

THE ANNUAL REPORT FOR 1982

GC(XXVII)/684

Printed by the
International Atomic Energy Agency
in Austria - August 1983



INTERNATIONAL ATOMIC ENERGY AGENCY

THE ANNUAL REPORT FOR 1982

CONTENTS

	<u>Paragraphs</u>	<u>Page</u>
INTRODUCTION	1 - 63	7
THE AGENCY'S ACTIVITIES		
Technical co-operation	64 - 80	17
Nuclear power	81 - 113	27
Nuclear fuel cycle	114 - 155	34
Nuclear safety	156 - 188	40
Food and agriculture	189 - 212	45
Life sciences	213 - 230	49
Physical sciences	231 - 256	52
The Laboratories	257 - 283	55
International Centre for Theoretical Physics	284 - 302	58
Safeguards	303 - 322	61
Information and technical services	323 - 339	89
ADMINISTRATION	340 - 356	92

LIST OF ABBREVIATIONS

Agency	International Atomic Energy Agency
AGRIS	Agricultural Information System
CANDU	Canada deuterium-uranium (reactor)
CMEA	Council for Mutual Economic Assistance
EURATOM	European Atomic Energy Community
FAO	Food and Agriculture Organization of the United Nations
GCR	Gas-cooled reactor
GSF	Gesellschaft für Strahlen- und Umweltforschung (Federal Republic of Germany)
GW(e)	Gigawatt (electrical)
HTR	High-temperature reactor
HWR	Heavy-water reactor
IAEA	International Atomic Energy Agency
ILO	International Labour Organisation
IMO	International Maritime Organization
INTOR	International Tokamak Reactor
ISIS	Integrated Scientific Information System
LLNL	Lawrence Livermore National Laboratory
LMFBR	Liquid-metal fast breeder reactor
LWR	Light-water reactor
MOX	Mixed-oxide (fuel)
MW(e)	Megawatt (electrical)
NEA	Nuclear Energy Agency of the Organisation for Economic Co-operation and Development
NPT	Treaty on the Non-Proliferation of Nuclear Weapons
NUSS	Nuclear Safety Standards (programme)
PWR	Pressurized-water reactor
RCA	Regional Co-operative Agreement for Research, Development and Training Related to Nuclear Science and Technology (INFCIRC/167)
SQ	Significant Quantity
TCDC	Technical Co-operation among Developing Countries
Tlatelolco Treaty	Treaty for the Prohibition of Nuclear Weapons in Latin America

UNDP	United Nations Development Programme
UNEP	United Nations Environment Programme
UNESCO	United Nations Educational, Scientific and Cultural Organization
VIC	Vienna International Centre
WHO	World Health Organization

All sums of money are expressed in United States dollars

I N T R O D U C T I O N

General

1. 1982 was the twenty-fifth anniversary of the International Atomic Energy Agency, its Statute having entered into force on 29 July 1957.
2. To mark this event a major conference on nuclear power experience was held in Vienna from 13 to 17 September, and during the twenty-sixth regular session of the General Conference a Round Table meeting was convened on the role of nuclear power in overall energy planning.

Staff employed

3. During 1982 the Secretariat had an average of 601 staff members in the Professional and higher categories, 939 in the General Service category and 142 in the Maintenance and Operatives Service category - a total of 1683.
4. Compared with 1981, this represented an increase of 2.74% in the Professional and higher categories, an increase of 5.56% in the General Service category and a decrease of 5.33% in the Maintenance and Operatives Service category.

Financial resources

5. The Regular Budget total for 1982 was \$86 369 000, of which \$77 344 000 was to be financed from contributions made by Member States on the basis of the 1982 scale of assessment, \$3 710 000 from income from work for others and \$5 315 000 from other miscellaneous income.
6. The appropriation Sections were based on a rate of exchange of 15.50 Austrian schillings to the United States dollar. Throughout 1982, however, the mean United Nations operational rate of exchange was 16.83, resulting in a reduction of the estimated requirements by \$5 079 000.
7. The actual obligations in 1982 amounted to \$79 590 787, resulting in an unobligated balance of \$6 778 213, of which \$5 079 000 was due to currency exchange rate fluctuations. The total provisional budgetary surplus, including additional and special income and savings on the liquidation of prior years' obligations, amounted to \$10 455 606, compared with \$17 710 800 in 1981.
8. The target for voluntary contributions to the Technical Assistance Fund in 1982 was established at \$16 million. At the end of the year, \$14 896 675 had been pledged by Member States in support of the technical assistance programme. Actual obligations incurred during 1982 amounted to \$14 996 492. In addition, \$8 215 464 were made available in 1982 by Member States over and above their contributions to the Technical Assistance Fund; however, not all of this amount was applicable to the 1982 programme year.

Conference on Nuclear Power Experience

9. The Agency held a Conference on Nuclear Power Experience in September 1982 with the main purpose of summarizing the technical and economic experience gained from more than 2600 reactor-years of nuclear power plant operations. The Conference clearly demonstrated that nuclear power is a dependable and economic energy source, although it showed also that there are significant differences between countries as regards economic factors (primarily capital costs) and operating results. There are also significant differences in current programme development; some countries, such as France and the Soviet Union, have established policies whereby nuclear power will be a most important contributor to the national energy balance. This has permitted plant standardization, which leads to improved economics. In France, for example, capital cost increases have been limited to about 50% in constant money terms over a period of ten years, whereas in some other countries (for example the Federal Republic of Germany and the United States of America) capital costs have increased by about a factor of five during the same length of time.

10. Economic performance experience reported by a number of countries (Argentina, Canada, France, the Federal Republic of Germany, the Republic of Korea and the United States of America) showed, for nuclear plants, total generation costs ranging from 50% to 90% of those for coal-fired plants. However, recent trends indicate that the advantage of nuclear power generation in the United States of America is being eroded by large increases in the capital costs of nuclear plants.

11. The operating results achieved in some countries for a variety of reactor types can now be taken by the nuclear industry as a whole as performance goals with a firm basis of actual experience. The achievement of goals such as consistent load factors near or even above 80% in a number of base-load power plants will, however, depend on the existence of strong supporting infrastructures and a good regulatory climate.

Nuclear power

12. The present economic recession resulted in nearly all countries in lower-than-forecast energy demands. However, it is expected that the long-term demand for electricity will grow in practically all countries at a faster rate than the demand for primary energy. This trend will be accelerated by increasing urbanization, particularly in the developing countries, where the share of electricity in total energy may increase from 16% in 1982 to 26% at the end of the century. However, it is not expected that nuclear electricity generation in developing countries will exceed 7% of total electricity generation by the year 2000, compared to around 30% in industrialized countries.

13. It is expected that total installed nuclear capacity will be about 310 GW(e) in 1985, corresponding to 17% of the world's electricity generating capacity.

14. According to Agency information, 143 nuclear power plants with a total capacity of about 138 GW(e) are in the planning stage in 26 countries; in most cases, however, there are no firm commitments to start construction, owing to falls in the demand for electricity, policy uncertainties in some countries and financial constraints on utilities.

15. Despite the uncertainty of the present situation, a world-wide nuclear capacity of around 720 to 950 GW(e) - or 23% of total electricity generating capacity - is projected by the Agency for the year 2000. This means entering into commitments, within the next ten years, for an additional 400 GW(e) of nuclear capacity - or for investments totalling approximately US \$800 000 million.

16. In addition to high financing requirements, the projected expansion implies a viable nuclear industry. In 1982 the problems facing the nuclear industry varied from country to country. There was substantial overcapacity in the nuclear component manufacturing sectors in many countries (for example Canada, the Federal Republic of Germany, Spain and the United States of America), whereas some other countries (like India and the Soviet Union) were having to expand their industrial capacity in order to meet the demands of their nuclear power programmes.

17. There was some progress as regards the reduction of licensing and construction times towards those already achieved in France and Japan. In the Federal Republic of Germany the recently introduced "convoy" procedure (whereby several plants with one standardized design are taken together through the licensing process) has led to a simplification of licensing.

Nuclear safety

18. In 1982 the Agency produced its first annual nuclear safety review, which outlined world-wide trends in nuclear safety and described related Agency activities. It was concluded in the review that no dramatic change in the approach to nuclear safety appears necessary in the light of recent research, development and operating experience. Priority should be given to consolidating safety requirements, improving the techniques available for safety assessment and ensuring that the safety level in nuclear facilities remains high throughout their lifetime. Emphasis is shifting from design aspects to construction and operation, and also to an increase in emergency response capabilities, but accident prevention retains the highest priority.

19. The Agency's expanding nuclear safety programme continued to be directed principally at encouraging international co-operation through the promotion of information exchange, promoting implementation of the NUSS codes and guides and of the Basic Safety Standards for Radiological Protection, and generally assisting Member States by organizing safety missions.

20. Plans were started for making available teams of experts to assist the regulatory bodies of countries with small nuclear power programmes in performing operational reviews of their power plants.

21. Work continued on the development of procedures for national incident reporting systems. In addition, the Agency continued its efforts to organize an international system for the exchange of information on abnormal events significant for safety which occur at nuclear power plants in Member States. It is hoped that, when information on the lessons learned from such events is widely disseminated, the repetition of such events can be avoided or, if such events still occur, operators will know how to cope with them.

Nuclear fuel cycle

22. The Agency continued to co-operate with NEA in the fields of uranium geology, uranium resources and exploration and uranium extraction techniques.

23. Work continued on improvements in reactor fuel performance, and a guidebook on quality control in water reactor fuel technology was completed.

Spent fuel management

24. A major study on international spent fuel management was completed by a group of experts convened in 1979 to examine the potential for international co-operation in the management of spent fuel and to assist the Agency in defining what role it might play in solving problems created by growing accumulations of spent fuel.

25. Data on amounts of spent fuel show that by the year 2000, approximately 200 000 metric tons of spent fuel will have been generated world-wide. However, there is reasonably good assurance that until 1990 adequate provision will exist for dealing with spent fuel through either interim storage or reprocessing.

26. The group concluded that arrangements similar to those provided for in various existing bilateral and multinational agreements in the nuclear field would be feasible for spent fuel management.

27. The technical aspects of spent fuel management were the subject of increasing attention, with the publication of the results of a survey of spent fuel management experience world-wide.

Waste management

28. An Agency/WHO booklet entitled "Nuclear Power, the Environment and Man" was generally well received.

29. Since the United Nations Conference on the Human Environment, held in Stockholm in 1972, which focused the world's attention on the importance of protecting and conserving the environment, new knowledge has been gained about the effects of the use of nuclear energy.

30. The Agency's major conference on waste management, in Seattle, United States of America, in May 1983 should provide the nuclear industry with an opportunity of getting across the message that nuclear waste disposal is a soluble problem and good progress with it is being made. This should enhance the environmental advantages of nuclear power over other widely available sources of energy.

31. Although waste management is still a national responsibility, there is a need for regional and international approaches (for example the question of limiting the number of final disposal sites). Since some countries do not favour the sea disposal route, research and development work in other methods of low-level waste disposal should be pursued energetically.

32. An event of importance for the development of a permanent repository for high-level commercial waste in the United States of America was the approval of a waste management bill by the United States Congress in December.

International plutonium storage

33. An expert group on international plutonium storage completed its work in October and submitted a report to the Director General.

Committee on Assurances of Supply

34. The Committee on Assurances of Supply (CAS) has continued its consideration of the question of assurance of supplies of nuclear material, equipment and technology and fuel cycle services in accordance with mutually acceptable considerations of non-proliferation, and of the Agency's role and responsibilities thereto. This has been an issue not only between industrially advanced and developing countries but also among industrially advanced countries. The Committee on Assurances of Supply is trying to achieve a consensus among the different viewpoints.

35. CAS, established by the Board of Governors in June 1980, held its fifth and sixth sessions in April and October 1982 respectively. At these sessions, CAS continued its consideration of "Principles of international co-operation in the field of nuclear energy in accordance with the mandate of the Committee on Assurances of Supply" and "Emergency and back-up mechanisms". In addition, CAS started considering a third topic, "Revision mechanisms".

36. In June 1982, at the request of the Board of Governors, a report by CAS on its first five sessions was transmitted by the Director General to the Chairman of the Preparatory Committee of the United Nations Conference for the Promotion of International Co-operation in the Peaceful Uses of Nuclear Energy.

Controlled nuclear fusion

37. Recognizing that controlled nuclear fusion could be an effectively inexhaustible energy source, the Agency continued to encourage the international exchange of scientific and technical information on fusion research and other forms of international co-operation in this field. The latest of the Agency's biennial conferences on plasma physics and controlled nuclear fusion research was held in Baltimore, United States of America.

Technical co-operation and the application of nuclear techniques

38. Total resources available in support of Agency technical co-operation activities amounted to \$27.6 million in 1982, which is 12.5% more than the \$24.5 million received for such activities in 1981. On the utilization side, the volume of assistance provided exceeded \$23 million, which represents an increase of 9.8% over the level of 1981, when assistance valued at nearly \$21 million was provided.

