	13	0	0	67,757 (CC)
REGIONAL WORKSHOP ON IMAGE PROCESSING TECHNIQUES FOR NON-DESTRUCTIVE TESTING, RAS/8/061/033	TOKYO, JAPAN 3 OCTOBER - 7 OCTOBER	JAPAN	10	0	0	9,864 (CC)
REGIONAL TRAINING COURSE ON ADVANCED METHODOLOGIES OF ISOTOPE APPLICATIONS IN HYDROLOGY, RAS/8/063/001	KUALA LUMPUR, MALAYSIA 31 OCTOBER - 26 NOVEMBER	AGENCY	15	0	0	82,310 (CC)
REGIONAL TRAINING COURSE ON DEVELOPMENT OF INFRASTRUCTURES FOR ENSURING RADIATION PROTECTION, RAS/9/006/001	SYDNEY, AUSTRALIA 28 MARCH - 29 APRIL	AGENCY JAPAN AUSTRALIA	21	0	0	40,516 (CC) 4,250 (CC) 105,353 (CC)
REGIONAL TRAINING COURSE ON THE HANDLING AND DISPOSAL OF NUCLEAR WASTES, RAS/9/008/001	BEIJING, CHINA 2 MAY - 27 MAY	AGENCY	13	0	12	86,796 (CC) 17,258 (NCC)
REGIONAL WORKSHOP FOR EVALUATION OF TECHNO-ECONOMIC FEASIBILITY STUDIES FOR FOOD IRRADIATION, RER/5/003/001	DAMASCUS, SYRIAN A.R. 29 FEBRUARY - 4 MARCH	AGENCY	6	0	3	1,870 (CC)
REGIONAL WORKSHOP ON FOOD IRRADIATION TECHNOLOGY, RER/5/003/002	WARSAW, POLAND 30 MAY - 16 JUNE	AGENCY	9	0	2	4,915 (CC) 6,923 (NCC)
REGIONAL WORKSHOP ON GOOD IRRADIATION PRACTICES AND CONDUCT OF PILOT-SCALE FOOD IRRADIATION STUDIES, RER/5/003/003	BUDAPEST, HUNGARY 8 NOVEMBER - 18 NOVEMBER	AGENCY	8	0	0	1,958 (CC) 9,867 (NCC)
REGIONAL PRACTICAL WORKSHOP ON THE INTRODUCTION TO THE OPTIMUM USE OF RADIOPHARMACEUTICALS IN NUCLEAR MEDICINE, RER/6/002/001	KUWAIT 22 MAY - 26 MAY	AGENCY	11	0	0	12,014 (CC)
REGIONAL WORKSHOP ON GAMMA-SPECTROMETRY, RER/9/003/002	LJUBLJANA, YUGOSLAVIA 6 JUNE - 17 JUNE	AGENCY	6	0	0	16,325 (CC)
REGIONAL WORKSHOP ON DERIVED INTERVENTION LEVELS FOR ARAB MIDDLE EAST, RER/9/003/003	AMMAN, JORDAN 12 NOVEMBER - 24 NOVEMBER	AGENCY	9	0	4	2,054 (CC)

Project title and code	Place(s) and dates	Source of funds	Participation <sup>a)</sup>			Amount(s) expended <sup>b)</sup> (\$)
			(1)	(2)	(3)	
FIRST REGIONAL WORKSHOP ON NUCLEAR INFORMATION, RLA/0/009/002	RIO DE JANEIRO, BRAZIL 8 MARCH - 11 MARCH	AGENCY	9	0	0	12,248 (CC)
SECOND REGIONAL TRAINING COURSE FOR LIBRARIANS AND INFORMATION SPECIALISTS IN NUCLEAR SCIENCE AND TECHNOLOGY, RLA/0/009/003	BOGOTA, COLOMBIA 21 NOVEMBER - 7 DECEMBER	AGENCY	12	0	4	39,576 (CC)
REGIONAL PRACTICAL COURSE OF PHYSICAL DOSIMETRY IN RADIOTHERAPY FOR LATIN AMERICAN PHYSICISTS, RLA/1/008/001	SAN ANTONIO, TX, USA 3 AUGUST - 7 AUGUST	AGENCY	7	0	0	18,942 (CC)
REGIONAL TRAINING COURSE ON NUCLEAR ANALYTICAL TECHNIQUES IN THE AGROINDUSTRY AND FOOD ANALYSIS, RLA/2/004/001	RIO DE JANEIRO, BRAZIL 7 NOVEMBER - 2 DECEMBER	AGENCY	13	0	3	65,621 (CC)
REGIONAL TRAINING COURSE FOR TECHNICIANS ON MAINTENANCE AND ELECTROMECHANICAL PROBLEMS OF NUCLEAR AND RELATED INSTRUMENTS IN MEDICINE, RLA/4/006/011	SAN JOSE, COSTA RICA 11 JULY - 29 JULY	AGENCY	8	0	3	20,453 (CC)
REGIONAL WORKSHOP ON DEVELOPMENT OF APPROPRIATE SOFTWARE FOR SMALL COMPUTERS, RLA/4/006/012	ASUNCION, PARAGUAY 18 APRIL - 6 MAY	AGENCY	5	0	0	10,486 (CC)
REGIONAL TRAINING COURSE ON HIGH-RESOLUTION RADIATION DETECTORS, RLA/4/006/013	BARILOCHE, ARGENTINA 25 APRIL - 13 MAY	AGENCY USA	13	0	7	25,771 (CC) 3,950 (CC)
REGIONAL WORKSHOP ON DESIGN AND CONSTRUCTION OF AN X-RAY SPECTOMETER, RLA/4/006/014	QUITO, ECUADOR 8 AUGUST - 9 SEPTEMBER	AGENCY	3	0	3	8,125 (CC)
REGIONAL WORKSHOP ON LOCAL AREA NETWORKS AND THEIR APPLICATION IN DATA TRANSFER IN NUCLEAR EXPERIMENTS, RLA/4/006/015	MONTEVIDEO, URUGUAY 21 NOVEMBER - 2 DECEMBER	AGENCY	7	0	2	4,060 (CC)
REGIONAL TRAINING COURSE ON WATER TREATMENT AND CONDITIONING OF RESEARCH REACTORS, RLA/4/007/003	LIMA, PERU 8 AUGUST - 19 AUGUST	GERMANY, F.R.	5	0	5	5,919 (CC)
REGIONAL TRAINING COURSE ON MEASUREMENT OF BASIC PARAMETERS OF RESEARCH REACTORS, RLA/4/007/004	SANTIAGO, CHILE 24 OCTOBER - 18 NOVEMBER	GERMANY, F.R.	4	0	5	9,562 (CC)

Project title and code	Place(s) and dates	Source of funds	Participation <sup>a)</sup>			Amount(s) expended <sup>b)</sup> (\$)
			(1)	(2)	(3)	
REGIONAL COURSE ON SMALL COMPUTERS IN RESEARCH REACTOR OPERATION AND USE, RLA/4/007/005	SAO PAULO, BRAZIL 21 NOVEMBER - 2 DECEMBER	GERMANY, F.R.	4	0	5	6,494 (CC)
REGIONAL TRAINING COURSE ON GENERAL ASPECTS OF FOOD IRRADIATION, RLA/5/020/003	SANTIAGO, CHILE 20 JUNE - 15 JULY	AGENCY CHILE	12	0	5	15,970 (CC) 6,500 (CC)
REGIONAL WORKSHOP ON IMPROVEMENT OF RICE AND OTHER CEREALS THROUGH MUTATION BREEDING, RLA/5/021/002	BOGOTA, COLOMBIA 6 JUNE - 10 JUNE	AGENCY USA	10	1	3	12,897 (CC) 1,429 (CC)
REGIONAL TRAINING COURSE ON IMMUNOASSAY METHODS AND LABELLED DNA PROBES IN ANIMAL DISEASE DIAGNOSIS, RLA/5/022/001	BUENOS AIRES, ARGENTINA 14 NOVEMBER - 2 DECEMBER	AGENCY	21	0	4	91,402 (CC)
REGIONAL TRAIN-THE-TRAINERS COURSE ON RADIOISOTOPE METHODOLOGY WITH SPECIAL EMPHASIS ON RADIOIMMUNOASSAY, RLA/6/011/001	BARILOCHE, ARGENTINA 7 NOVEMBER - 25 NOVEMBER	AGENCY	16	0	4	18,982 (CC)
REGIONAL TRAINING COURSE ON PROMOTION AND USE OF BULK REAGENTS FOR RADIOIMMUNOASSAY OF THYROID RELATED HORMONES, RLA/6/012/001	SANTIAGO, CHILE 7 MARCH - 25 MARCH	AGENCY	14	0	3	60,878 (CC)
REGIONAL TRAINING COURSE ON MEDICAL SCINTIGRAPHY, RLA/6/013/001	HAVANA, CUBA 16 MAY - 18 JUNE	AGENCY	14	0	0	52,734 (CC) 72,551 (NCC)
REGIONAL INFORMATIVE COURSE ON ON-LINE APPLICATIONS NDT, RLA/8/005/216	SAO PAULO, BRAZIL 18 JULY - 29 JULY	GERMANY, F.R.	13	0	0	33,104 (CC)
REGIONAL INFORMATIVE COURSE EDDY CURRENT TESTING IN BOILER-TUBE INSPECTION, RLA/8/005/223	SANTIAGO, CHILE 1 AUGUST - 12 AUGUST	AGENCY GERMANY, F.R.	16	0	0	3,714 (CC) 28,445 (CC)
IX REGIONAL WORKING GROUP MEETING, RLA/8/005/232	LIMA, PERU 19 SEPTEMBER - 23 SEPTEMBER	GERMANY, F.R.	17	0	0	10,258 (CC)
REGIONAL II CONGRESS ON NON-DESTRUCTIVE TESTING, RLA/8/005/233	LIMA, PERU 25 SEPTEMBER - 28 SEPTEMBER	GERMANY, F.R.	16	0	0	10,258 (CC)
REGIONAL II CONGRESS OF NDT FOR LATIN AMERICA AND THE CARIBBEAN, RLA/8/005/234	LIMA, PERU 25 SEPTEMBER - 28 SEPTEMBER	AGENCY	6	0	0	8,004 (CC)

Project title and code	Place(s) and dates	Source of funds	Participation <sup>a)</sup>			Amount(s) expended <sup>b)</sup> (\$)
			(1)	(2)	(3)	
REGIONAL WORKSHOP ON DEVELOPMENT OF REGIONAL NDT ORGANIZATION, RLA/8/006/014	BUENOS AIRES, ARGENTINA 13 JULY - 15 JULY	UNFSTD	3	0	0	1,632 (CC)
INTERNATIONAL WORKSHOP ON IMPLEMENTATION AND IMPLICATIONS OF ISO INTERNATIONAL STANDARD, RLA/8/006/015	GUATEMALA CITY, GUATEMALA 18 JULY - 22 JULY	UNFSTD	6	0	0	10,717 (CC)
REGIONAL INFORMATIVE COURSE ON THERMOGRAPHY, RLA/8/006/016	CARACAS, VENEZUELA 29 AUGUST - 9 SEPTEMBER	UNFSTD	14	0	0	24,295 (CC)
REGIONAL INFORMATIVE COURSE ON COMPUTERS IN NDT, RLA/8/013/001	BUENOS AIRES, ARGENTINA 17 OCTOBER - 28 OCTOBER	ITALY	17	0	0	27,171 (CC)
REGIONAL WORKSHOP ON QUALIFICATION AND CERTIFICATION, RLA/8/013/002	SAO PAULO, BRAZIL 24 OCTOBER - 28 OCTOBER	ITALY	17	0	0	51,707 (CC)
REGIONAL WORKSHOP ON PREPARATION OF TEST SPECIMENS, RLA/8/013/003	SAO PAULO, BRAZIL 31 OCTOBER - 11 NOVEMBER	ITALY	17	0	0	1,896 (CC)
REGIONAL SEMINAR ON NON-DESTRUCTIVE TESTING IN RAILWAYS, RLA/8/013/004	KINGSTON, JAMAICA 24 OCTOBER - 28 OCTOBER	ITALY	7	0	0	6,911 (CC)
REGIONAL INFORMATIVE COURSE ON NON-DESTRUCTIVE TESTING IN COMPOSITE MATERIALS, RLA/8/013/005	LIMA, PERU 7 NOVEMBER - 11 NOVEMBER	ITALY	16	0	0	14,241 (CC)
REGIONAL SEMINAR ON NON-DESTRUCTIVE TESTING IN PETROCHEMICAL INDUSTRY, RLA/8/013/006	TRINIDAD AND TOBAGO 14 NOVEMBER - 18 NOVEMBER	ITALY	12	0	0	5,591 (CC)
REGIONAL TRAINING COURSE ON QUALITY CONTROL OF DIAGNOSTIC X-RAY EQUIPMENT, RLA/9/009/008	RIO DE JANEIRO, BRAZIL 29 AUGUST - 9 SEPTEMBER	AGENCY	9	0	7	13,876 (CC)
REGIONAL WORKSHOP IV ON RADIATION PROTECTION, RLA/9/009/010	BOGOTA, COLOMBIA 7 MARCH - 11 MARCH	AGENCY	10	0	1	11,281 (CC)
REGIONAL TRAINING COURSE ON DOSIMETRIC ASSESSMENT ON INTERNAL CONTAMINATION, RLA/9/009/011	RIO DE JANEIRO, BRAZIL 19 SEPTEMBER - 7 OCTOBER	AGENCY	5	1	6	10,830 (CC)
REGIONAL SEMINAR ON QUALITY CONTROL IN RADIOTHERAPY, RLA/9/009/012	LIMA, PERU 12 SEPTEMBER - 16 SEPTEMBER	AGENCY	10	0	0	18,076 (CC)

<sup>a)</sup>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).

<sup>b)</sup>The amounts expended do not represent the total cost of the course since travel costs are no longer obligated and advances to host countries are held on a suspense account until final accounts are received. The amounts expended do not include expenditures by host governments in respect of local lecturers, or expenditures for laboratory, lecture room and other facilities.

## ANNEX III PUBLISHED REPORTS

Recipient	Subject and project code	Author(s)	Reference no.	Status <sup>a</sup>
ARGENTINA	STUDIES OF COMPACT LATTICES IN NUCLEAR REACTORS (ARG/4/077)	OLDEKOP, WERNER EWALD	IAEA/UNDP-ARG/78/020-35	R
IRAN ISLAMIC REP.	GEOPHYSICAL TECHNIQUES (IRA/3/002)	STEELE, JOHN PAUL	IAEA-TA-2419	R
SYRIAN ARAB REP.	MICRO PLANT OPERATION (SYR/3/003)	GASOS, PABLO	IAEA-TA-2418	R
	FAVOURABILITY STUDY FOR SEDIMENTARY-TYPE URANIUM DEPOSITS (SYR/3/004)	MORABITO, SYLVESTRE JEAN	IAEA/UNDP-SYR/86/005-01	D
	IMPLEMENTATION OF RADIOLOGICAL PROTECTION REGULATIONS (SYR/9/005)	ROPERO GONZALEZ, MATILDE	IAEA-TA-2428	R
INTERREGIONAL	RAPAT MISSION TO GREECE (INT/9/055)	STROHAL, PETAR WESTERLUND, ERIK-ANDERS MOISEEV, ALEXEIJ	IAEA-TA-2425	D
	RAPAT MISSION TO THE REPUBLIC OF KOREA (INT/9/055)	STROHAL, PETAR BIANCO, ANDREA THOMAS, KARYANIL THOMAS	IAEA-TA-2426	R
	RAPAT MISSION TO THE PHILIPPINES (INT/9/055)	BUSH, W.R. INABA, JIRO STROHAL, PETAR BIANCO, ANDREA THOMAS, KARYANIL THOMAS	IAEA-TA-2427	R
	WORKSHOP ON PROBABILISTIC SAFETY ANALYSIS (INT/9/063)	GUBLER, REINHARD	IAEA-TA-2417	D
	RADIOACTIVE WASTE MANAGEMENT ADVISORY PROGRAMME (WAMAP) (INT/9/081)	BAEHR, WERNER WILHELM LEE, DAVID JOHN FENTON, ANDREW THOMAS, KARYANIL THOMAS	IAEA-TA-2420	R
	RADIOACTIVE WASTE MANAGEMENT ADVISORY PROGRAMME (WAMAP) (INT/9/081)	BAEHR, WERNER WILHELM LARSSON, ALF HARALD THOMAS, KARYANIL THOMAS	IAEA-TA-2421	R