39. As in 1980 and 1981, more than half of the total resources came from Member States' voluntary contributions to the Technical Assistance and Co-operation Fund and from miscellaneous income to the Fund. The Fund's share of total resources in 1981 was 52.7%; in 1982 it rose to 58.0%. This development was not due entirely to higher voluntary contributions in response to annual increases in the target for such contributions to the Fund; it was also due to a steady decline in UNDP resources. These resources, which totalled \$6 million in 1979, declined to \$4.6 million in 1982; during the same period the Fund's resources increased from \$8.8 million to \$16 million.

40. Another factor contributing to the Fund's prominent position in the resource profile in 1982 was a decline in assistance in kind; its value fell by 10.6%, from \$2.8 million in 1981, to \$2.5 million in 1982. As potential donors have expressed interest in assisting some footnote-a/ projects[1] through in-kind contributions, it is anticipated that this resource component will regain its former importance, provided the major donors do not further reduce their offers of in-kind assistance. In 1981 and 1982, 95% of these resources were used for training, mainly through fellowships.

41. By the end of 1982, about 80% of the funds needed for making footnote-a/ projects under the 1981 programme operational were on hand, as were 72% of the funds needed for making the 1982 footnote-a/ projects operational. In all, 65% of the extrabudgetary funds spent in 1982 were designated for the implementation of these projects; the share of Special Programme projects rose to 21%, and training accounted for the remaining 14%.

42. At 963 man-months, the volume of expert services delivered in 1982 was 13% more than the volume delivered in 1981. The number of experts and lecturers rose by 39% to 642 and the number of assignments rose by 59% to 932. In 1982, 31% of the assignments were carried out by Agency staff members.

43. In both 1981 and 1982, more than \$1 million was expended in support of regional and interregional projects (excluding study tours, training courses and workshops). Whereas 92% of these expenditures were met from UNDP funds in 1981, UNDP's share dropped to 36% in 1982 and the share financed from Agency

[1] A footnote-a/ project is a project that has been approved by the Agency's Board of Governors for implementation but for which assistance is provided only in substitution for other assistance which it is planned to provide to the Member State in question or if additional contributions from Member States of funds or services become available.

resources increased to 64%, made up of 40% from the Technical Assistance and Co-operation Fund and 24% from extrabudgetary funds. UNDP funds and extrabudgetary funds were used for a regional project on industrial applications of isotopes and radiation technology under the RCA. Regular Programme funds were used for a growing number of regional and interregional projects that, in many cases, hold promise of serving as a more efficient vehicle for the provision of assistance than numerous country projects in the same subjects.

44. During 1982, financial support was provided from a number of sources for activities being carried out under RCA, to which 13 Member States in Asia and the Pacific region are parties. Within the framework of RCA the following programmes were under way:

Funds obligated in 1982

Programme	Source of funds			Total
	Regular Budget	Extra-budgetary	UNDP	
Animal production	45 591	-	-	45 591
Food preservation	-	55 556 ^{a/}	-	55 556
Plant breeding	97 728	-	-	97 728
Radiation biology	15 000	-	-	15 000
Impact of mineral substances on man and the environment	12 300	-	-	12 300
Maintenance of medical instrumentation	40 800	-	-	40 800
Physics	4 000	-	-	4 000
Isotope hydrology	20 000	49 187 ^{b/}	-	69 187
Industrial applications of isotopes and radiation technology	-	106 258 ^{a/b/}	918 839	1 025 097
Total	235 419	211 001	918 839	1 365 259

^{a/} Met from cash contributions made by the Government of Japan.

^{b/} Met from cash contributions made by the Government of Australia.

45. In meeting its objective to assist its developing Member States in the peaceful uses of nuclear energy, the Agency conducts a programme of work in nuclear power planning and implementation including economic assessments to determine the appropriate role of nuclear power within the national energy plans of developing countries. These assessments involve three major types of activity: the development of appropriate methodologies specifically adapted to developing countries; training courses on energy and power planning techniques; and energy and nuclear power planning studies in co-operation with requesting Member States.

46. The use of nuclear technology, particularly radioisotope and radiation applications, can make an important contribution in support of agricultural, medical and industrial activities in many developing countries, and the Agency's programmes in the fields of food and agriculture, health and hydrology are substantially oriented towards the needs of such countries.

47. Discussion continued on the feasibility of establishing a regional co-operative agreement for Latin America on the lines of the RCA, which has been functioning successfully for ten years in Asia and the Pacific region.

48. The IAEA/WHO Network of Secondary Standard Dosimetry Laboratories continued to receive support; by the end of 1982 it comprised 45 member laboratories and was supported by 12 large national laboratories and five international organizations.

49. An agreement on the use of an integrated pest management programme involving the sterile-insect technique as the principal suppression component for the eradication of the Mediterranean fruit fly was concluded by the Agency and Egypt in October. The estimated cost of the programme is \$19 320 000, of which the Agency is responsible for \$11 320 000 - covered by contributions from Italy (\$10 320 000) and Austria (\$1 000 000) - and Egypt for \$8 000 000. The Egyptian Government will provide the local staff and land necessary for the mass-rearing and auxiliary facilities.

International Centre for Theoretical Physics

50. In recognition of the needs of physicists from developing countries, several Member States provided substantial further support for the Trieste Centre. In particular, the Government of Italy constructed a new building for the Centre and agreed to increase its contribution to a level of \$3 million per annum over the forthcoming four-year period.

International Laboratory of Marine Radioactivity

51. Following an offer by the Monegasque authorities in March 1982, interim arrangements have been made for the provision of additional space for the Laboratory. A draft seat agreement is being prepared, to take effect in July 1984, covering long-term arrangements for new premises located in the Principality of Monaco.

52. With the co-operation and financial support of UNESCO, UNEP, the Mediterranean Action Plan and the Kuwait Action Plan, the Laboratory continued to undertake investigations of non-nuclear pollutants.

Safeguards

53. In June 1982, at the United Nations General Assembly's second special session on disarmament, the Minister for Foreign Affairs of the Soviet Union stated that his country was willing to place some of its peaceful nuclear installations under Agency safeguards. When a safeguards agreement to give effect to the Soviet Union's offer has been concluded, voluntary-offer safeguards agreements will be in force between the Agency and the four nuclear-weapon States that are Members of the Agency.

54. In 1982, as in previous years, the Secretariat, in carrying out the safeguards programme of the Agency, did not detect any anomaly which would indicate the diversion of a significant amount of safeguarded nuclear material - or the misuse of facilities or equipment subject to safeguards under certain agreements - for the manufacture of any nuclear weapon, or for any other military purpose, or for the manufacture of any other nuclear explosive device, or for purposes unknown[2]. With the exception of two cases where the Agency was unable to draw conclusions[3], the Secretariat considers it reasonable to conclude that the nuclear material under Agency safeguards in 1982 remained in peaceful nuclear activities or was otherwise adequately accounted for.

Credentials of the delegate of Israel

55. At the twenty-sixth regular session of the General Conference, in September, the credentials of the delegate of Israel were not accepted following a number of roll-call votes. Following the General Conference, the United States of America conducted a reassessment of its support for and participation in the Agency.

United Nations Conference for the Promotion of International Co-operation in the Peaceful Uses of Nuclear Energy

56. The Preparatory Committee for the United Nations Conference for the Promotion of International Co-operation in the Peaceful Uses of Nuclear Energy held two meetings in June and October/November 1982. At the thirty-seventh session of the United Nations General Assembly, the Assembly received a report from the Secretary-General of the Conference. It decided that the Preparatory Committee should meet twice during 1983; to take suitable decisions in regard to the date of the Conference in the light of the results of the Preparatory Committee meeting to be held early in 1983. It reiterated the aim of the Conference; it invited the Agency to contribute to the Conference in accordance with the relevant General Assembly resolution and with its Statute; and it urged States to co-operate actively in the preparation and holding of

[2] In the case of voluntary-offer agreements with nuclear-weapon (NW) States nuclear material to which safeguards were applied was not withdrawn from safeguards except in conformity with these agreements.

[3] In these two cases there has been significant progress since the end of 1982 and the technical safeguards measures implemented at the plants in question now enable the Agency once more to perform effective verification.

the Conference. In response to the United Nations General Assembly's invitation to the Agency to contribute to the Conference in accordance with its responsibilities under its Statute, the Agency provided working papers on relevant Agency activities for the second and third sessions of the Preparatory Committee for the Conference.

57. In addition, the Agency started work on the preparation of papers for the Conference itself.

Matters of special interest to the Agency discussed by the General Assembly of the United Nations

58. At its thirty-seventh session, the General Assembly discussed several matters of interest to the Agency. In the debate on the Agency's annual report for 1981, delegations drew particular attention to the Agency's responsibilities for technical assistance and safeguards and expressed their appreciation of and support for the Agency's work. In its resolution on the report, the General Assembly urged Member States to strive for effective and harmonious international co-operation in carrying out the work of the Agency and to implement strictly its Statute; also, it affirmed its confidence in the role of the Agency in the application of nuclear energy for peaceful purposes.

59. A number of resolutions dealing with arms control and disarmament issues were adopted by the General Assembly.

60. The General Assembly adopted resolutions directed towards the establishment of nuclear-weapon-free zones in the Middle East and in South Asia. Also, it decided to make a further study of nuclear-weapon-free zones following a comprehensive study made in 1974/75. The Agency was invited to contribute.

61. The Secretary-General was requested by the General Assembly to prepare, with the assistance of a group of experts, a comprehensive study on the consequences of Israel's armed attack against the Iraqi nuclear installations devoted to peaceful purposes and to submit that study to the General Assembly at its thirty-eighth session.

62. The General Assembly welcomed the approval by the General Conference of Namibia, represented by the United Nations Council for Namibia, for membership of the Agency.[4]

63. In resolutions on South Africa, the General Assembly demanded that South Africa terminate its development of the capability to produce nuclear weapons and submit all its nuclear installations to inspection by the Agency. Also, it requested the Agency to refrain from extending to South Africa any facilities which might assist it in its nuclear plans and, in particular, to exclude South Africa from all its technical working groups.

[4] Namibia became a Member of the Agency on 17 February 1983.

THE AGENCY'S ACTIVITIES

TECHNICAL CO-OPERATION

64. The format used in this chapter for describing the Agency's technical co-operation activities was introduced last year.[5] It is based on the categories of resources - namely, the Technical Assistance and Co-operation Fund, extrabudgetary funds, assistance in kind and UNDP funds - from which Agency technical assistance is provided. Figure 1 shows the development of resources in these categories over the period 1973-82.

65. Total resources for Agency technical co-operation activities continued to rise in 1982; however, the increase of 12.5% over the 1981 level was considerably lower than the increase (17%) registered in 1981. In all, \$27.6 million was available for technical co-operation activities in 1982, as compared with \$24.5 million in 1981.

66. The volume of assistance actually delivered was 9.8% higher in 1982 than in the previous year: \$23 005 700 in 1982 against \$20 960 300 in 1981. As in the case of resources, the rate of increase in the assistance provided in 1982 was lower than the rate for 1981 (11.3%). A comparison, by source, of resources and expenditures in respect of 1981 and 1982 is given in Figure 2.

[5] See documents GC(XXVI)/664 (The Annual Report for 1981) and GC(XXVI)/INF/206 (The Agency's Technical Co-operation Activities in 1981).

FIGURE 1

RESOURCES AVAILABLE FOR
AGENCY TECHNICAL CO-OPERATION PROGRAMMES, 1973 - 1982

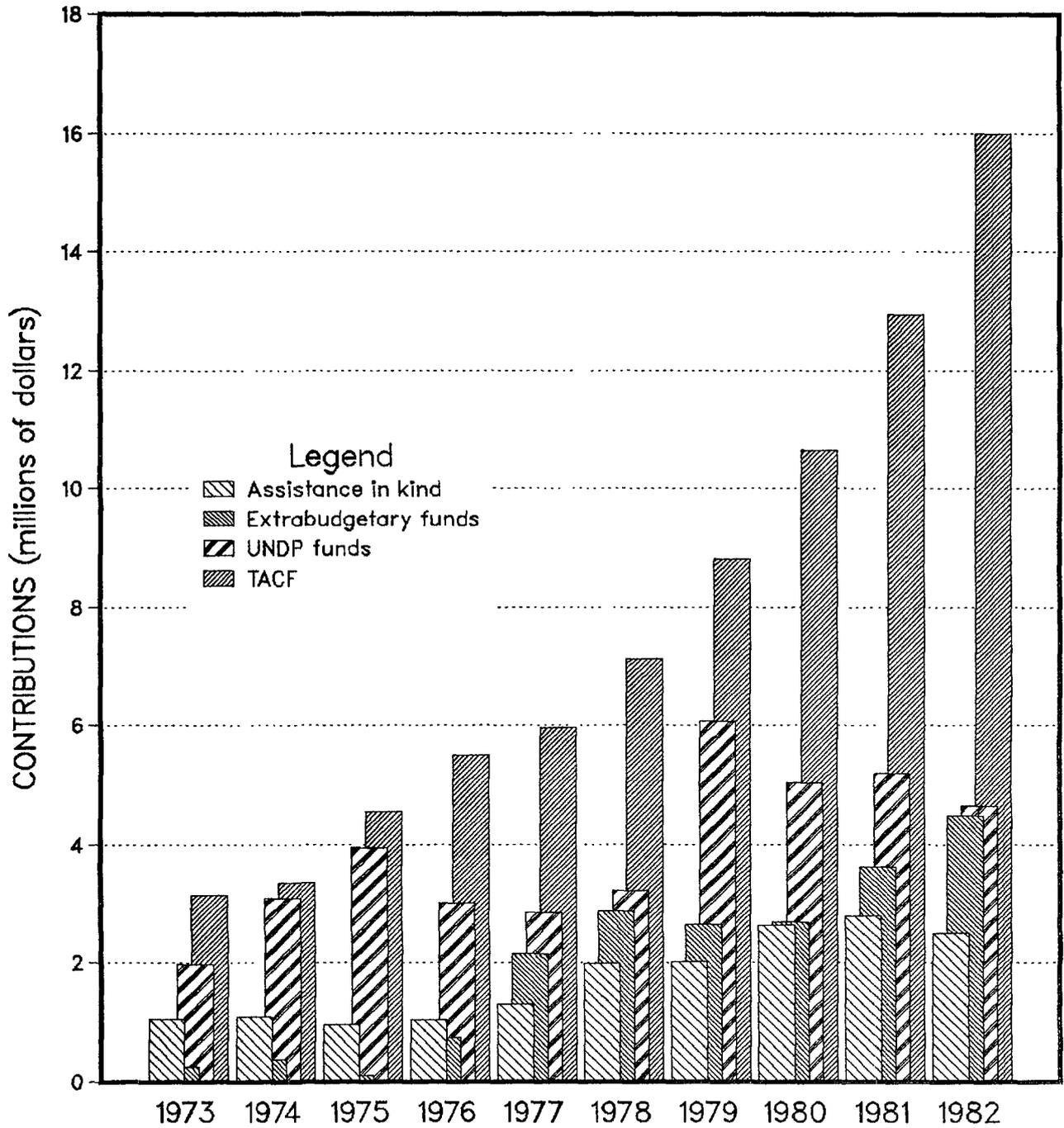
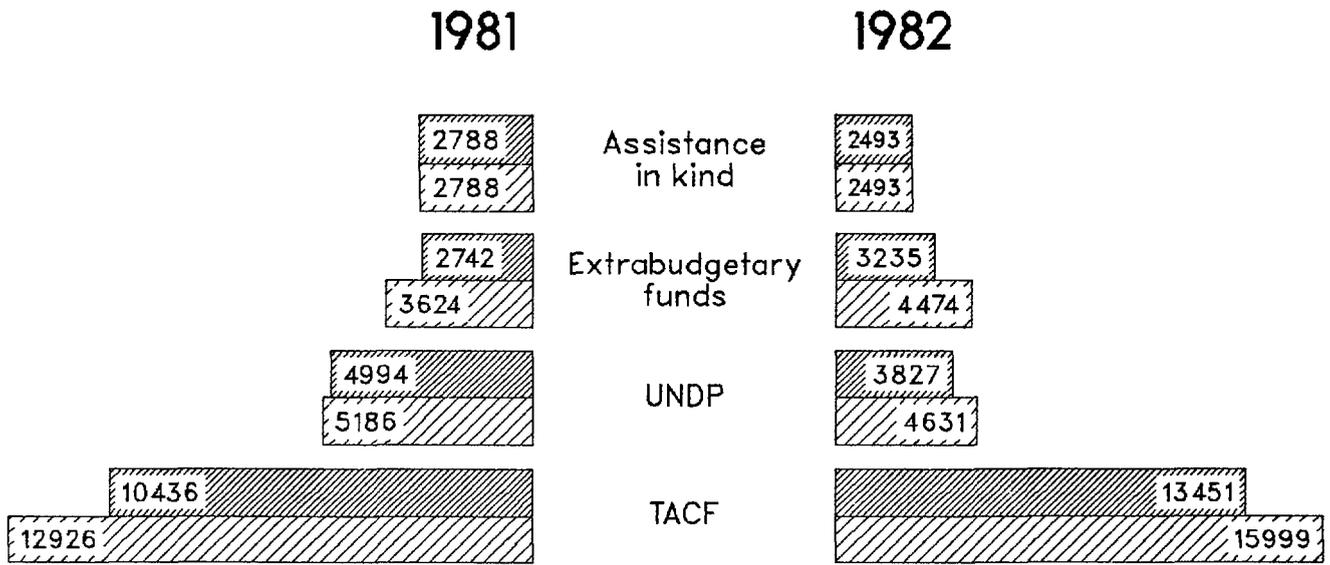


FIGURE 2

COMPOSITION OF AGENCY
TECHNICAL CO-OPERATION RESOURCES AND EXPENDITURES
(in thousands of dollars)



Legend

-  Expenditures
-  Resources

1. Technical Assistance and Co-operation Fund (TACF)

67(i) Resources: These consist of voluntary contributions of Member States towards the annual target and miscellaneous income (interest earnings and payments of assessed programme costs by recipient countries). Income to the Fund rose by 23.8%, from \$12 926 000 in 1981 to \$15 999 000 in 1982, which is somewhat higher than the 21.6% increase in 1981 over 1980. Whereas pledges for only 90.6% of the 1981 target had been made by the end of 1981 (pledges made in 1982 raised the percentage to 92.5%), 93.1% of the 1982 target had been met by 31 December 1982. It is hoped that countries which have not already done so will still make pledges for 1982.

67(ii) Expenditures: At \$13 450 800, the assistance provided from the Fund was \$3 million, or 28.9%, higher than in 1981 (\$10 436 500). Whereas TACF expenditures accounted for 50% of the assistance provided in 1981, they accounted for 58.5% in 1982, owing to a decline in the assistance provided in kind and from UNDP funds. Commitments for assistance still to be delivered at year-end, such as equipment on order, were, at \$11 099 000, 16.2% higher in 1982 than in 1981, for which the corresponding total was \$9 553 000. Earmarkings for approved assistance still to be implemented - for example, equipment not yet ordered - were also higher at the end of 1982 (\$9 046 000) than they were one year earlier (\$7 301 000).

2. Extrabudgetary funds

68(i) Resources: Together with the TACF, this category of resources for Agency technical co-operation has shown the greatest growth potential. The funds received from 15 countries in support of 1982 activities totalled \$4 473 800, which is 23.4% more than the \$3 624 700 received for 1981 from 12 countries. The major donors were the United States (30.6%), the Federal Republic of Germany (15.2%), Italy (14.6%) and Sweden (12.6%); smaller shares were contributed by Australia, Belgium, Finland, France, Japan, Saudia Arabia and the United Kingdom. Also reflected in the above totals are "funds in trust" received from developing countries to finance assistance for themselves. Not included are funds made available by Australia and Japan for RCA research projects and \$4.9 million in contributions received in 1982 in support of projects scheduled for implementation beginning in 1983.

68(ii) Expenditures: The assistance provided from these funds in 1982 amounted to \$3 235 300, which is 18% more than in 1981, when expenditures from extrabudgetary funds totalled \$2 742 100. As the major donors of these funds often make their contributions during the second half of the year, the rate of implementation tends to be quite low, in that year, but increases considerably (to approximately 40%) in the following year. During 1982, it was possible to commence work on 37 of the 46 footnote-a/ projects that had been approved as part of the 1982 programme. About 65% of all extrabudgetary funds went for expert services and equipment in support of Regular Programme (mainly footnote-a/) projects, 21% for Special Programme projects and the balance for fellowships and training courses. The share devoted to Special Programme projects is expected to increase in 1983.

3. Assistance in kind

69(i) Resources: Some of the countries that traditionally provide assistance in kind made smaller contributions in 1982. The volume of resources provided under this heading in 1982 dropped to \$2 493 000 from \$2 788 000 in 1981. The major donors were the United States (\$1 296 500), the Federal Republic of Germany (\$235 400) and the United Kingdom (\$106 400). As potential donors have indicated interest in providing assistance in kind for footnote-a/ projects, it is hoped that there will be a healthy increase in such resources in the near future.

69(ii) Expenditures: Whereas 57 countries received assistance in kind in 1981, only 48 countries did so in 1982. The in-kind programme dates from the time of the Agency's first technical co-operation activities (1958), when almost all of this assistance was provided in the form of fellowship training. In 1982, fellowships accounted for 84.7% of the estimated \$2 493 000 made available by donors; the corresponding share for 1981 was 91.5%. In 1982, the next largest share, 10.7%, went for training courses (3.7% in 1981). The balance, 4.6%, was used for providing expert services and equipment. In both 1981 and 1982, 95% of all in-kind resources went towards training of one kind or another.

4. UNDP

70(i) Resources: UNDP's share of the total resources at the Agency's disposal declined from 24% in 1980 to 21% in 1981 and to slightly less than 17% in 1982; the figure for 1981 was \$5.2 million and that for 1982 was \$4.6 million. The \$4.6 million in 1982 included approximately \$200 000 from the United Nations Financing System for Science and Technology for Development, which is administered by UNDP. These funds were designated for a training course on solid state physics in Ghana and a workshop on monsoon dynamics and forecasting in Bangladesh, both of which were conducted by the International Centre for Theoretical Physics, Trieste. In addition, the Agency is associated with UNIDO in a joint regional project in Latin America aimed at promoting non-destructive testing technology in industry; this developed out of a UNDP-financed large-scale project executed by the Agency in Argentina.

70(ii) Expenditures: As expected, owing to UNDP's deteriorating resource situation and to resulting curtailments in project budgets, the volume of assistance provided from UNDP funds declined from \$5 893 400 in 1980 to \$4 993 700 in 1981 and, at \$3 826 600 in 1982, represented only 16.6% of the total assistance provided by the Agency. Whereas the Agency was executing 36 UNDP-financed projects in 1981, only 28 country projects, plus one regional and one interregional project, were being implemented by the Agency in 1982. In view of UNDP's resource difficulties, it is not expected that delivery of project inputs from this component will increase in 1983. Australia and Japan, however, provided extrabudgetary and in-kind contributions to the value of \$618 050 in 1982 in connection with a UNDP-assisted RCA project on industrial applications of isotopes and radiation technology. This amount is not reflected in the totals given above.

Distribution of the assistance provided

71. The utilization of resources placed at the Agency's disposal (in 1981 and 1982 and for the period 1973-82) is shown in Figure 3 by field of activity and type. The average shares represented by experts, equipment and fellowships (and other training) over the past ten years were 27.9%, 43.2% and 28.9% respectively. Although only minor fluctuations have occurred in recent years in the share of expert services, there has been a steady decline in the share of training (31.8% in 1980, 28.8% in 1981 and 25.4% in 1982), accompanied by a sustained upward trend in the proportion of assistance provided as equipment and supplies (43.5% in 1980, 47.1% in 1981 and 50.0% in 1982). With regard to the fields of activity in which Agency assistance has been provided, agriculture and nuclear engineering and technology continue to rank most prominently; however, nuclear physics, prospecting, mining and processing of nuclear materials, and general atomic energy (particularly assistance to centres and laboratories dedicated to applied nuclear research) have gradually been growing in importance. The three latter fields combined accounted for nearly 35% of total programme delivery in 1982; their share in 1981 was 24%.

72. Figure 4 shows the distribution of assistance by field of activity and region for 1982. Agriculture was by far the most important field in the African region (also in 1981); it was also the leading field in two other regions and for interregional activities. Overall, 25.2% of the assistance went to Asia and the Pacific region, followed by Latin America (24.8%), Africa (22.0%) and Europe (14.8%); the corresponding shares in 1981 were 24.7%, 27.9%, 23.1% and 13.2% respectively.

73. Figure 5 shows the distribution of assistance provided in 1982 by source and by region. Africa's share of the total programme delivered in 1982 was above its long-term average share; however, its share of the assistance delivered from TACF resources was lower than its long-term average share. The distribution of UNDP resources showed a different pattern from that of the Agency's own resources, almost 40% of the former going to Latin America. If only Agency resources are considered, however, Latin America's share is 21.8%.

General observations

74. It is encouraging to note that the number of countries that offered to finance footnote-a/ projects under the Regular Programme doubled, from five in 1981 to ten in 1982. Contributions received in respect of such projects in 1981-82 represented 80% of the funds needed for 1981 and 72% of those required for 1982. It is hoped that additional offers will be received for the remaining unfunded footnote-a/ projects approved in 1982.

75. With the growth of the Agency's technical co-operation programmes it has become increasingly difficult for the Secretariat to recruit sufficient experts, and in recent years the number of man-months delivered had been declining. This trend was arrested in 1981, and 963 man-months, or 13% more than the 851 man-months delivered in 1981, were provided in 1982. The number

of individual assignments increased more dramatically: 642 experts and lecturers undertook 932 assignments in 1982, as compared with 461 experts and lecturers on 587 assignments in 1981. In spite of the increase in man-months provided in 1982, the number of man-months still to be delivered by year-end increased, by 3.7%, to 1197.

76. The greater number of assignments carried out in 1982 was due to three factors: (i) increased efforts on the part of the Secretariat to recruit experts, (ii) a greater number of lecturer assignments (there were 100 more in 1982 than in 1981), and (iii) the fact that staff members undertook more expert and lecturer assignments (31% of the total).

77. Responsibility for the quality of Agency technical assistance devolves on all Departments of the Secretariat. The success of the programme in transferring nuclear technology and techniques to recipient countries depends to a large extent on "technical-substantive" Departments.