Recipient	Subject and project code	Author(s)	Reference no.	Status <sup>a</sup>
INTERREGIONAL (cont'd)	RADIOACTIVE WASTE MANAGEMENT ADVISORY PROGRAMME (WAMAP) (INT/9/081)	DLOUHY, ZDENEK THOMAS, KARYANIL THOMAS	IAEA-TA-2422	R
	WAMAP MISSION TO MOROCCO (INT/9/081)	THOMAS, KARYANIL THOMAS	IAEA-TA-2423	R
	WAMAP MISSION TO MALAYSIA (INT/9/081)	BAEHR, WERNER WILHELM DLOUHY, ZDENEK THOMAS, KARYANIL THOMAS	IAEA-TA-2424	R
	WAMAP MISSION TO MEXICO (INT/9/081)	COLOMBO, PETER SQUIRES, DAVID J. THOMAS, KARYANIL THOMAS	IAEA-TA-2429	R
REGIONAL	ULTRASONIC TESTING OF MATERIALS AT LEVEL 2 TRAINING MANUAL FOR NON-DESTRUCTIVE TESTING TECHNIQUES (RAS/8/061)	GILMOUR, ROBERT STIRLING	IAEA/UNDP-RAS/86/073-01	D
	NON-DESTRUCTIVE TESTING TECHNIQUES TRAIN-THE-TRAINER COURSE; COURSE NOTES (RAS/8/061)	GILMOUR, ROBERT STIRLING	IAEA/UNDP-RAS/86/073-02	D
	THIRD MEETING OF NATIONAL CO-ORDINATORS SUB-PROJECT: RADIATION TECHNOLOGY (RAS/8/061)	TAJUDDIN-ALI, AHMAD	IAEA/UNDP-RAS/86/073-03	D
	FOURTH MEETING OF NATIONAL CO-ORDINATORS SUB-PROJECT: NON-DESTRUCTIVE TESTING (RAS/8/061)	TAJUDDIN-ALI, AHMAD	IAEA/UNDP-RAS/86/073-04	D
	TRACER TECHNOLOGY IN INDUSTRY DEMONSTRATION: MERCURY INVENTORY IN ELECTROLYTIC CELLS BY RADIOACTIVE TRACER TECHNIQUES (RAS/8/061)	AJMERA, R.L. RAO, S.M.	IAEA/UNDP-RAS/86/073-05	D

<sup>a</sup> D = De-restricted distribution; R = Restricted distribution.

## ANNEX IV

### VOLUNTARY CONTRIBUTIONS PLEDGED AND PAID TO THE TECHNICAL ASSISTANCE AND CO-OPERATION FUND FOR 1988 (as at 31 December 1988)

Member State	Base rate %	Share of \$38.0 million target for voluntary contributions for 1988 using base rate *	Pledged	Paid
Afghanistan	0.01	3,800	-	-
Albania	0.01	3,800	3,800	-
Algeria	0.14	53,200	-	-
Argentina	0.61	231,800	116,000	-
Australia	1.64	623,200	431,655	431,655
Austria	0.73	277,400	277,400	277,400
Bangladesh	0.02	7,600	-	-
Belgium	1.17	444,600	110,803	-
Bolivia	0.01	3,800	-	-
Brazil	1.38	524,400	262,000	-
Bulgaria	0.16	60,800	60,800	60,800
Burma	0.01	3,800	-	-
Byelorussian SSR	0.34	129,200	124,916	124,916
Cameroon	0.01	3,800	4,076	-
Canada	3.03	1,151,400	1,067,255	1,067,255
Chile	0.07	26,600	26,600	26,600
China	0.78	296,400	296,400	296,400
Colombia	0.13	49,400	-	-
Costa Rica	0.02	7,600	-	-
Côte d'Ivoire	0.02	7,600	-	-
Cuba	0.09	34,200	34,200	34,200
Cyprus	0.02	7,600	7,600	7,600
Czechoslovakia	0.69	262,200	262,200	262,200
Democratic Kampuchea	0.01	3,800	-	-
Dem. P.R. Korea	0.05	19,000	19,000	19,000
Denmark	0.71	269,800	269,800	269,800
Dominican Republic	0.03	11,400	-	-
Ecuador	0.03	11,400	-	-
Egypt	0.07	26,600	23,800	14,594
El Salvador	0.01	3,800	-	-
Ethiopia	0.01	3,800	-	-
Finland	0.49	186,200	186,200	186,200
France	6.30	2,394,000	2,394,000	2,394,000
Gabon	0.03	11,400	-	-
German D.R.	1.31	497,800	497,800	497,800
Germany, F.R.	8.17	3,104,600	3,104,600	3,104,600
Ghana	0.01	3,800	6,000	-
Greece	0.43	163,400	163,400	-
Guatemala	0.02	7,600	7,600	-
Haiti	0.01	3,800	-	-
Holy See	0.01	3,800	2,000	2,000
Hungary	0.22	83,600	92,340	92,340
Iceland	0.03	11,400	11,400	11,400
India	0.35	133,000	133,000	133,000
Indonesia	0.14	53,200	39,000	39,000

\* As recommended in GC(V)/RES/100 and amended in GC(XV)/RES/286.

Member State	Base rate %	Share of \$38.0 million target for voluntary contributions for 1988 using base rate *	Pledged	Paid
Iran, I.R.	0.62	235,600	-	-
Iraq	0.12	45,600	45,600	45,600
Ireland	0.18	68,400	-	-
Israel	0.22	83,600	-	-
Italy	3.75	1,425,000	586,081	586,081
Jamaica	0.02	7,600	-	-
Japan	10.73	4,077,400	4,077,400	4,077,400
Jordan	0.01	3,800	3,800	-
Kenya	0.01	3,800	-	-
Korea, R.	0.20	76,000	76,000	76,000
Kuwait	0.29	110,200	-	-
Lebanon	0.01	3,800	-	-
Liberia	0.01	3,800	-	-
Libyan A.J.	0.26	98,800	-	-
Liechtenstein	0.01	3,800	3,800	3,800
Luxembourg	0.05	19,000	-	-
Madagascar	0.01	3,800	3,250	-
Malaysia	0.10	38,000	38,000	38,000
Mali	0.01	3,800	-	-
Mauritius	0.01	3,800	-	-
Mexico	0.88	334,400	261,000	261,000
Monaco	0.01	3,800	-	-
Mongolia	0.01	3,800	3,800	-
Morocco	0.05	19,000	19,000	19,000
Namibia	-	-	-	-
Netherlands	1.72	653,600	653,600	653,600
New Zealand	0.24	91,200	-	-
Nicaragua	0.01	3,800	-	-
Niger	0.01	3,800	-	-
Nigeria	0.19	72,200	72,200	72,200
Norway	0.53	201,400	201,400	201,400
Pakistan	0.06	22,800	22,800	22,800
Panama	0.02	7,600	-	-
Paraguay	0.02	7,600	-	-
Peru	0.07	26,600	-	-
Philippines	0.10	38,000	-	-
Poland	0.63	239,400	239,400	239,400
Portugal	0.18	68,400	-	-
Qatar	0.04	15,200	-	-
Romania	0.19	72,200	-	-
Saudi Arabia	0.96	364,800	-	-
Senegal	0.01	3,800	3,800	-
Sierra Leone	0.01	3,800	-	-
Singapore	0.10	38,000	-	-
South Africa	0.43	163,400	-	-
Spain	2.01	763,800	30,000	30,000
Sri Lanka	0.01	3,800	3,800	3,800
Sudan	0.01	3,800	3,800	-
Sweden	1.24	471,200	471,200	471,200
Switzerland	1.11	421,800	421,800	421,800

Member State	Base rate %	Share of \$38.0 million target for voluntary contributions for 1988 using base rate *	Pledged	Paid
Syrian A.R.	0.04	15,200	-	-
Thailand	0.09	34,200	34,200	34,200
Tunisia	0.03	11,400	-	-
Turkey	0.34	129,200	129,200	129,200
Uganda	0.01	3,800	-	-
Ukrainian SSR	1.27	482,600	468,923	468,923
USSR	10.09	3,834,200	3,843,541	3,843,541
U.A. Emirates	0.18	68,400	-	-
United Kingdom	4.81	1,827,800	1,827,800	1,827,800
U.R. Tanzania	0.01	3,800	-	-
USA	25.00	9,500,000	8,914,394	8,914,394
Uruguay	0.04	15,200	-	-
Venezuela	0.59	224,200	40,000	40,000
Viet Nam	0.01	3,800	500	-
Yugoslavia	0.45	171,000	171,000	-
Zaire	0.01	3,800	-	-
Zambia	0.01	3,800	3,800	-
Zimbabwe	0.02	7,600	-	-
<b>TOTAL</b>	<b>100.00</b>	<b>38,000,000</b>	<b>32,710,534</b>	<b>31,833,899</b>

## ANNEX V

### COST-FREE FELLOWSHIPS OFFERED AND AWARDED: 1988

Donor	Number of fellowships offered	Number of man-months offered	Number of fellowships awarded <sup>a)</sup>	Number of man-months awarded <sup>a)</sup>
Argentina	6	72	2	2
Austria	1	12	5	13
Belgium	3	12	6	29
Brazil	10	-	1	3
Czechoslovakia	9	-	8	35
Denmark	5	60	5	16
France	-	50	12	42
Germany, F.R.	-	105	12	52
Hungary	4	48	15	73
India	10	-	10	52
Israel	-	45	-	-
Italy	25	200	10	76
Japan	5	45	4	20
Netherlands	8	-	3	16
Poland	10	-	2	12
Spain	5	60	4	19
United Kingdom	- <sup>b)</sup>	-	9	72
United States of America	- <sup>b)</sup>	-	20	105

a) Awards less rejections and withdrawals as at 31 December 1988, including awards against prior-year offers.

b) A specific amount of money was made available rather than a given number of fellowships.