78. These Departments are intimately involved in all aspects of technical co-operation: programming, project identification and formulation, implementation, monitoring and evaluation. In 1982, some 90 Agency staff members, in addition to their other duties, had responsibility for numerous technical co-operation projects in their capacity as "technical officers". Outside the Department of Technical Co-operation, the Departments most intimately involved in technical co-operation activities are the Department of Research and Isotopes and the Department of Nuclear Energy and Safety. Many of the staff members in these Departments undertake technical co-operation assignments. In terms of man-months, roughly 60% of all such assignments were carried out by staff of the Department of Research and Isotopes and about 25% by staff of the Department of Nuclear Energy and Safety.

79. Good progress is being made in the implementation of the new computerized technical co-operation monitoring system. The modules for Regular and Special Programme projects, which became available in mid-1981, were improved further in 1982. The improved versions of these modules are designed to ensure more effective financial control - especially of extrabudgetary funds, which already exceed 20 in number. In addition, the Fellowship Programme module became operational in 1982. Establishing the fellowship data base involved the laborious and time-consuming conversion of data compiled under a previous system going back to 1958; the project was led by a systems analyst made available cost-free by the United States of America. Extensive use is being made of the improved monitoring system both inside and outside the Department of Technical Co-operation. During 1983 work will begin on the UNDP module, with the training course module to follow in 1984.

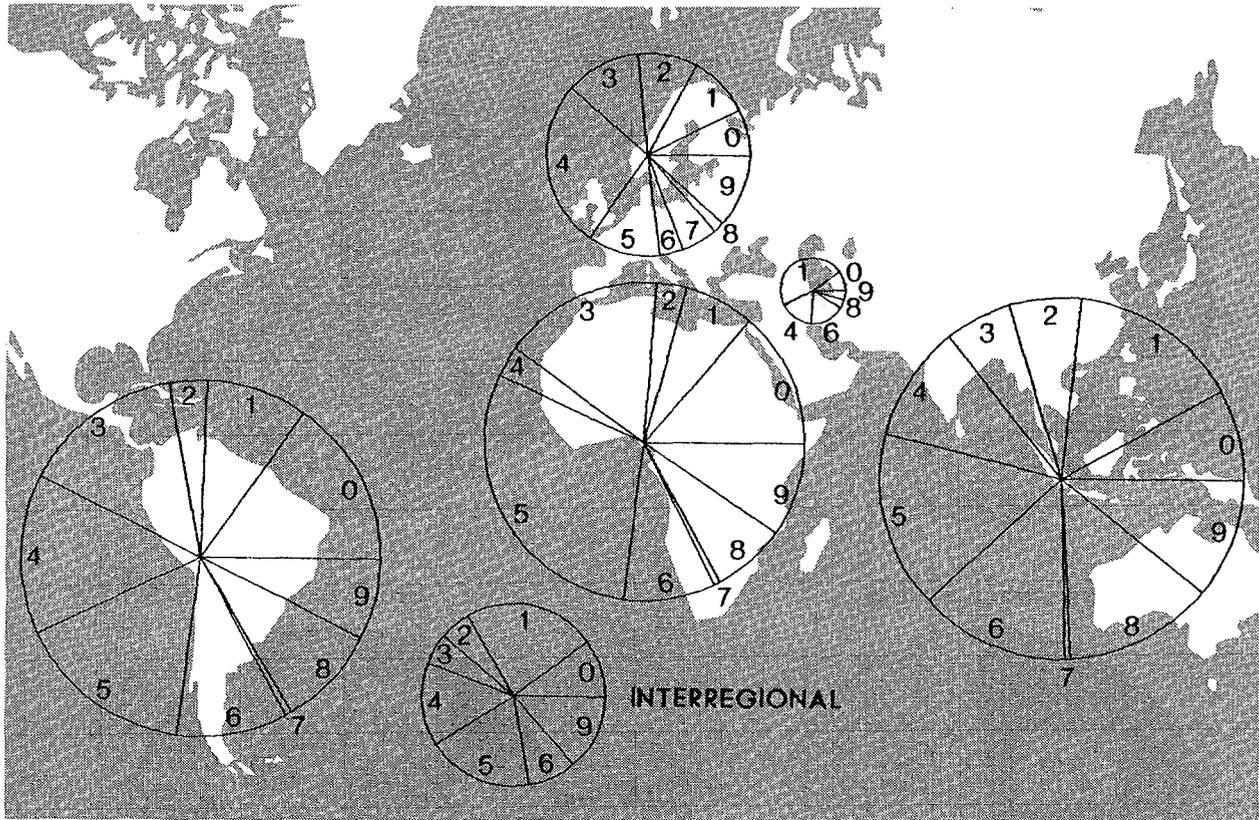
80. Another activity of interest to donors and recipients alike is evaluation of the technical assistance provided by the Agency. In 1982, the tasks of the new Evaluation Unit, established in the Department of Technical

Co-operation, were defined and the recruitment of two persons at the Professional level was initiated. It is expected that the Unit will produce its first report in time for the session of the Board of Governors' Technical Assistance and Co-operation Committee late in 1983. Among the subjects to be dealt with in that report are the findings of an evaluation survey of Agency fellows who completed their training in the United States of America during the period 1975-79. The survey is being carried out for the Agency by the Division of Educational Programmes of Argonne National Laboratory. A special questionnaire was drawn up for the survey, covering such topics as the former fellow's present responsibilities, the degree to which the training objectives were met, the use made of the training in the home country, the relevance of the training to the country's development programme, and how the knowledge gained was shared with others in the home country.

FIGURE 3
UTILIZATION OF RESOURCES: 1981, 1982 AND 1973-1982
(in thousands of dollars)

Field of activity	Year	Experts	Equipment	Fellow-	Share of total		
		\$	\$	ships	\$	%	
General atomic energy development	1981	508.5	849.0	273.0	1 630.5	7.8	
	1982	746.9	1 610.6	258.2	2 615.7	11.4	
Nuclear physics	1981	304.7	993.4	308.8	1 606.9	7.7	
	1982	444.7	1 031.1	540.3	2 016.1	12.2	
Nuclear chemistry	1981	34.9	365.6	322.7	723.2	3.4	
	1982	83.9	774.3	342.0	1 200.2	5.2	
Prospecting, mining and processing of nuclear materials	1981	1 063.6	568.7	217.1	1 849.4	8.8	
	1982	1 094.8	1 192.0	270.5	2 557.3	11.1	
Nuclear engineering and technology	1981	673.7	1 544.1	893.5	3 111.3	14.8	
	1982	520.1	1 501.2	989.7	3 011.0	13.1	
Application of isotopes and radiation in	Agriculture	1981	1 095.4	2 315.2	1 450.0	4 860.6	23.2
		1982	1 331.3	1 689.2	1 252.1	4 272.6	18.6
	Medicine	1981	309.1	900.3	1 342.3	2 551.7	12.2
		1982	325.7	952.5	928.8	2 207.0	9.6
	Biology	1981	56.5	127.6	177.0	361.1	1.7
		1982	27.2	105.3	153.6	286.1	1.2
	Industry and Hydrology	1981	359.8	1 324.1	285.4	1 969.3	9.4
		1982	457.7	1 003.8	263.2	1 724.7	7.5
Safety in nuclear energy	1981	643.2	877.5	775.6	2 296.3	11.0	
	1982	624.2	850.3	840.5	2 315.0	10.1	
Total assistance	1981	5 049.4	9 865.5	6 045.4	20 960.3	100.0	
	1982	5 656.5	11 510.3	5 838.9	23 005.7	100.0	
Ten-year total	1973- 1982	36 350.7	56 415.0	37 662.5	130 428.2	100.0	

FIGURE 4
DISTRIBUTION OF TECHNICAL CO-OPERATION INPUTS BY FIELD AND REGION, 1982

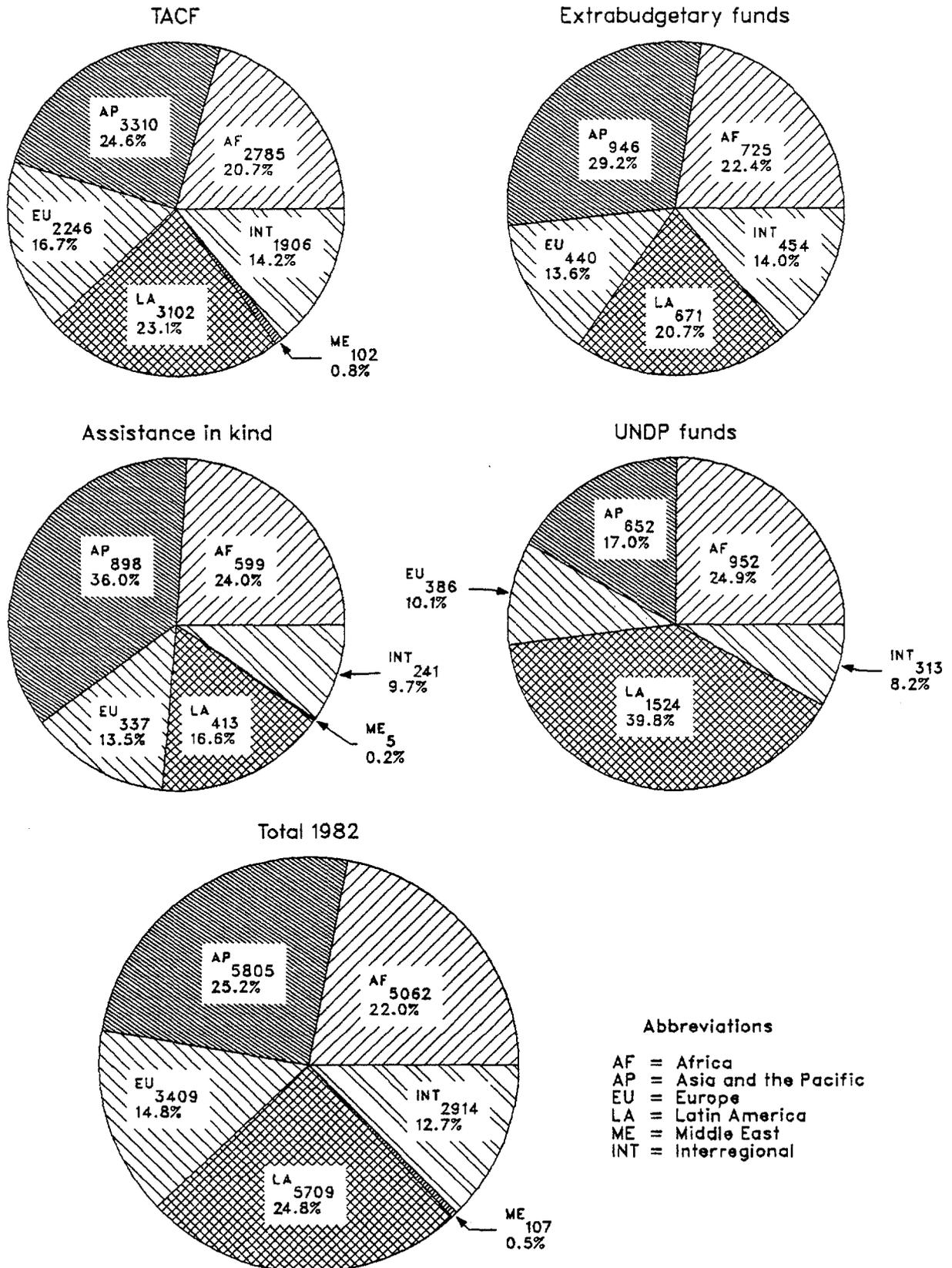


SUMMARY
(in thousand of dollars)

Field of activity	Africa \$	Asia and the Pacific \$	Europe \$	Latin America \$	Middle East \$	Inter- regional \$	All regions \$
0 - General atomic energy development	700.9	473.2	257.1	878.2	10.5	295.8	2 615.7
1 - Nuclear physics	358.7	872.4	331.6	525.1	50.9	677.4	2 816.1
2 - Nuclear chemistry	154.7	369.7	322.0	194.2	0.9	158.7	1 200.2
3 - Prospecting, mining and processing of nuclear materials	815.2	340.0	408.6	835.2	-	158.3	2 557.3
4 - Nuclear engineering and technology	160.0	657.5	913.7	829.4	17.0	433.4	3 011.0
Application of isotopes and radiation in	5 - Agriculture	1 506.2	917.0	395.6	-	546.8	4 272.6
	6 - Medicine	473.5	766.5	124.6	574.2	18.0	2 207.0
	7 - Biology	29.2	29.3	198.4	29.2	-	286.1
	8 - Industry and Hydrology	379.1	757.8	59.0	524.4	4.4	-
9 - Safety in nuclear energy	484.1	621.9	398.8	411.8	5.1	393.3	2 315.0
Total	5 061.6	5 805.3	3 409.4	5 708.7	106.8	2 913.9	23 005.7

FIGURE 5

DISTRIBUTION OF TECHNICAL CO-OPERATION EXPENDITURES
BY SOURCE AND REGION: 1982
(in thousands of dollars)



NUCLEAR POWER

General

81. In 1982, as in the years just preceding it, the pace of development of nuclear power differed between Member States; the advances made in France, Japan and the Soviet Union contrasted with the continuing slow growth of nuclear power in developing countries and in some other developed countries.

82. The Agency's activities were therefore oriented towards the specific situations in different Member States. The most important activity was the development of improved tools and guidance for nuclear power planning and for strengthening nuclear power programme infrastructures. Also, more emphasis was placed on detailed economic analyses of nuclear power and of its competitiveness with other electricity generation systems.

83. Statistical data collected by the Agency indicate that the total installed nuclear power capacity in the world increased by 11.7% during 1982, reaching 173 GW(e) or around 8% of the world's total electricity generating capacity by the end of the year. Nuclear plants accounted for around 10% of the world's total electricity production during the year. Twenty-one new nuclear plants with a total capacity of 18 GW(e) were connected to grids in 12 countries, in two of which (Brazil and Hungary) they were the first nuclear power plants.

84. The status of nuclear power programmes at the end of 1982 is summarized in Table 1, which shows 24 Agency Member States with 293 nuclear power plants in operation. Nine of these are developing countries (Argentina, Brazil, Bulgaria, Czechoslovakia, Hungary, India, the Republic of Korea, Pakistan and Yugoslavia), with 17 nuclear power plants (6.5 GW(e)) in operation and 26 (16.5 GW(e)) under construction. Four other developing countries (Cuba, Mexico, the Philippines and Romania) had six plants (3.7 GW(e)) under construction.

85. The data base for the Agency's two annual reports on power reactor operating experience ("Operating Experience with Nuclear Power Plants in Member States" and "Performance Analysis Report" - see paragraphs B.2.5/2-4 of document GC(XXVI)/666 - was transferred to the computer and, with the help of the Power Reactor Information System (PRIS) thus created, the Agency is now in a position to analyse in detail the operating records of nuclear power plants and of major components; this is important from the point of view of improving the safety, reliability and economics of nuclear power plants.

Table 1
Nuclear power reactors in operation
and under construction
at the end of 1982

Country ^{a/}	In operation		Under construction ^{b/}		Electricity supplied by nuclear power reactors in 1982 ^{c/}	
	Number of units	Total MW(e)	Number of units	Total MW(e)	TW·h(e)	% Share of total
Argentina	1	335	2	1 291	1.75	4.85
Belgium	6	3 473	2	2 012	14.52	30.29
Brazil	1	626	2	2 490	0.05	0.04
Bulgaria	4	1 632	2	1 906	9.93	29.16
Canada	14	7 278	9	6 310	39.99	10.55
Cuba			1	408		
Czechoslovakia	2	762	6	2 520	n.a. ^{*/}	
Finland	4	2 156			15.83	42.42
France	32	23 355	27	30 200	103.06	38.70
German Democratic Republic	5	1 694			n.a.	
Germany, Federal Republic of	15	9 831	12	13 155	60.05	17.40
Hungary	1	408	3	1 224	n.a.	
India	4	809	4	880	2.06	
Italy	3	1 232	3	1 999	6.39	3.63
Japan	25	16 587	11	10 289	100.01	19.45
Korea, Republic of	2	1 193	7	6 227	3.55	7.33
Mexico			2	1 308		
Netherlands	2	501			3.70	6.43
Pakistan	1	125			0.07	0.40
Philippines			1	620		
Romania			2	1 320		
South Africa			2	1 842		
Spain	4	1 973	11	10 156	8.54	7.78
Sweden	10	7 330	2	2 100	37.30	38.65
Switzerland	4	1 940	1	942	14.39	27.58
Union of Soviet Socialist Republics	40	17 219	31	30 486	n.a.	
United Kingdom	32	6 462	10	6 052	38.73	15.21
United States of America	80	62 376	61	67 228	279.46	12.10
Yugoslavia	1	632			n.a.	
World total^{d/}	293	169 929	214	202 966		

^{a/} An entry in this column does not imply the expression of any opinion whatsoever on the part of the Secretariat concerning the legal status of any country or territory or of its authorities, or concerning the delimitation of its frontiers.

^{b/} Construction in Austria and the Islamic Republic of Iran has been interrupted and plants in these countries are not included.

^{c/} Nuclear electricity production figures received officially by the Agency by 1 March 1983.

^{d/} In the territory of Taiwan, there were four units with a total capacity of 3110 MW(e) in operation and two units with a total capacity of 1814 MW(e) under construction.

^{*/} n.a. - not available.

86. Work continued on assessing the future of advanced nuclear systems likely to play an important role in the next century, with further exchanges of information on R&D efforts.

International Conference on Nuclear Power Experience

87. The main purpose of this Conference, held in Vienna from 13 to 17 September 1982, was to examine the major aspects of the technical and economic experience gained with nuclear power and its fuel cycle and to point to the major lessons to be drawn for the future. The information presented was generally of high quality and much of the Conference proceedings will be of lasting value as a reference source. The Conference was attended by almost 1200 participants from 63 countries, including 37 developing countries, and 20 organizations.

Energy demand analysis and nuclear power planning

88. The Agency strengthened its interdependent activities concerned with helping developing Member States to assess the appropriate role of nuclear energy within their national energy plans: (a) the development of methodologies suited to developing countries; (b) carrying out nuclear power planning studies; and (c) conducting training courses on energy planning and nuclear power planning with the help of - inter alia - methodologies developed by the Agency.

89. One of the most important determinants of the need for nuclear power is the future demand for electrical energy. However, in carrying out nuclear power planning studies jointly with developing countries the Agency has found that in many cases national electricity demand forecasts are the weakest link. Accordingly, the Agency continued its work on procedures for ensuring internal consistency between the national electricity demand forecasts and the overall development objectives and possibilities in developing countries thinking of embarking on nuclear power programmes. In particular, improvements were made to the computerized Model for the Analysis of Energy Demand (MAED)[6]. The results of a nuclear power planning study carried out in Algeria using MAED and the WASP (Wien Automatic System Planning Package) methodology for planning the expansion of electric power generation systems[1] were presented to the Algerian authorities in the spring of 1982 (they are being published by the Agency in 1983).

90. The first draft of a guidebook on planning the expansion of electric power generation systems and a users' manual for MAED were completed.

91. A joint World Bank/Agency electricity planning advisory team visited Jordan in October and an Agency nuclear power planning advisory team visited Colombia in November.

[6] GC(XXVI)/664, para. 84.

92. The fifth session of an interregional training course on "Energy Planning in Developing Countries with Special Attention to Nuclear Energy"[7] was held in Jakarta from 24 May to 12 June. It was followed by one week of technical visits in the Philippines.

93. Late in 1982 a group of consultants assisted in the final planning of a co-ordinated research programme aimed at a more comprehensive assessment of the economic merits of nuclear power in the context of the overall economic development of developing countries. It is expected that the programme will lead to improved procedures for assessing the role of nuclear energy within the energy planning of developing countries.

94. The Agency continued its work aimed at improving methodologies for projecting energy, electricity and nuclear power demands at the global, regional and country level[8] and thereby providing a framework for decisions about nuclear power development. A technical committee on such methodologies met in November, with the participation of experts from various United Nations agencies and other international organizations; a primary objective of this technical committee is improved co-ordination and information exchange between the participating organizations.

95. A booklet entitled "Energy, Electricity and Nuclear Power Estimates for the Period up to 2000" (Reference Data Series No. 1), prepared using data from the Energy and Economic Data Bank[9] and the Agency's demand projection methodologies, was published in September.

Economics of nuclear power

96. A draft report on the economic status of nuclear power reactors in relation to fossil-fired power plants in a number of Member States was modified in the light of recommendations made by an advisory group in December 1981. Data from the modified draft report, presented during the International Conference on Nuclear Power Experience, show that in industrial countries world-wide nuclear power has a significant economic advantage over oil-fired electricity generation and that in most industrial countries it also has a significant economic advantage over coal-fired electricity generation.

Power reactors of proven types

(a) Support to nuclear power programme development

97. Activities aimed at preparing and strengthening the infrastructures needed for nuclear power programmes in developing Member States continued during 1982. These consisted of the preparation of guidebooks, advisory missions to Member States, and nuclear power training courses.

[7] The title of this course was previously "The Role of Nuclear Energy within a National Energy Plan" - see GC(XXVI)/664, para. 85.

[8] GC(XXVI)/664, para. 85.

[9] Ibid., para. 79.

98. The preparation of a series of guidebooks on planning for nuclear power and on specific aspects of nuclear power plants continued. A "Guidebook on the Introduction of Nuclear Power"[10] was published (Technical Review Series No. 217), replacing an earlier publication entitled "Steps to Nuclear Power". Advisory groups met to review Secretariat-prepared drafts of guidebooks on nuclear power project management, bid specifications for nuclear power plants and the qualification and training of nuclear power plant operations staff, which are scheduled for completion in 1983-84. The sales figures for guidebooks in this series were high and frequent reference was being made to some of the guidebooks in power plant bid requests.

99. With the help of consultants work started on guides concerning education requirements for the graduate engineers and the technicians needed in nuclear power programmes in developing countries.

100. Two missions visited Egypt to advise on manpower development, and missions visited Mexico and Portugal to advise on the application of the quality assurance (QA) code and guides produced under the Agency's NUSS programme.

101. A general course entitled "Introduction to Nuclear Power" was organized by the Agency at its Headquarters and specialized courses on "Pressure Boundary Integrity" and "Nuclear Power Plant Control and Instrumentation" were held in the United States and the Federal Republic of Germany respectively. By the end of 1982, almost 1300 trainees from 59 developing countries had participated in Agency nuclear power training courses since the inception of the programme of courses in 1975.

102. A preliminary evaluation was initiated of existing design concepts for Small and Medium Power Reactors (SMPRs)[11] and advice was given to Bangladesh in connection with an SMPR study.

103. Three UNDP projects concerned with nuclear manpower development and 18 Agency technical co-operation projects were supported.

[10] GC(XXVI)/664, para. 90. A guidebook on the interaction of grid characteristics with the design and performance of nuclear power plants was published (as Technical Reports Series No. 224) in January 1983 and the the manuscript was completed in 1982 of a guidebook on nuclear power plant control and instrumentation.

[11] GC(XXVI)/664, para. 94.

(b) Technology of nuclear power plants of proven types

104. With the creation in 1982 of the Power Reactor Information System (PRIS)[12] it became possible to produce the Agency's two annual reports on power reactor operating experience directly from the computer, with consequent substantial time-saving. Requests began to be received from Member States for assistance, through the PRIS, in analysing particular data on the operation of their power reactors. Considerable interest in the PRIS was shown at the International Conference on Nuclear Power Experience.

105. An advisory group reviewed the formats of the annual reports on power reactor operating experience and suggested modifications designed to make the reports more useful.

106. A symposium on nuclear power plant control and instrumentation brought out the great progress which is being made in the use of computers in control and instrumentation systems and the resulting potential for improvements in the man-machine interface. A symposium on the water chemistry and corrosion problems of nuclear reactor systems and components highlighted the uncertainties which persist in determining satisfactory water chemistry regimes despite some evident convergence in the results of the considerable amount of research work going on.

107. The International Working Groups on Nuclear Power Plant Control and Instrumentation (IWGNPPCI) and on Reliability of Reactor Pressure Components (IWGRRPC) formulated recommendations on information exchange and research co-ordination over the next few years through specialists' meetings, which have proved to be a useful mechanism in enabling the Agency to respond quickly when the need for an international exchange of information on some highly specialized topic is identified. One specialists' meeting - on nuclear power plant repair procedures - was held in 1982.

108. With the work on the NUSS documents relating to QA nearing completion,[13] attention was increasingly paid to the application of these documents through advisory missions and with the help of practical manuals; preparatory work was done on two such manuals, one on QA programme auditing and the other on QA level selection. The Agency's QA code and guides are being used by ten countries.

[12] See para. 85 above.

[13] GC(XXVI)/664, para. 92.

Advanced nuclear power reactor technology

109. The International Working Group on Fast Reactors (IWGFR) reviewed Member States' programmes for developing advanced nuclear power reactor systems and concluded that these programmes, which are directed mainly towards the demonstration and commercialization of such systems, were continuing as planned, without major changes. Also, the IWGFR organized three specialists' meetings on safety-related topics of current interest: one on sodium combustion phenomena, the prevention and mitigation of sodium fires, and the effects of sodium fires on plant structures; one on the thermal stratification of sodium in LMFBR systems and the associated effects on plant components; and one on advances in the analysis and design of structural components.

110. A compilation was begun of the parameters of LMFBRs in operation, under construction or planned in Member States, and work continued on a technical report on the status of fast breeder reactor development throughout the world.

111. The International Working Group on Gas-Cooled Reactors (IWGGCR) reviewed current development programmes, and specialists' meetings were held on gas-cooled reactor core instrumentation and on gas-cooled reactor seismic design problems. The IWGGCR completed a draft report on the status of and prospects for gas-cooled reactors, and a summary paper on the world-wide status of HTR development was presented at the International Conference on Nuclear Power Experience.

112. A group of consultants considered the objectives of, and ways of conducting, a study of the potential contribution of advanced reactors to the world's energy supply and recommended country-specific or regional case studies as a means of examining the long-term consequences of the introduction of such reactors; another group of consultants advised on economic guidelines for the study and on the systems analysis methods to be used in it.