**ANNEX VI**  
**APPROVED AND ON-GOING UNDP PROJECTS**  
(in thousands of dollars)

Recipient	Project title and code	Total amount approved	Prior to 1988	Approved budgets				
				1988	1989	1990	1991	1992
<b>A. Projects executed by the IAEA</b>								
Argentina	Nuclear engineering, ARG/78/020	3474	3037	220	217	-	-	-
Costa Rica	Strengthening national capacity for mineral prospection, COS/83/T02 (UNFSTD)	617	602	15	-	-	-	-
China	Manpower development for nuclear power programme, CPR/85/085	1683	430	567	686	-	-	-
	Use of radiation and isotopes in food and agriculture, CPR/86/022	415	-	149	266	-	-	-
Cuba	Extension of the application of nuclear technology to the national economy, CUB/86/018	600	-	254	264	82	-	-
Egypt	National Centre for Radiation Technology - Phase II, EGY/78/011	1173	678	57	438	-	-	-
Ghana	Teaching applied nuclear physics, GHA/85/015	87	87	-	-	-	-	-
Hungary	Strengthening of an advanced automated radiation laboratory, HUN/86/004	32	-	22	10	-	-	-
Indonesia	Application of isotopes and radiation to increasing agricultural production, INS/78/074	1575	1550	25	-	-	-	-
	Application of isotopes and radiation to increasing agricultural production - Phase II, INS/88/013	469	-	116	238	89	26	-
Iran, I.R.	Pilot demonstration plant for radio-sterilization and other applications of radiation technology, IRA/82/003	1547	1547	-	-	-	-	-
Korea, R.	Isotopes and radiation in agricultural research, ROK/84/003	635	183	189	263	-	-	-
Peru	Medfly eradication in Southern Peru, PER/86/017	206	79	127	-	-	-	-
Romania	Assistance for nuclear power stations ROM/82/001	661	661	-	-	-	-	-
	Improvement of nuclear safety and reliability, ROM/87/002	640	-	30	383	227	-	-
Syrian A.R.	Uranium exploration in Syria, SYR/86/005	464	233	231	-	-	-	-

Recipient	Project title and code	Total amount approved	Prior to 1988	Approved budgets				
				1988	1989	1990	1991	1992
Thailand	Improving food and agricultural production, THA/85/004	1491	708	268	382	133	-	-
Turkey	Development of non-destructive testing in nuclear research and training centre of IAEA, TUR/87/016	239	59	78	73	29	-	-
Venezuela	Centre for Nuclear Agriculture, VEN/86/007	279	-	139	140	-	-	-
Asia and the Pacific	Support for regional co-operation in the industrial application of isotopes and radiation technology - Phase II, RAS/86/073	3135	646	748	788	581	372	-
Latin America	Regional non-destructive testing (NDT) project for Latin America and the Caribbean, RLA/84/T01 (UNFSTD)	1611	1596	15	-	-	-	-
<b>Sub-total</b>		<b>21033</b>	<b>12096</b>	<b>3250</b>	<b>4148</b>	<b>1141</b>	<b>398</b>	<b>-</b>

**B. Projects for which IAEA is associated agency  
(IAEA budget portion only)**

China	Nuclear safety administration, CPF/85/067	590	188	402	-	-	-	-
Iran, I.R.	Strengthening the Water Resources Research Institute, IRA/85/015	106	76	30	-	-	-	-
<b>Sub-total</b>		<b>696</b>	<b>264</b>	<b>432</b>	<b>-</b>	<b>-</b>	<b>-</b>	<b>-</b>
<b>Grand total</b>		<b>21729</b>	<b>12360</b>	<b>3682</b>	<b>4148</b>	<b>1141</b>	<b>398</b>	<b>-</b>

**ANNEX VII**  
**FOOTNOTE-a/ PROJECTS MADE OPERATIONAL**  
**OR EXTENDED DURING 1988**

Recipient	Expert services	Equipment	Fellow- ships	Group training	Sub- contracts	Source <sup>a)</sup>
Project title and code	(m/m)	(\$)	(\$)	(\$)	(\$)	
<b>BANGLADESH</b>						
NUCLEAR TECHNIQUES IN AGRICULTURE BGD/5/013 <sup>b)</sup>	5	100,000	0	0	0	UK
<b>BRAZIL</b>						
STUDY OF MULTI-LAYER SEMICONDUCTOR STRUCTURE, BRA/1/029 <sup>b)</sup>	6	90,000	27,000	0	0	GFR
<b>CHILE</b>						
RESEARCH REACTOR CORE CONVERSION (RECH-1), CHI/4/013 <sup>b)</sup>	0 2	20,000 5,000	0 4,500	0 0	0 0	CHI TACF
<b>COLOMBIA</b>						
UPGRADING OF RESEARCH REACTOR COL/4/008 <sup>b)</sup>	4	30,000	0	0	0	USA
RADIATION PROTECTION COL/9/002 <sup>b)</sup>	4	42,000	0	0	0	UK
<b>ECUADOR</b>						
ADVANCED MEDICAL PHISICS TRAINING ECU/6/008 <sup>c)</sup>	2	0	0	0	0	USA
INDUSTRIAL APPLICATIONS ECU/8/011 <sup>b)</sup>	2	55,000	13,500	0	0	GFR
<b>EGYPT</b>						
QUALITY ASSURANCE EGY/4/027 <sup>b)</sup>	5	100,000	0	148,500	0	GFR
RADIOIMMUNOASSAY IN ANIMAL SCIENCE EGY/5/018 <sup>b)</sup>	2	7,500	0	0	0	USA
COMPUTER-AIDED SAFETY ANALYSIS EGY/9/018 <sup>c)</sup>	6	0	0	0	0	ROK
<b>EL SALVADOR</b>						
NUCLEAR INSTRUMENTATION ELS/4/003 <sup>b)</sup>	3	45,000	0	0	0	USA
<b>GHANA</b>						
GENETIC IMPROVEMENT OF COCOA AND COFFEE GHA/5/016 <sup>b)</sup>	3	28,000	13,500	0	0	UK
EVALUATION OF GROUNDWATER RESOURCES GHA/8/006 <sup>b)</sup>	2	121,000	9,300	0	0	UK
<b>GREECE</b>						
UPGRADING OF NEUTRON SPECTROMETER GRE/1/033 <sup>b)</sup>	1	6,000	0	0	0	USA
<b>GUATEMALA</b>						
DOSIMETRY LABORATORY (SSDL) GUA/1/004 <sup>b)</sup>	1	100,000	0	0	0	USA



Recipient Project title and code	Expert services (m/m)	Equipment (\$)	Fellow- ships (\$)	Group training (\$)	Sub- contracts (\$)	Source <sup>a)</sup>
<b>GUATEMALA (continued)</b>						
CONTROL OF THE MEDITERRANEAN FRUIT FLY GUA/5/007 <sup>b)</sup>	12	30,000	0	0	0	USA
<b>INDONESIA</b>						
RADIOBIOLOGICAL LABORATORY INS/7/002 <sup>b)</sup>	1	30,000	0	0	0	USA
<b>KOREA, REPUBLIC OF</b>						
STANDARDIZATION OF NEUTRON MEASUREMENTS ROK/1/007 <sup>b)</sup>	1	40,000	0	0	0	USA
URANIUM EXPLORATION ROK/3/006 <sup>b)</sup>	2	8,000	0	0	0	GFR
NUCLEAR POWER PLANT OPERATOR TRAINING ROK/4/019 <sup>b)</sup>	5	0	0	0	0	USA
<b>MALAYSIA</b>						
NUCLEAR INSTRUMENTATION CENTRE MAL/4/006 <sup>b)</sup>	5	36,000	0	0	0	USA
<b>MEXICO</b>						
PARTICLE-INDUCED X-RAY EMISSION TECHNIQUES, MEX/2/011 <sup>b)</sup>	2	35,000	9,000	0	0	UK
IN-CORE FUEL MANAGEMENT MEX/4/034 <sup>b)</sup>	2	50,000	0	0	0	USA
RADIATION TECHNOLOGY MEX/8/016 <sup>b)</sup>	6	20,000	0	0	0	USA
<b>MOROCCO</b>						
TRAINING AND RESEARCH IN NUCLEAR SCIENCE MOR/1/006 <sup>b)</sup>	2	25,000	0	0	0	USA
<b>NIGERIA</b>						
NUCLEAR ANALYTICAL TECHNIQUES NIR/1/007 <sup>b)</sup>	2	67,000	0	0	0	USA
TRACE-ELEMENT DETERMINATION NIR/2/004 <sup>b)</sup>	3	154,000	0	0	0	UK
<b>PORTUGAL</b>						
NEUTRON SCATTERING SPECTROMETER POR/1/005 <sup>b)</sup>	2	49,100	0	0	0	USA
<b>SRI LANKA</b>						
NUCLEAR ENGINEERING (MORATUWA) SRL/4/010 <sup>b)</sup>	3	12,000	0	0	0	USA
<b>SUDAN</b>						
NUCLEAR SCIENCE LABORATORY SUD/0/006 <sup>c)</sup>	0	26,000	0	0	0	UK
NUCLEAR INSTRUMENTATION SUD/4/003 <sup>b)</sup>	2	20,000	0	0	0	TACF
PESTICIDE RESIDUESE SUD/5/012 <sup>b)</sup>	1	10,000	0	0	0	TACF
USE OF GAMMA CAMERA SUD/6/012 <sup>c)</sup>	3	90,000	0	0	0	TACF

Recipient	Expert services	Equipment	Fellowships	Group training	Sub-contracts	Source <sup>a)</sup>
Project title and code	(m/m)	(\$)	(\$)	(\$)	(\$)	
<b>THAILAND</b>						
CALIBRATION AND STANDARDIZATION OF RADIONUCLIDES, THA/1/008 <sup>b)</sup>	2	70,000	0	0	0	USA
RADIOCHEMISTRY TRAINING THA/2/009 <sup>c)</sup>	2	50,000	0	0	0	GFR
PESTICIDE RESIDUES THA/5/035 <sup>b)</sup>	4	85,000	55,800	0	0	UK
TREATMENT PLANNING AND CLINICAL DOSIMETRY, THA/6/024 <sup>b)</sup>	2	70,000	0	0	0	UK
<b>UNITED REPUBLIC OF TANZANIA</b>						
GROUNDWATER MONITORING IN THE DODOMA REGION, URT/8/006 <sup>b)</sup>	2	20,000	9,000	0	0	GFR
<b>YUGOSLAVIA</b>						
QUALIFICATION OF NUCLEAR POWER PLANT EQUIPMENT, YUG/4/025 <sup>b)</sup>	2	135,000	0	0	0	USA
<b>ZIMBABWE</b>						
NUCLEAR TECHNIQUES IN BIOCHEMISTRY ZIM/5/003 <sup>b)</sup>	0	30,000	0	0	0	TACF
<b>REGIONAL LATIN AMERICA</b>						
NUCLEAR ANALYTICAL TECHNIQUES (ARCAL IV) RLA/2/003 <sup>c)</sup>	0	0	0	60,000	0	TACF
NUCLEAR INSTRUMENTATION (ARCAL II) RLA/4/006 <sup>b)</sup>	2	70,000	0	0	0	USA
RESEARCH REACTOR UTILIZATION (ARCAL V) RLA/4/007 <sup>c)</sup>	0	0	0	65,000	0	TACF
FOOD IRRADIATION (ARCAL VI) RLA/5/020 <sup>b)</sup>	0	0	1,650	6,500	0	CHI
IMPROVEMENT OF CEREALS THROUGH MUTATION BREEDING (ARCAL VII), RLA/5/021	0	100,000	0	0	0	USA
NUCLEAR TECHNIQUES IN AGRICULTURE (ARCAL XI), RLA/5/023 <sup>b)</sup>	12	0	0	0	0	TACF
RADIOIMMUNOASSAY OF THYROID-RELATED HORMONES (ARCAL VIII), RLA/6/011 <sup>b)</sup>	2	55,900	0	20,000	0	CEC
NON-DESTRUCTIVE TESTING IN LATIN AMERICA RLA/8/005 <sup>b)</sup>	10	140,000	186,000	160,000	0	GFR
<b>INTERREGIONAL</b>						
ELECTRON BEAM TECHNOLOGY FOR FLUE GAS PURIFICATION, INT/8/002 <sup>b)</sup>	6	0	0	0	0	USA

a) Explanation of abbreviations: CHI = Chile; CEC = Commission of the European Communities; GFR = Federal Republic of Germany; ROK = Republic of Korea; TACF = Technical Assistance and Co-operation Fund; UK = United Kingdom; USA = United States of America.

b) Project extended or made operational in 1988 and approved in that year by the Board.

c) Project extended or made operational in 1988 but approved in a prior year by the Board.

**ANNEX VIII**  
**APPROVALS AGAINST THE RESERVE FUND IN 1988**

Recipient	Project title and number	Experts m/m	Equipment \$	Other \$	Total \$
<b>A. New projects</b>					
Chile	Research reactor core conversion, CHI/4/013 <sup>a</sup>	2/00	5000	4500 <sup>b</sup>	23900
Colombia	Training in mediterranean fruit fly control, COL/5/011	1/00	-	-	7200
China	Tracer studies for monitoring potential zones in oil fields, CPR/8/004	2/00	-	35600 <sup>b</sup>	50000
Egypt	Energy planning, EGY/0/009	3/00	-	-	21600
El Salvador	Nuclear science laboratory construction, ELS/0/005	-	27000	-	27000
Indonesia	Silicide experimental fuel element, INS/4/022	1/00	-	-	7200
Iraq	Core conversion, IRQ/4/010	3/00	-	-	21600
Malaysia	Radiation technology, MAL/8/011	-	50000	-	50000
Poland	Modernization of Maria reactor, POL/4/009	-	25000	-	25000
Tunisia	Assessment of a teaching reactor, TUN/9/006	1/00	-	-	7200
United Arab Emirates	Radioactive environmental and food contamination, UAE/9/003	1/00	-	-	7200
<b>Sub-total</b>		<b>14/00</b>	<b>107000</b>	<b>40100</b>	<b>247900</b>
<b>B. Supplementary assistance to existing projects</b>					
Cuba	Nuclear cardiology, CUB/6/007	2/00	-	-	14400
Indonesia	Energy economics calculations with nuclear options, INS/0/007	-	-	2314 <sup>b</sup>	2314
Sudan	Liquid nitrogen plant, SUD/1/004	-	-	2700 <sup>c</sup>	2700
Regional Asia and the Pacific	Isotope hydrology workshop and seminar support (RCA), RAS/8/059	-	5000	-	5000
<b>Sub-total</b>		<b>2/00</b>	<b>5000</b>	<b>5014</b>	<b>24414</b>
<b>TOTAL</b>		<b>16/00</b>	<b>112000</b>	<b>45114</b>	<b>272314</b>

<sup>a</sup> Previously approved footnote-g/ project upgraded through TACF. <sup>b</sup> Approval for fellowship. <sup>c</sup> Approval for sub-contract.