113. A course on reactor physics aspects of safety analysis, for scientists from developing countries, was organized with the help of the International Centre for Theoretical Physics in Trieste. A co-ordinated research programme continued on the preparation of computer codes suitable for the small or medium-size computers typically available in developing countries for in-core fuel management.[14]

[14] GC(XXVI)/664, para. 99.

NUCLEAR FUEL CYCLE

General

114. During 1982 the uranium industry continued to experience a depressed phase[15] owing to earlier over-optimistic projections of nuclear power growth, and uranium prices dropped further, to the range \$44-50/kg uranium (\$17-20/lb U₃O₈) under short-term contracts.

115. On the other hand, while there were major cut-backs in exploration and unprofitable mines and mills were closed, the opening of new mines and mills at low-cost deposits in Canada and Australia continued. Despite the overall downward trend, in the light of demand forecasts it is expected that there will be a recovery in uranium exploration and production.

116. The Agency continued to co-operate with NEA, through - inter alia - the Steering Group and Working Party on Uranium Resources[16] and working groups on uranium exploration techniques and uranium extraction, in making the data on uranium resources and production more complete and consistent. The latest NEA/IAEA report on "Uranium Resources, Production and Demand" ("Red Book") was published early in 1982.

117. In the area of fuel performance and technology emphasis continued to be placed on water reactor fuel reliability and safety and on improving fuel utilization. A guidebook on quality control in water reactor fuel technology was completed, publication taking place in January 1983.

118. The technical aspects of spent fuel management received further attention. Altogether over 20 000 MTHM (metric tons of heavy metal) of spent LWR and HWR fuel have accumulated in various parts of the world and, as only a small fraction of it is being reprocessed, spent fuel storage is now a matter of concern in many countries. The results of a survey of spent fuel storage experience was published and a guidebook is being finalized.[17]

119. The Agency continued to assign high priority to its activities in the field of radioactive waste management, as the acceptance of nuclear power depends to a large extent on the safe disposal of radioactive wastes. Several documents were issued in - inter alia - the Safety Series and the Technical Reports Series. Together with WHO, the Agency published a booklet entitled "Nuclear Power, the Environment and Man" which was generally well received.

120. In the United States of America, a comprehensive waste management bill which had been under consideration for several years and which will permit the development of a permanent repository for high-level commercial nuclear waste, passed Congress in December 1982 (it was signed by the United States President in January 1983). It is expected that this development will provide an impetus for R&D work in the waste management field.

[15] GC(XXVI)/664, para. 101.

[16] Ibid. para. 105.

[17] Ibid., para. 113.

Nuclear materials and fuel cycle technology

Uranium resources and production

121. The NEA/IAEA Steering Group and Working Party on Uranium Resources held two meetings and started work on a further "Red Book", scheduled for completion towards the end of 1983. A manual on the projection of uranium production capacities was prepared and work started on reassessing estimates of speculative uranium resources in the light of new information; the reassessment will be completed in 1983 and the results included in the next "Red Book".

122. The Working Group on Uranium Geology[18] met twice to consider six major geological types of uranium deposit, drawing on the results of the exploration and research efforts of the past decade; a report on sandstone deposits was completed.

123. The NEA/IAEA group of experts on R&D in the field of uranium exploration techniques[19] sponsored a symposium held in Paris in June 1982, where over 60 papers were presented.

124. As a result of the activities of this expert group and of the Working Group on Uranium Geology, a technical report entitled "Vein-Type and Similar Uranium Deposits in Rocks Younger than Proterozoic" and a manual entitled "Borehole Logging for Uranium Exploration" were issued. Reports on "Geology and Metallogenesis of Uranium Deposits of South America" and "Uranium Exploration in Tropical Wet Environments" were prepared for publication.

125. Through the International Uranium Geology Information System (INTURGEO) additional data were gathered on world uranium deposits and their geological environments. A graphics system for data presentation was developed and assistance was provided to Member States interested in setting up geological information systems.

126. The NEA/IAEA Working Group on Uranium Extraction completed a report (for issue in 1983) on the status of uranium ore processing technology.

127. Assistance was provided to the Department of Technical Co-operation in connection with uranium projects in over 30 countries. Ten missions to nine countries were carried out and a training course in uranium exploration methods was conducted.

Fuel performance and technology

128. The activities in this area focused on water reactor fuel and were carried out under the guidance of the International Working Group on Water Reactor Fuel Performance and Technology (IWGFPT).

[18] GC(XXVI)/664, para. 106.

[19] Ibid., para. 108.

129. Specialists' meetings were held on "Water Reactor Fuel Element Computer Modelling" and "Power Ramping and Cycling Behaviour of Water Reactor Fuel", and the proceedings of specialists' meetings held in 1981 on "Influence of Power Reactor Water Chemistry on Fuel Cladding Reliability" and "Examination of Fuel Assembly for Water-Cooled Power Reactors" were issued.

130. A guidebook on "Quality Control of Water Reactor Fuel" was printed for issue in January 1983.[20]

131. Under a co-ordinated research programme on computer modelling of the behaviour of water reactor fuels[21], in which eleven countries are participating, a report was prepared for publication in 1983. The first stage of a co-ordinated research programme on fuel element cladding interactions with water coolant in power reactors[21] was completed and a report prepared for publication in 1983. The second stage, dealing with analytical methods and techniques for monitoring the water chemistry of and corrosion processes in reactor circuits, was initiated.

132. Plans for a co-ordinated research programme on examination and documentation methodologies for water reactor fuels were drawn up by the IWGFPT.

133. Preparations were started for holding an international seminar on heavy water fuel technology, to take place in Argentina in June/July 1983.

134. A report on the utilization of particle fuels in different advanced reactor concepts was completed.

135. Assistance was provided to the Department of Technical Co-operation in connection with projects involving reactor materials and nuclear fuel fabrication. Two missions were carried out to Romania in connection with a UNDP project under way there.

Spent fuel management

136. The collection and evaluation of information on short-, medium- and long-term options for the storage of spent fuel and on transportation, reprocessing and recycling technologies continued and a review of world experience of water reactor spent fuel storage in water-filled pools[22] was published (Technical Reports Series No. 2). Work continued on a guidebook on spent fuel storage[23], the draft of which was prepared. It will be the first Agency publication on this subject which is important for many Member States developing nuclear power programmes.

[20] GC(XXVI)/664, para. 110.

[21] Ibid., para. 111.

[22] Ibid., para. 112.

[23] Ibid., para. 113.

137. A co-ordinated research programme on the behaviour of spent fuel assemblies during extended storage continued[24], with preparations being made for a research co-ordination meeting in 1983. Also, preparations started for a seminar on technical and environmental aspects of spent fuel management, being held in Madrid in September 1983.

138. Preliminary evaluations of recent developments in reprocessing and recycling technologies were made and possible Agency programmes in this field were discussed at a consultants' meeting. On the basis of recommendations made by the consultants, the preparation of a reference book on this subject was initiated.

139. A compilation of operational data on nuclear fuel cycle facilities, including fuel fabrication, spent fuel storage and reprocessing facilities, was completed.

Waste management

140. The Agency continued to attach great importance to the exchange of information, the publication of reports and the furthering of co-ordinated research on waste management questions. In response to several requests, arrangements were initiated for publication of the Agency/WHO booklet "Nuclear Power, the Environment and Man" (see para. 119 above) - already published in English - in French, Russian and Spanish as well.

141. A training course and study tour were organized covering facilities in Belgium, Czechoslovakia, France, the Federal Republic of Germany and Hungary. There were participants from 17 countries.

142. Preparations started for a major Agency conference on radioactive waste management (scheduled for May 1983 in Seattle, United States of America), with two sessions of an advisory group created for this purpose.

Handling and treatment of radioactive wastes

143. Two symposia, a seminar, two research co-ordination meetings, and a number of technical committee and advisory group meetings were held on a range of subjects including the handling and treatment of solid, liquid and gaseous low- and intermediate-level wastes, high-level and alpha-bearing wastes, and decontamination and decommissioning wastes.

144. Among the material on waste management questions issued during 1982 were: (a) Radioactive Waste Management Glossary[24] (IAEA-TECDOC 264); (b) Waste Management Research Abstracts No. 13; (c) IAEA Provisional Code of Practice on Management of Radioactive Waste from Nuclear Power Plants (IAEA-TECDOC 272); (d) Control of Semivolatile Radionuclides in Gaseous Effluents at Nuclear Facilities[25] (Technical Reports Series No. 220); and (e) Management of Wastes from Uranium Mining and Milling (symposium proceedings).

[24] GC(XXVI)/664, para. 117.

[25] Ibid., para. 116.

145. Reports on the following subjects were completed: (a) The Management of Wastes from Nuclear Power Plants; (b) The Conditioning of Waste for Storage and Disposal; (c) The Decommissioning of Nuclear Facilities (Decontamination, Disassembly and Waste Management); (d) Characteristics of Radioactive Wastes Conditioned for Storage and Disposal (Guidance for the Development of Waste Acceptance Criteria); (e) The Handling and Storage of Conditioned High-Level Wastes; and (f) The Handling of Tritium-Contaminated Effluents and Wastes.

146. In addition, preparatory work was done on reports concerning the treatment of low- and intermediate-level liquid waste, the retention of gaseous radionuclides during normal and accident conditions at nuclear power plants, and the testing and in-plant monitoring of off-gas cleaning systems at nuclear facilities.

147. Co-ordinated research programmes[26] continued on the treatment of spent ion-exchange resins, the evaluation of solidified high-level waste forms, and particulate filter testing.

148. Assistance was provided to the Department of Technical Co-operation in connection with two projects.

149. The Technical Review Committee on Underground Disposal, which meets once each year, reviewed the work done by the Agency and formulated recommendations on a variety of subjects of interest for the Agency's future activities relating to underground disposal. The design, construction, operation, shut-down and surveillance of shallow-ground depositories and the basic criteria for underground disposal of radioactive wastes are the subjects of other technical committee and advisory group meetings.

Underground disposal of radioactive waste

150. Two reports were published in 1982: (a) Site Investigations for Repositories for Solid Radioactive Wastes in Deep, Continental Geological Formations (Technical Reports Series No. 215); and (b) Site Investigations for Repositories for Solid Radioactive Wastes in Shallow Ground (Technical Reports Series No. 216).[27]

151. Reports on the following subjects were completed: (a) The Disposal of Low- and Intermediate-Level Radioactive Solid Wastes in Rock Cavities; (b) Concepts and Examples of Safety Analysis for Radioactive Waste Repositories in Continental Geological Formations; (c) The Design, Construction, Operation, Shut-down and Surveillance of Repositories for Solid Radioactive Waste in Shallow Ground; and (d) The Disposal of Radioactive Wastes by Hydraulic Fracturing.

152. In addition, preparatory work was done on reports concerning: the disposal of low- and intermediate-level radioactive waste in rock cavities; methodologies for the safety analysis of radioactive waste repositories in

[26] GC(XXVI)/664, para. 120.

[27] Ibid., para. 122.

shallow ground; site investigations, design, construction, operation, shut-down and surveillance of repositories for low- and intermediate-level radioactive wastes in rock cavities; criteria for the underground disposal of solid radioactive waste; and the performance requirements of waste isolation systems.

Environmental aspects of nuclear energy

153. Jointly with IMO and UNEP, the Agency held a meeting on environmental assessment methodologies for the sea dumping of radioactive waste. Terrestrial and oceanic de minimis issues, global releases of radionuclides, atmospheric dispersion models, and the environmental migration of radium and other contaminants were the subject of other meetings.

154. A report entitled "Transuranic Cycling Behaviour in the Marine Environment" (IAEA-TECDOC 265) was published and work on the following reports was completed: (a) "Hydrodynamic Modelling of Littoral Zones"; (b) "Control of Radioactive Waste Disposal into the Marine Environment"; (c) "Regional and Global Behaviour of Radionuclides Released from the Nuclear Fuel Cycle"; (d) "Considerations Concerning de minimis Levels of Low-level Solid Waste for Release into the Terrestrial Environment"; and (e) "Chemical Durability of Solidified High-Level Waste Forms".

155. In addition, preparatory work was done on reports concerning the behaviour of radium in aquifers and waterways, environmental assessment methodologies for the sea dumping of radioactive wastes, a revision of the radiological basis for the Agency's Definition and Recommendations under the London Dumping Convention, an oceanographic model for the dispersion of wastes disposed of in the deep sea, and the migration and dispersion of radionuclides from the storage of radioactive waste in the terrestrial environment.

NUCLEAR SAFETY

General

156. In 1982 the Agency increased the orientation of its nuclear safety activities towards providing direct assistance to Member States, especially with the use of the documents produced under the Nuclear Safety Standards (NUSS) programme which has reached an advanced stage, and of other documents issued in the Safety Series.

157. The first annual review of nuclear safety was presented to the Board of Governors in June. It pointed out that nuclear power plants can be operated safely, that safety systems can ensure safety even in accident conditions, and that safety can still be improved; also, it dealt briefly with the current status of nuclear power plant safety world-wide, gave details of the Agency's activities in the nuclear safety area and described the related activities of other international organizations.