**ANNEX IX**  
**NET PROGRAMME CHANGES BY RECIPIENT**

Recipient	Component	Existing approval	Net change
<b>AFGHANISTAN</b>			
	EXPERTS (M/M)	2/00	0/00
	EQUIPMENT (NCC)	20,000	-20,000
<b>ALBANIA</b>			
	EXPERTS (M/M)	1/15	0/00
	EQUIPMENT (CC)	217,150	4,740
	FELLOWSHIPS (CC)	0	9,500
<b>ALGERIA</b>			
	EXPERTS (M/M)	23/05	-4/02
	EQUIPMENT (CC)	834,540	2,666
	EQUIPMENT (NCC)	71,000	-15,361
	FELLOWSHIPS (CC)	20,850	958
<b>BANGLADESH</b>			
	EXPERTS (M/M)	25/00	-4/01
	EQUIPMENT (CC)	1,891,850	71,072
	EQUIPMENT (NCC)	1,086,500	90,366
	FELLOWSHIPS (CC)	3,500	-549
<b>BOLIVIA</b>			
	EXPERTS (M/M)	29/21	-3/13
	EQUIPMENT (CC)	562,890	-13,316
	FELLOWSHIPS (CC)	59,800	-5,770
<b>BRAZIL</b>			
	EXPERTS (M/M)	164/20	-2/15
	EQUIPMENT (CC)	2,027,519	68,456
	EQUIPMENT (NCC)	21,600	10,200
	FELLOWSHIPS (CC)	49,150	-140
	SUB-CONTRACTS (CC)	25,000	-25,000
<b>BULGARIA</b>			
	EXPERTS (M/M)	12/16	-5/00
	EQUIPMENT (CC)	638,600	-2,400
	EQUIPMENT (NCC)	738,089	111,000
	FELLOWSHIPS (CC)	0	24,000
<b>BURMA</b>			
	EXPERTS (M/M)	6/00	-2/00
	EQUIPMENT (CC)	84,000	-344
	EQUIPMENT (NCC)	22,256	25,700

Recipient	Component	Existing approval	Net change
<b>CAMEROON</b>			
	EXPERTS (M/M)	19/07	-4/03
	EQUIPMENT (CC)	136,000	10,601
	FELLOWSHIPS (CC)	13,500	-13,500
<b>CHILE</b>			
	EXPERTS (M/M)	41/13	-6/29
	EQUIPMENT (CC)	875,325	19,474
	FELLOWSHIPS (CC)	118,366	1,966
<b>CHINA</b>			
	EXPERTS (M/M)	43/15	-6/02
	EQUIPMENT (CC)	852,000	-13,261
	EQUIPMENT (NCC)	0	78,400
	FELLOWSHIPS (CC)	52,650	14,765
<b>COLOMBIA</b>			
	EXPERTS (M/M)	38/00	-5/00
	EQUIPMENT (CC)	903,922	50,313
	EQUIPMENT (NCC)	15,000	5,000
	FELLOWSHIPS (CC)	83,400	-13,014
<b>COSTA RICA</b>			
	EXPERTS (M/M)	5/16	-3/00
	EQUIPMENT (CC)	362,895	-28,052
	EQUIPMENT (NCC)	95,300	3,900
	FELLOWSHIPS (CC)	29,600	-12,109
<b>COTE D'IVOIRE</b>			
	EXPERTS (M/M)	20/26	-6/16
	EQUIPMENT (CC)	291,950	-85,360
	EQUIPMENT (NCC)	114,000	14,000
	FELLOWSHIPS (CC)	58,450	-35,368
<b>CUBA</b>			
	EXPERTS (M/M)	8/00	1/26
	EQUIPMENT (CC)	580,350	2,254
	EQUIPMENT (NCC)	123,000	19,000
	FELLOWSHIPS (CC)	106,500	-12,110
<b>CYPRUS</b>			
	EXPERTS (M/M)	3/00	-1/00
<b>CZECHOSLOVAKIA</b>			
	EXPERTS (M/M)	1/00	-0/09
	FELLOWSHIPS (CC)	0	2,197

Recipient	Component	Existing approval	Net change
<b>DEM. P.R. KOREA</b>			
	EXPERTS (M/M)	17/00	-5/22
	EQUIPMENT (CC)	776,100	15,090
	EQUIPMENT (NCC)	2,147,500	199,788
<b>DOMINICAN REPUBLIC</b>			
	EXPERTS (M/M)	9/15	0/00
	FELLOWSHIPS (CC)	13,500	-13,500
<b>ECUADOR</b>			
	EXPERTS (M/M)	33/00	-7/17
	EQUIPMENT (CC)	1,328,483	10,418
	EQUIPMENT (NCC)	1,507,600	64,535
	FELLOWSHIPS (CC)	137,250	20,881
	FELLOWSHIPS (NCC)	0	3,500
<b>EGYPT</b>			
	EXPERTS (M/M)	101/21	-21/22
	EQUIPMENT (CC)	1,368,804	107,856
	EQUIPMENT (NCC)	535,000	-231,047
	FELLOWSHIPS (CC)	148,500	-135,500
	FELLOWSHIPS (NCC)	0	42,750
	TRAINING COURSES (CC)	0	148,500
	SUB-CONTRACTS (CC)	110,000	206,000
<b>EL SALVADOR</b>			
	EQUIPMENT (CC)	256,000	1,959
	FELLOWSHIPS (CC)	61,200	-18,000
<b>ETHIOPIA</b>			
	EXPERTS (M/M)	42/27	-4/16
	EQUIPMENT (CC)	312,720	-7,600
	EQUIPMENT (NCC)	88,200	-30,000
	FELLOWSHIPS (CC)	106,200	-51,915
<b>GABON</b>			
	EXPERTS (M/M)	7/00	-1/23
	EQUIPMENT (CC)	25,000	7,200
<b>GHANA</b>			
	EXPERTS (M/M)	47/07	-5/26
	EQUIPMENT (CC)	567,945	-33,800
	EQUIPMENT (NCC)	3,583	13,596
	FELLOWSHIPS (CC)	94,398	-4,290
<b>GREECE</b>			
	EXPERTS (M/M)	6/16	-1/01
	EQUIPMENT (CC)	639,775	-22,824
	FELLOWSHIPS (CC)	8,650	-4,800

Recipient	Component	Existing approval	Net change
<b>GUATEMALA</b>			
	EXPERTS (M/M)	24/03	-11/07
	EQUIPMENT (CC)	567,409	-10,284
	FELLOWSHIPS (CC)	13,950	-6,750
	SUB-CONTRACTS (CC)	0	115,065
<b>HAITI</b>			
	EXPERTS (M/M)	5/08	-2/00
<b>HUNGARY</b>			
	EQUIPMENT (NCC)	336,221	33,779
<b>ICELAND</b>			
	EQUIPMENT (CC)	309,250	10,558
<b>INDONESIA</b>			
	EXPERTS (M/M)	131/13	4/09
	EQUIPMENT (CC)	999,500	-180,633
	EQUIPMENT (NCC)	350,000	77,500
	FELLOWSHIPS (CC)	56,350	-14,491
<b>IRAN, ISLAMIC REPUBLIC OF</b>			
	EXPERTS (M/M)	16/08	-7/22
	EQUIPMENT (CC)	867,713	35,830
	FELLOWSHIPS (CC)	57,465	-13,389
	FELLOWSHIPS (NCC)	0	2,000
<b>IRAQ</b>			
	EXPERTS (M/M)	44/20	-0/12
	EQUIPMENT (CC)	295,000	20,000
	FELLOWSHIPS (CC)	13,365	2,880
	FELLOWSHIPS (NCC)	13,395	12,255
	TRAINING COURSES (CC)	30,000	-30,000
<b>JAMAICA</b>			
	EXPERTS (M/M)	20/09	-9/05
	EQUIPMENT (CC)	351,700	4,800
	SUB-CONTRACTS (CC)	0	55,000
<b>JORDAN</b>			
	EXPERTS (M/M)	18/00	-4/09
	EQUIPMENT (CC)	215,000	-36,920
	EQUIPMENT (NCC)	60,000	-16,220
	FELLOWSHIPS (CC)	18,900	9,360
<b>KENYA</b>			
	EXPERTS (M/M)	90/20	-2/18
	EQUIPMENT (CC)	499,700	4,290
	FELLOWSHIPS (CC)	30,150	18,465

Recipient	Component	Existing approval	Net change
<b>KOREA, REPUBLIC OF</b>			
	EXPERTS (M/M)	128/15	-25/16
	EQUIPMENT (CC)	467,633	-72,834
	FELLOWSHIPS (CC)	74,700	11,780
	TRAINING COURSES (CC)	36,000	-1,084
<b>LIBYAN ARAB JAMAHIRIYA</b>			
	EXPERTS (M/M)	10/05	-2/19
	EQUIPMENT (CC)	149,700	-22,472
	EQUIPMENT (NCC)	45,400	7,176
	FELLOWSHIPS (CC)	81,065	-120
<b>MADAGASCAR</b>			
	EXPERTS (M/M)	47/00	-2/00
	EQUIPMENT (CC)	317,250	21,880
	FELLOWSHIPS (CC)	0	7,050
<b>MALAYSIA</b>			
	EXPERTS (M/M)	37/18	-5/20
	EQUIPMENT (CC)	711,840	54,273
	FELLOWSHIPS (CC)	88,000	-4,446
<b>MALI</b>			
	EXPERTS (M/M)	29/27	-2/06
	EQUIPMENT (CC)	200,450	11,708
	FELLOWSHIPS (CC)	4,400	-1,740
<b>MAURITIUS</b>			
	EXPERTS (M/M)	6/00	-2/00
	EQUIPMENT (NCC)	0	5,922
	FELLOWSHIPS (CC)	15,750	14,250
<b>MEXICO</b>			
	EXPERTS (M/M)	58/00	-13/28
	EQUIPMENT (CC)	267,530	-63,727
	FELLOWSHIPS (CC)	30,600	-12,600
	SUB-CONTRACTS (CC)	535,880	77,100
<b>MONGOLIA</b>			
	EXPERTS (M/M)	21/15	-0/23
	EQUIPMENT (CC)	530,000	17,927
	EQUIPMENT (NCC)	0	1,800
	FELLOWSHIPS (CC)	58,200	-22,173
	FELLOWSHIPS (NCC)	0	12,000
<b>MOROCCO</b>			
	EXPERTS (M/M)	63/22	-5/23
	EQUIPMENT (CC)	444,650	-22,400
	EQUIPMENT (NCC)	7,000	-7,000
	FELLOWSHIPS (CC)	13,850	9,600