158. A revised edition of the Basic Safety Standards for Radiation Protection, with guidelines for increasing the protection of workers and the public, was issued in November. The Basic Safety Standards are an example of a system which, although it already provides for adequate safety for individuals by specifying that exposure be as low as reasonably achievable, still requires that there be consideration of a further decrease in the remaining potential hazard.

159. Work continued on the development of an international incident reporting system by means of which information will be collected on significant events occurring in nuclear power plants throughout the world; it is expected that member countries of CMEA and NEA and also developing countries will participate in the system.

160. In September the Board of Governors took note of a report on emergency planning in which an expert group had recommended the development of a document which would outline a single set of provisions to be used by Member States in the event of an emergency and set forth the special planning considerations applicable to accidents that could have impacts across national boundaries.

Radiological safety

Radiation protection

161. An important milestone was reached in 1982 with the long-awaited publication - under the joint sponsorship of the Agency, WHO, ILO and NEA - of revised Basic Safety Standards for Radiation Protection (Safety Series No. 9). [28] The main aim of the revised Basic Safety Standards is the practical implementation of the system of dose

[28] GC(XXVI)/664, paras 135 and 136.

limitation recommended by the International Commission on Radiological Protection (ICRP). The underlying objectives of the system are achieved by justifying practices involving exposure to radiation, optimizing protection and limiting individual risks. A salient feature is that, even though adequate protection is provided to any individual, a further assessment for possible reduction of the remaining health radiation risk is still required.

162. The proceedings of a symposium on the application of the ICRP-recommended dose limitation system in nuclear fuel cycle facilities and in radiation protection, sponsored by the Agency, WHO, NEA and ICRP, were published in 1982; they describe experience in applying the system in various fields where ionizing radiation has to be taken into account, including the design of nuclear facilities, waste management, the monitoring of individual and population exposures, and the development of practices for dealing with emergencies.

163. Also published in 1982 were an Annex to Safety Series No. 45 ("Principles for establishing limits for the release of radioactive materials into the environment") and the final summary report of a co-ordinated research programme on cell membrane probes as biological indicators in radiation accidents (IAEA-TECDOC 273). Work was completed on a revised version of Safety Series No. 26 ("Radiation protection in the mining and milling of radioactive ores") and on a further issue of "Health Physics Research Abstracts".

164. Staff members carried out 16 missions to 14 developing countries in order to advise them on radiation protection practices, and served as lecturers at four training courses. A total of 47 requests from 20 Member States for technical assistance in the form of fellowships (81), expert missions (ten) and equipment were evaluated.

165. Research in Member States continued to be supported through co-ordinated research programmes on the following subjects: carbon-14 from nuclear facilities; lung monitoring for plutonium; chromosome aberration analysis; and radioactive material in the Baltic Sea. A radiological impact assessment of the River Danube was completed.[29]

Safe transport

166. As part of its efforts to provide adequate and compatible safety standards for use as a basis for the national and international transport of radioactive material, the Agency continued its work on developing and updating universally applicable regulations for safe transport. A revised and expanded edition of the "Advisory material for the application of the IAEA transport regulations" (Safety Series No. 37) was issued and a draft revision of the Transport Regulations was circulated for review by Member States.[30] Also, a brochure on safe transport was published for distribution to the general public.

[29] GC(XXVI)/664, para. 139.

[30] Ibid., para. 142.

167. A training course for persons responsible for transport was held in the United Kingdom. In response to a request, advice was given to a Member State on the shipment of irradiated fuel from a research reactor for reprocessing. INTERTRAN, a computer code for assessing the radiological impact of the transport of radioactive material, was finalized and is being made available to Member States.

Emergency preparedness in support of nuclear facilities

168. The Agency continued to expand its activities designed to help Member States develop and improve their emergency planning and preparedness programmes for nuclear facilities. These activities are divided into four main parts: the development of additional technical guidance needed to complement three Safety Series documents on emergency planning and preparedness; the provision of training programmes; special missions to Member States to assist them in the evaluation and further development of emergency plans for new nuclear power plants; and upgrading of the Agency's capability to respond, together with its Member States, to a request for assistance in the event of a serious nuclear accident.

169. A technical guidance document entitled "Emergency response planning for transport accidents involving radioactive materials" (IAEA-TECDOC-262) was published and considerable work was done on two others.

170. An interregional training course on planning and preparedness for and response to radiological emergencies was conducted in the United States. A seminar for Middle East countries was held on health physics and medical aspects of emergency preparedness. Missions were sent to two developing countries with nuclear power plants.

171. As the result of a request from the Board of Governors, a group of experts met to study the most appropriate means of responding to the need for mutual assistance in connection with nuclear accidents. The group recommended (a) the development of a single set of provisions that could be applied to emergency assistance, and (b) determination of the special planning considerations applicable to cases where a nuclear accident in one State might have a significant impact on other States.

Safety of nuclear installations

Nuclear safety review

172. A review of nuclear safety presented to the Board in June covered events during the period 1980-81 that had an important bearing on safety, new approaches in safety technology and recent changes in safety policy; also, it outlined the activities of the Agency and other international organizations. Present plans are to prepare a similar report annually.

Standards development programme

173. Under the NUSS programme, which started in 1974 and entails the development of five codes of practice (already published in the Agency's four working languages) and 56 safety guides, four further safety guides were

completed (bringing the total number of completed safety guides to 41) and seven published in English (by the end of the year 33 of these 41 guides had been published in English and many in the other working languages). Most of the safety guides on governmental organization, siting and quality assurance have been completed, but several years will be needed in order to complete those relating to design and operation.

174. Efforts to assist Member States in the use of NUSS documents continued, with two training courses, advisory missions to the Libyan Arab Jamahiriya, Mexico and Morocco, and a seminar on nuclear power plant siting.

175. Work on updating standards for the safe operation of research reactors (Safety Series No. 35) was completed; publication of the updated standards is scheduled for 1983.

Advisory services

176. Missions visited Brazil, Mexico and Yugoslavia to advise on safety aspects of nuclear power plants and Egypt and Venezuela to advise on siting aspects. Research reactor safety missions also visited a number of Member States.

177. Under a programme for providing assistance with the application of complex computer codes used in nuclear power plant safety evaluations, Agency staff members visited several Member States, while specialists from Member States visited Headquarters in order to carry out calculations on the Agency's computer using these codes. Possibilities for improving this programme (for example, the introduction of training courses) were considered at a technical committee meeting attended by specialists from 14 Member States.

Incident reporting system

178. The Agency continued its efforts to develop an international system, in which member countries of CMEA and NEA and also developing countries would participate, for collecting information on incidents of safety significance occurring at nuclear power plants, and for making it available to plant operators and designers and to nuclear safety regulatory bodies in order that it may be used in preventing the occurrence of similar incidents at other plants and in mitigating the consequences of such incidents as do occur.

179. At a number of technical meetings organized by the Agency, specialists from Member States discussed the criteria to be applied in reporting incidents to the international system, methods of analysing reported incidents, procedures for disseminating information, the organization of national incident reporting systems, and incidents of safety significance that had actually occurred.

180. Documents were developed on the organization of national and international incident reporting systems.

Exchange of information

181. Information on national safety research programmes was exchanged at a technical committee meeting at which recommendations were also made regarding co-ordination of the Agency's various activities concerned with safety research. In addition, a meeting was held on the early diagnosis of failures in primary system components.

Radiation protection service

182. Radiation protection services continued to be provided for the Agency's laboratories, for safeguards inspectors (about 250 in 1982), for technical co-operation experts, and for individuals from Member States being trained on Agency premises or participating in training courses sponsored by the Department of Technical Co-operation.

183. Two training courses in radiation protection were held for new safeguards inspectors, and individual training was given to new laboratory staff. At an interregional training course on the use of radionuclides in soil studies, laboratory exercises involving the handling of radioactive materials were performed under the supervision of health physics staff from Seibersdorf. Five training courses on radiation protection were produced on video tape for use within the Agency.

184. The services of the Agency's personnel monitoring system were made available to a number of Member States where Agency-assisted activities were being carried out and where personnel monitoring services were not yet available locally; about 100 dosimeters worn by local staff in Nigeria, Senegal and Sierra Leone were evaluated.

Risk assessment

185. In 1982, the emphasis shifted to the collection, assessment and dissemination of information, complemented by the provision of assistance to Member States.

186. Two research programmes being conducted in Member States on methods and criteria to be applied by decision-makers when making risk assessments for safety policy formulation purposes continued to be supported and co-ordinated; these programmes deal with the cost-effectiveness of risk reduction for different energy systems and the development of risk criteria for the nuclear fuel cycle.

187. Member States were assisted in applying probabilistic risk analysis techniques using computer codes.

188. Assistance to Member States in carrying out studies of public attitudes towards nuclear power continued; the results of opinion sampling in the Federal Republic of Germany, Japan and the Philippines were compared and new results from Brazil and the Federal Republic of Germany were analysed. This work was complemented by the collection of opinion poll data from Member States and the analysis of newspaper articles.

FOOD AND AGRICULTURE

General

189. The Joint FAO/IAEA programme has continued to help developing Member States solve economically important agricultural problems by the application of isotope and radiation techniques. The activities embrace: soil fertility, irrigation and crop production; plant breeding and genetics; the control of insects and other pests; studies of agrochemicals and residues; research aimed at improving the health and productivity of animals; and food preservation.

190. During 1982, support was given to some 100 technical co-operation projects in 46 developing Member States. Approximately 350 agricultural laboratories and institutes took part in 27 co-ordinated research programmes financed by the Agency, and in several cases also supported by the Federal Republic of Germany, Italy and Sweden. In addition, six training courses and study tours were held and programming missions visited Brazil, Colombia, Egypt, Mexico and Peru.

Improving crop production

191. The use of labelled fertilizer techniques to determine the biological fixation of atmospheric nitrogen by field legumes, in order to reduce fertilizer requirements and to conserve the environment, continued in co-ordinated research programmes.[31] Work performed by co-operating institutions confirmed that certain local legume species and varieties are more capable than others of utilizing atmospheric nitrogen for the production of protein; this opens up the possibility of breeding crops with higher nitrogen fixation potential. Studies aimed at assessing the input of symbiotically fixed nitrogen into pastures and other multiple cropping systems containing legumes were initiated with a view to optimizing management practices.

192. Specific management practices were worked out for different soil water regimes in areas of rain-fed agriculture in a co-ordinated research programme involving the use of isotopically labelled fertilizers and neutron moisture meters, the aim being to ensure the most efficient use of fertilizers.

193. Two interregional training courses were conducted - one, at the Agency's Laboratory at Seibersdorf, on the use of isotope and radiation techniques in studies of soil-plant relationships; the other, in Ghent, Belgium, on the use of isotopes and radiation in soil physics studies. They were attended by more than 30 participants from developing Member States.

194. Improved grain legume production through the use of induced mutations was the aim of three co-ordinated research programmes, including one RCA programme, that continued during 1982. Scientists involved in these programmes met in Seoul, Republic of Korea, to discuss ways of solving problems responsible for the low production of this nutritionally important group of food plants.

[31] GC(XXVI)/664, para. 152.

195. To stimulate co-operative work on mutation breeding for crop improvement in Latin America, a regional seminar was held in Lima, Peru. It was attended by 37 scientists from Latin America and four from other regions.

196. A training course on mutation breeding held at the Seibersdorf Laboratory was attended by scientists from 14 developing Member States. A national mutation breeding training course was held in Thailand at the request of the Thai Government; it was attended by 27 Thai scientists, and members of the Joint FAO/IAEA Division served as instructors.

197. The long involvement of FAO and the Agency, with assistance from the Federal Republic of Germany and Sweden, in co-ordinated research aimed at providing technology and genetic stocks for grain protein improvement through mutation induction culminated during December in a final research co-ordination meeting where it was concluded that many of the technological problems had been overcome and that improved genetic stocks are now available. The major difficulties remaining concern the establishment of marketing systems with appropriate price policies in order to achieve wide use of crop varieties containing more or better-quality protein.

Animal production and health[32]

198. Co-ordinated research programmes continued on the nutrient value and use of low-quality roughages and agro-industrial by-products as potential feedstuffs for ruminant animals, on the productivity of domestic buffalo in Asia (carried out within the framework of RCA), and on the control of parasitic disease.

199. A co-ordinated research programme on the use of nuclear techniques in controlling tick-borne diseases in livestock came to a successful conclusion, one result being the development of an effective radiation-attenuated vaccine against Babesiosis in cattle. Co-ordinated research programmes were initiated on: the optimization of grazing animal productivity in the Mediterranean and North African regions; the productivity of sheep and goats in Africa and the Middle East; and the reproductive efficiency of large ruminants.

200. A regional training course and study tour on the use of isotopes and radiation in animal production studies were held in Australia and an interregional training course on the use of radioimmunoassay in animal production and health research was held in the United States.

Insect control

201. The BICOT project in Nigeria[33] continued to be supported by Belgium, the Federal Republic of Germany, Italy, Sweden and the United Kingdom. Mass-rearing of the tsetse species continued, the flies being fed on the blood of living animals or - through a membrane - on freeze-dried blood. Ecological studies were completed in most of the proposed release areas.

[32] GC(XXVI)/664, paras 162 and 169.