Recipient	Component	Existing approval	Net change
<b>NICARAGUA</b>			
	EXPERTS (M/M)	14/00	-5/00
	EQUIPMENT (CC)	45,814	3,491
	EQUIPMENT (NCC)	120,000	67,195
	FELLOWSHIPS (CC)	77,850	-28,750
<b>NIGER</b>			
	EXPERTS (M/M)	3/25	-0/17
	EQUIPMENT (CC)	216,555	-2,979
	EQUIPMENT (NCC)	10,000	20,000
	FELLOWSHIPS (CC)	17,693	12,100
<b>NIGERIA</b>			
	EXPERTS (M/M)	53/15	-8/23
	EQUIPMENT (CC)	489,367	37,626
	EQUIPMENT (NCC)	65,000	-6,364
	FELLOWSHIPS (CC)	110,850	-55,470
<b>PAKISTAN</b>			
	EXPERTS (M/M)	52/07	-14/00
	EQUIPMENT (CC)	914,590	-6,980
	EQUIPMENT (NCC)	0	1,500
	FELLOWSHIPS (CC)	28,950	3,650
	SUB-CONTRACTS (CC)	4,750	-750
	SUB-CONTRACTS (NCC)	1,250	-40
<b>PANAMA</b>			
	EXPERTS (M/M)	37/07	-5/20
	EQUIPMENT (CC)	179,700	3,960
	FELLOWSHIPS (CC)	13,500	-13,500
<b>PARAGUAY</b>			
	EXPERTS (M/M)	9/00	-2/10
	EQUIPMENT (CC)	376,556	22,219
	EQUIPMENT (NCC)	24,925	-24,925
	FELLOWSHIPS (CC)	104,100	-34,050
<b>PERU</b>			
	EXPERTS (M/M)	148/13	-0/14
	EQUIPMENT (CC)	1,956,628	20,112
	FELLOWSHIPS (CC)	93,000	-45,296
	SUB-CONTRACTS (CC)	0	44,640
<b>PHILIPPINES</b>			
	EXPERTS (M/M)	95/11	-11/22
	EQUIPMENT (CC)	1,188,346	124,213
	FELLOWSHIPS (CC)	24,750	-8,900
	SUB-CONTRACTS (CC)	72,600	9,652

Recipient	Component	Existing approval	Net change
<b>POLAND</b>			
	EXPERTS (M/M)	17/15	-1/29
	EQUIPMENT (CC)	351,795	-2,154
	EQUIPMENT (NCC)	0	1,165,000
	FELLOWSHIPS (CC)	30,600	12,160
<b>PORTUGAL</b>			
	EXPERTS (M/M)	20/15	-5/04
	EQUIPMENT (CC)	817,440	21,989
	EQUIPMENT (NCC)	520,000	132,000
<b>ROMANIA</b>			
	EXPERTS (M/M)	1/21	0/21
	EQUIPMENT (NCC)	592,000	-115,089
	FELLOWSHIPS (CC)	21,000	-9,000
	FELLOWSHIPS (NCC)	0	5,742
<b>SAUDI ARABIA</b>			
	EXPERTS (M/M)	9/00	-5/00
	FELLOWSHIPS (CC)	0	14,250
<b>SENEGAL</b>			
	EXPERTS (M/M)	20/06	-4/18
	EQUIPMENT (CC)	121,000	14,100
<b>SIERRA LEONE</b>			
	EQUIPMENT (CC)	80,000	-1,056
<b>SINGAPORE</b>			
	EXPERTS (M/M)	6/00	-1/11
	EQUIPMENT (CC)	157,000	-1,452
<b>SRI LANKA</b>			
	EXPERTS (M/M)	38/00	-2/11
	EQUIPMENT (CC)	743,600	4,576
	EQUIPMENT (NCC)	76,700	-30,250
	FELLOWSHIPS (CC)	19,500	-7,800
<b>SUDAN</b>			
	EXPERTS (M/M)	27/00	1/14
	EQUIPMENT (CC)	895,596	135,423
	FELLOWSHIPS (CC)	75,150	13,210
	SUB-CONTRACTS (CC)	10,200	5,408
<b>SYRIAN ARAB REPUBLIC</b>			
	EXPERTS (M/M)	20/21	-3/03
	EQUIPMENT (CC)	399,247	14,100
	FELLOWSHIPS (CC)	27,900	-13,500
	TRAINING COURSES (CC)	42,000	-10,000

Recipient	Component	Existing approval	Net change
<b>THAILAND</b>			
	EXPERTS (M/M)	103/01	-9/23
	EQUIPMENT (CC)	2,172,106	42,561
	EQUIPMENT (NCC)	270,000	-3,000
	FELLOWSHIPS (CC)	120,200	18,925
<b>TUNISIA</b>			
	EXPERTS (M/M)	10/20	-2/09
	EQUIPMENT (CC)	539,545	-10,685
	EQUIPMENT (NCC)	10,000	-10,000
	FELLOWSHIPS (CC)	65,555	-43,527
<b>TURKEY</b>			
	EXPERTS (M/M)	97/09	-14/18
	EQUIPMENT (CC)	175,750	64,415
	FELLOWSHIPS (CC)	227,187	-42,234
	SUB-CONTRACTS (CC)	37,850	-20,075
<b>UGANDA</b>			
	EXPERTS (M/M)	20/00	-4/13
	EQUIPMENT (CC)	53,844	4,072
<b>UK (HONG KONG)</b>			
	EXPERTS (M/M)	2/00	-1/03
	EQUIPMENT (CC)	18,000	-6,569
<b>UNITED ARAB EMIRATES</b>			
	EXPERTS (M/M)	13/00	0/20
<b>UNITED REPUBLIC OF TANZANIA</b>			
	EXPERTS (M/M)	20/00	-2/28
	EQUIPMENT (CC)	676,069	-2,144
	EQUIPMENT (NCC)	0	6,000
<b>URUGUAY</b>			
	EXPERTS (M/M)	47/03	-9/05
	EQUIPMENT (CC)	600,878	48,444
	FELLOWSHIPS (CC)	60,930	-8,803
<b>VENEZUELA</b>			
	EXPERTS (M/M)	17/21	-4/15
	EQUIPMENT (CC)	63,525	25,200
	FELLOWSHIPS (CC)	39,900	-13,500
<b>VIET NAM</b>			
	EXPERTS (M/M)	38/19	-12/25
	EQUIPMENT (CC)	593,585	87,372
	EQUIPMENT (NCC)	1,667,000	217,963
	FELLOWSHIPS (NCC)	0	6,000

Recipient	Component	Existing approval	Net change
<b>YUGOSLAVIA</b>			
	EXPERTS (M/M)	74/27	-13/25
	EQUIPMENT (CC)	1,097,804	-10,382
	EQUIPMENT (NCC)	1,046,500	2,178,571
	FELLOWSHIPS (CC)	0	38,941
<b>ZAIRE</b>			
	EXPERTS (M/M)	42/05	-13/07
	EQUIPMENT (CC)	548,700	54,330
	FELLOWSHIPS (CC)	43,770	24,123
<b>ZAMBIA</b>			
	EXPERTS (M/M)	46/21	-5/23
	EQUIPMENT (CC)	606,100	102,945
<b>ZIMBABWE</b>			
	EXPERTS (M/M)	5/00	-2/00
	EQUIPMENT (CC)	46,000	2,000
<b>REGIONAL AFRICA</b>			
	EXPERTS (M/M)	37/00	8/24
	EQUIPMENT (CC)	778,000	-35,160
	FELLOWSHIPS (CC)	0	25,000
	TRAINING COURSES (CC)	106,000	-6,200
<b>REGIONAL ASIA AND PACIFIC</b>			
	EXPERTS (M/M)	12/00	2/18
	EQUIPMENT (CC)	471,700	-22,840
	EQUIPMENT (NCC)	0	5,000
	FELLOWSHIPS (CC)	0	5,000
<b>REGIONAL EUROPE</b>			
	EXPERTS (M/M)	58/17	5/23
	EQUIPMENT (CC)	72,600	-4,258
	EQUIPMENT (NCC)	35,000	-25,000
	FELLOWSHIPS (CC)	3,000	45,004
	TRAINING COURSES (CC)	204,500	45,900
	TRAINING COURSES (NCC)	0	21,800
	SUB-CONTRACTS (CC)	1,200,000	-33,047
<b>REGIONAL LATIN AMERICA</b>			
	EXPERTS (M/M)	444/01	76/28
	EQUIPMENT (CC)	1,095,167	23,404
	FELLOWSHIPS (CC)	204,350	-61,051
	TRAINING COURSES (CC)	1,171,513	315,146

Recipient	Component	Existing approval	Net change
<b>INTERREGIONAL</b>			
	EXPERTS (M/M)	535/07	5/04
	EQUIPMENT (CC)	870,700	-157,345
	EQUIPMENT (NCC)	599,146	6,400
	FELLOWSHIPS (CC)	0	1,700
	FELLOWSHIPS (NCC)	0	11,500
	TRAINING COURSES (CC)	41,750	25,100
	SUB-CONTRACTS (CC)	30,000	-30,000
<b>TOTALS</b>			
	EXPERTS (M/M)	3,662/10	-260/14
	EXPERTS (\$)	22,965,928	-2,625,931
	EXPERTS (\$) (NCC)	0	43,710
	EQUIPMENT (CC)	42,141,456	529,688
	EQUIPMENT (NCC)	12,423,521	4,027,035
	FELLOWSHIPS (CC)	3,131,944	-419,939
	FELLOWSHIPS (NCC)	13,395	95,747
	TRAINING COURSES (CC)	1,631,763	487,362
	TRAINING COURSES (NCC)	0	21,800
	SUB-CONTRACTS (CC)	2,026,280	403,993
	SUB-CONTRACTS (NCC)	1,250	-40
	TOTAL ALLOTTED	84,335,539	2,563,424

## ANNEX X

### NET REPHASINGS UNDERTAKEN DURING 1988

Recipient	Project component	Net allotted/ Net rephased	Current year	Rephased into 1989	Rephased into 1990-91	Rephased into 1992-93
<b>ALBANIA</b>						
	Experts (m/m)	Allotted Rephased	3/00 -1/00	- 1/00	- -	- -
<b>BANGLADESH</b>						
	Experts (m/m)	Allotted Rephased	9/07 -3/16	- 3/16	- -	- -
<b>BULGARIA</b>						
	Equipment (NCC)	Allotted Rephased	1,000,000 -85,000	120,000 85,000	- -	- -
<b>BURMA</b>						
	Experts (m/m)	Allotted Rephased	9/00 -2/15	- 2/15	- -	- -
	Equipment (CC)	Allotted Rephased	89,500 -8,000	- 8,000	- -	- -
<b>CHINA</b>						
	Experts (m/m)	Allotted Rephased	9/00 -1/15	- 1/15	- -	- -
<b>CZECHOSLOVAKIA</b>						
	Equipment (CC)	Allotted Rephased	50,000 -50,000	- 50,000	- -	- -
<b>GABON</b>						
	Experts (m/m)	Allotted Rephased	6/00 -3/26	- 3/26	- -	- -
<b>GREECE</b>						
	Equipment (CC)	Allotted Rephased	65,300 -11,400	- 11,400	- -	- -
<b>GUATEMALA</b>						
	Fellowships (CC)	Allotted Rephased	13,500 -13,500	- 13,500	- -	- -
<b>INDONESIA</b>						
	Experts (m/m)	Allotted Rephased	18/00 -7/00	- 7/00	- -	- -
<b>IRAN, I.R.</b>						
	Experts (m/m)	Allotted Rephased	7/05 -2/00	3/00 2/00	4/00 -	- -

Recipient	Project component	Net allotted/ Net rephased	Current year	Rephased into 1989	Rephased into 1990-91	Rephased into 1992-93
<b>IRAQ</b>						
	Experts (m/m)	Allotted	6/14	-	-	-
		Rephased	-4/00	4/00	-	-
	Equipment (CC)	Allotted	295,000	-	-	-
		Rephased	-50,000	50,000	-	-
<b>JORDAN</b>						
	Experts (m/m)	Allotted	19/05	2/00	-	-
		Rephased	-9/18	9/18	-	-
	Equipment (CC)	Allotted	305,700	-	-	-
		Rephased	-50,000	50,000	-	-
<b>KENYA</b>						
	Fellowships (CC)	Allotted	6,750	-	-	-
		Rephased	-6,750	6,750	-	-
<b>MADAGASCAR</b>						
	Fellowships (CC)	Allotted	6,750	-	-	-
		Rephased	-6,750	6,750	-	-
<b>MALAYSIA</b>						
	Experts (m/m)	Allotted	16/00	-	-	-
		Rephased	-6/00	6/00	-	-
<b>MONGOLIA</b>						
	Experts (m/m)	Allotted	5/00	1/00	-	-
		Rephased	-3/00	1/00	2/00	-
<b>PERU</b>						
	Experts (m/m)	Allotted	20/20	-	-	-
		Rephased	-3/00	3/00	-	-
	Fellowships (CC)	Allotted	14,000	-	-	-
		Rephased	-14,000	14,000	-	-
<b>PHILIPPINES</b>						
	Experts (m/m)	Allotted	23/00	6/00	-	-
		Rephased	-6/25	4/25	2/00	-
	Equipment (CC)	Allotted	110,000	20,000	-	-
		Rephased	-30,000	30,000	-	-
	Fellowships (CC)	Allotted	24,750	-	-	-
		Rephased	-11,250	11,250	-	-
<b>SAUDI ARABIA</b>						
	Experts (m/m)	Allotted	5/19	-	-	-
		Rephased	-2/00	2/00	-	-
<b>SENEGAL</b>						
	Fellowships (CC)	Allotted	13,500	-	-	-
		Rephased	-13,500	13,500	-	-

Recipient	Project component	Net allotted/ Net rephased	Current year	Rephased into 1989	Rephased into 1990-91	Rephased into 1992-93
<b>SRI LANKA</b>						
	Experts (m/m)	Allotted Rephased	19/00 -12/00	- 12/00	- -	- -
<b>SYRIAN A.R.</b>						
	Experts (m/m)	Allotted Rephased	6/00 -3/00	3/00 3/00	- -	- -
	Equipment (NCC)	Allotted Rephased	220,000 -220,000	- 220,000	- -	- -
<b>TURKEY</b>						
	Experts (m/m)	Allotted Rephased	4/10 -2/00	4/00 2/00	- -	- -
	Fellowships (CC)	Allotted Rephased	31,500 -13,350	4,800 13,350	- -	- -
<b>U.A. EMIRATES</b>						
	Experts (m/m)	Allotted Rephased	3/00 -3/00	5/00 3/00	5/00 -	- -
<b>VIET NAM</b>						
	Experts (m/m)	Allotted Rephased	8/07 -6/00	4/00 4/00	- 2/00	- -
<b>ZAMBIA</b>						
	Experts (m/m)	Allotted Rephased	27/19 -4/00	- 4/00	- -	- -
<b>INTERREGIONAL</b>						
	Experts (m/m)	Allotted Rephased	109/15 -5/00	- 5/00	- -	- -
<b>TOTALS</b>						
	Experts (m/m)	Allotted Rephased	335/01 -90/25	28/00 84/25	9/00 6/00	- -
	Experts (\$)	Allotted Rephased	2,329,275 -648,785	210,000 636,250	71,550 47,700	- -
	Equipment (CC)	Allotted Rephased	915,500 -199,400	20,000 199,400	- -	- -
	Equipment (NCC)	Allotted Rephased	1,220,000 -305,000	120,000 305,000	- -	- -
	Fellowships (CC)	Allotted Rephased	110,750 -79,100	4,800 79,100	- -	- -
	TOTAL ALLOTTED		4,575,525	354,800	71,550	-
	TOTAL REPHASED		-1,232,285	1,219,750	47,700	-