[33] IAEA/Government of Nigeria Project on the Biological Control of Tsetse Flies by the Sterile-Insect Technique - see GC(XXVI)/664, para. 160.

202. The objectives of the programme for controlling the Mediterranean fruit fly (medfly) in Mexico having been achieved, the Agency's assistance was terminated. At the same time, an agreement was concluded between the Government of Egypt and the Agency for a four-year large-scale field project aimed at eradicating the medfly from the Nile Valley with the help of the sterile-insect technique (SIT). The technology used in the Mexican programme will be transferred to Egypt for use in this project, which is being supported by Austria and Italy. A proposal has been elaborated for a TCDC project agreement between Egypt and Mexico. In addition, preliminary work aimed at the initiation of a similar project in Peru was completed.

203. Work continued at the Seibersdorf Laboratory on the development of genetic methods for separating male from female medflies; these methods will be incorporated into medfly mass-rearing operations, with the aim of reducing mass-rearing costs.

204. A regional seminar on medfly control and/or eradication using the SIT as the basis for an integrated pest management programme in Latin America was held in Mexico, which also hosted a regional training course on this subject.

Protection of the environment[34]

205. The Agency continued co-ordinated isotope-aided research programmes on bound pesticide residues in soil, plants and food, on pesticide residues in milk and meat, and on the development of better methods for the rural production of methane from biomass (with the residual slurry being used as fertilizer material). Isotope-aided research was initiated on controlled-release pesticide formulations, persistent pesticides in the tropics, and pesticide residues in stored products. Programmes on agrochemical-biota interactions in soil and water were successfully completed, a major result being the development of improved labelled-substrate and other isotopic techniques for the detection and quantification of environmental contaminants in soil and inland aquatic bodies.

206. At a symposium on the fate of agrochemicals in food and the environment, held in Rome, participants discussed recent developments in agrochemical research and reviewed the potential for the use of nuclear techniques in this area.

Food preservation

207. The draft of a revised Recommended International General Standard for Irradiated Foods[35] was accepted with minor amendments at the fifteenth session of the Codex Committee on Food Additives (CCFA), which agreed that the revised Standard and the Code of Practice for Irradiated Foods should be amended as speedily as possible through the Codex Procedure for Amendments of Standards.

[34] GC(XXVI)/664, para. 164.

[35] Ibid., para. 166.

208. Research co-ordination meetings were held on the precommercial-scale radiation treatment of food and on factors influencing the use of food irradiation processes; 19 scientists from 14 Member States are participating in the two co-ordinated research programmes in question.

209. The project committee of the RCA project on food irradiation[36], consisting of representatives of eleven Member States, met at Bangkok in November to evaluate the results obtained so far and to plan future regional studies; the Government of Japan continued its sponsorship of the project.

210. The International Facility for Food Irradiation Technology (IFFIT) at Wageningen, Netherlands, organized two training courses in which 46 scientists from 29 developing Member States participated. Also, IFFIT assisted - through individual fellowships - in the training of ten scientists from developing countries for periods of up to one year.

211. A group of consultants on the marketing, market testing and consumer acceptance of irradiated foods made recommendations for introducing irradiated foods to the consumer market.

212. At the request of the Board of Management of the former International Project in the Field of Food Irradiation (IFIP), a proposal for continued international co-operation in the field of food irradiation was distributed by the Agency to the Member States of FAO, WHO and the Agency, and many Governments indicated their interest in continuing such co-operation.

[36] GC(XXVI)/664, para. 168.

LIFE SCIENCES

Medical applications

213. Efforts to secure the improved maintenance of nuclear instruments at laboratories in developing countries continued through co-ordinated research and technical co-operation activities. Power conditioning equipment was installed at 25 laboratories, with provision for its preventive and remedial maintenance. Local technician training courses were organized in eight countries of Asia and the Pacific by participants in a 1981 "train-the-trainers" workshop. A regional programme for nuclear instrument maintenance was initiated in Africa.

214. Radioimmunoassay and related procedures in medicine were supported through a symposium (with 221 participants from 49 countries), an interregional training course (with 13 participants from 13 countries), the initiation of a co-ordinated research programme on radioimmunoassay data processing (with 13 laboratories in 12 countries), and the design of a co-ordinated research programme for evaluating the role of in vitro assays of alternative thyroid-related hormones in the diagnosis of thyroid disease.

215. The quality assurance of instruments used in in vivo nuclear medicine was stimulated through three national workshops in Latin America, a seminar for the Asia and Pacific region, and an advisory group meeting on test procedures. A training course and study tour on nuclear medicine (with 29 participants from 17 countries) took place in the Soviet Union.

216. Support continued for the use of nuclear-based techniques in studying the concentrations of essential or toxic trace elements in biomedical samples, including support through two co-ordinated research programmes (with 15 participants in 11 countries); the results obtained under one of these programmes (a programme on human milk being conducted jointly by WHO and the Agency) suggest the need to reassess some of the currently recommended dietary allowances for infants. An advisory group meeting was held on quality assurance in this field, which was encouraged through the organization of interlaboratory comparison services.

Dosimetry

217. In 1982, China and Portugal each nominated a dosimetry laboratory for membership in the IAEA/WHO network of Secondary Standard Dosimetry Laboratories (SSDLs), raising the number of SSDLs in the network to 45.[37] Six other countries approached the network secretariat for information and assistance related to the setting up of SSDLs. At both the national and the international level, SSDLs have become an integral part of the world's radiological measurement system.

[37] GC(XXVI)/664, para. 176.

218. Dose calibration comparisons were undertaken by visiting experts at 13 dosimetry laboratories in Latin America under an interregional technical co-operation programme. Agency staff and other experts assisted in setting up SSDLs in Algeria, Colombia, Ecuador, the Republic of Korea, Malaysia, the Philippines, Portugal, Thailand, Turkey and Uruguay.

219. The postal dose service for the intercomparison of ^{60}Co dosimetry at radiotherapy centres continued to be provided; it was also provided for the dosimetry of high-energy photons from linear accelerators. Further calibrations and intercomparisons of ion chambers, ensuring the accuracy of the postal dose service, were carried out in co-operation with scientists from the Hungarian Office of Measures.

220. With the Dosimetry Laboratory at Seibersdorf now in full operation, [38] ion chamber calibration in ^{60}Co gamma-ray and X-ray beams at radiation therapy and radiation protection levels and also thermoluminescent and Fricke dosimetry were carried out. A comprehensive programme of training in these areas for SSDL staff was developed in co-operation with the Hungarian Office of Measures; three staff members from SSDLs in Indonesia, Pakistan and Thailand received three months of training based on this programme.

221. An intercomparison of gamma doses in the low and medium range was carried out with the participation of seven laboratories.

222. In co-operation with laboratories in Denmark, the Federal Republic Germany and the United Kingdom, an intercomparison was performed of 10-MeV electron beams in order to provide standardized electron fields.

223. A training seminar on high-dose dosimetry in industrial radiation processing was held at the Risø National Laboratory, Denmark, with 29 participants from 19 countries.

224. The co-ordinated research programme on high-dose standardization and intercomparison for industrial radiation processing [39] continued to make good progress; it is being concluded with a final research co-ordination meeting in 1983.

Radiation biology

225. The radiation sterilization of local medical supplies in countries of Asia and the Far East was promoted through a regional co-ordinated research programme. The radiation dosimetry calibration and standardization aspects of sterilization practices were reviewed at a research co-ordination meeting in the Philippines, account being taken of progress under the research programme and of new information that is becoming available. Also, an advisory group meeting on radiation sterilization was held in the United Kingdom.

[38] GC(XXVI)/664, para. 178.

[39] Ibid., para. 180.

226. Radiation sterilization practices developed under the programme began to be used also in sterilizing tissue grafts required for corrective and reconstructive surgery. Steps were taken, in co-operation with WHO, to help set up tissue bank facilities at major health care centres in Bangladesh, Burma, India and the Philippines.

227. The present status of knowledge, the practices being followed and the methods being developed in Member States with regard to the comparative environmental and health impacts of various energy sources were reviewed at a joint WHO/UNEP/Agency working group meeting in France. WHO regional co-ordinating centres have so far been established in France, the Soviet Union and the United States, and the establishment of one in India is planned.

228. The Agency continued to support studies aimed at developing nuclear techniques for dealing with parasitic infections. The results of a co-ordinated research programme on the preparation of radiation-attenuated vaccines for malaria and schistosomiasis were reviewed at a final research co-ordination meeting in the United States and programmes were initiated on the development of nuclear techniques for the diagnosis of infections and the definition of immunogens.

229. A co-ordinated research programme on improving cancer therapy through the combined use of conventional radiation and physical or chemical means in Asia and globally was initiated; data relating to the possibility of using high-LET radiation in cancer therapy were reviewed at a first research co-ordination meeting.

Health-related environmental research

230. The use of nuclear analytical techniques in assessing the impact of mineral substances (particularly heavy metals) on human health and environmental quality continued to receive support under a global co-ordinated research programme (with 23 research institutes participating) and an RCA project.

PHYSICAL SCIENCES

Physics

Physics-related activities in developing countries

231. An interregional and two regional courses were held on nuclear electronics, the main purpose being the transfer of expertise to the participating countries in order that they may become less dependent on outside help.

232. A group of consultants met to consider the teaching of nuclear sciences at universities in developing countries; a report containing the consultants' views and recommendations is being issued in the IAEA-TECDOC series.

233. An advisory group meeting on systems for data acquisition in nuclear science and technology provided an opportunity for a discussion of current trends in nuclear instrumentation as well as for a dialogue between users and manufacturers of such instrumentation; advice was given on equipment for use at laboratories in developing countries.

Research reactor support programme

234. Work continued on two documents designed to supplement a guidebook published in 1980 on the technical aspects of converting reactor cores to use low-enriched uranium (LEU).[40] A technical committee met to consider instrumentation and pre-operational procedures related to the conversion of cores to use LEU, the aim being to produce a report of value for reactor operators.

235. A consultants' meeting was held on the production of radioisotopes using low-power research reactors and a study tour was held (with 22 participants) on research reactor technology and utilization.

Nuclear fusion

236. The report on the "Phase One" INTOR Workshop[41] was published in March and the results were reported at a special session on INTOR during the Agency's Ninth International Conference on Plasma Physics and Controlled Nuclear Fusion Research, where the critical steps towards a practical demonstration of fusion power were delineated. The draft of a cost-benefit risk analysis of INTOR design alternatives was completed in September.

237. The needs of the developing countries in fusion were discussed at several informal meetings and at an Agency consultants' meeting.

[40] GC(XXVI)/664, para. 189.

[41] Ibid., para. 186.

Applications of isotopes and radiation

238. Under a UNDP-supported large-scale industrial demonstration programme on the use of nuclear techniques in the rubber, wood, paper, steel and mining industries, which is being conducted within the framework of RCA, construction of a plant for the radiation vulcanization of natural rubber (annual capacity of the plant - 1000 tons) was completed[42], commissioning of the plant is scheduled for 1983. Work on the preparation of plans for demonstration work and training under this programme was initiated at a technical review meeting on radiation processing.

239. A co-ordinated research programme on the immobilization of bioactive materials by radiation techniques was initiated.

240. The Agency co-operated in the organization of a meeting on radiation processing that was held in Dubrovnik, Yugoslavia, and attended by about 300 participants from 30 countries.

241. Under a co-ordinated research programme on the radiation-induced modification of polymer materials, progress was made in preparing new soil-conditioning agents for moisture retention in arid regions.

242. The Agency assisted a number of Member States with the use of pulsed spectroscopy in the investigation of actinide and radiation chemistry.

243. More effort was devoted to the production of radioisotopes for medical purposes through the use of particle accelerators and research reactors, to the development of new and more specific radiopharmaceuticals, to fast methods of quality control, and to optimization of the production of radionuclide generators (particularly technetium-99m) through the use of low-power research reactors; a co-ordinated research programme on technetium-99m production and one on radiopharmaceutical preparation were initiated.

244. A study of the chemistry of fusion systems included a review of developments in tritium breeding materials and in containment and structural materials, and also of interactions between these materials.

245. Activities relating to nuclear analytical techniques focused on radiochemical techniques for separation/concentration prior to analysis, with a view to achieving greater selectivity and sensitivity.

246. Co-ordination of the compilation of thermodynamic data for actinide elements and their compounds continued.[43]

247. An advisory group on radiation damage met to establish a methodology for predicting the lifetime of organic materials in nuclear reactor environments.

248. Work continued on the use of nuclear analytical methods in exploring for mineral resources in developing countries, with training seminars and co-ordinated research programmes.

[42] GC(XXVI)/664, para. 192.

[43] Ibid., para. 194.

Isotope hydrology

249. Isotope hydrology projects were being supported in more than 30 Member States during 1982. The Agency's support included assistance in the establishment of environmental isotope analytical facilities, in applied field studies directed to the solution of specific hydrological problems associated with the development of water resources, and in measurements of river discharge and sediment movement and accumulation.

250. The progress of an RCA isotope hydrology and sedimentology project funded by Australia[44] was reviewed in November.

251. An advisory group assessed the present status of the use of tracer methods in isotope hydrology and consultants examined the role of radioisotopes in sedimentological studies.

252. A joint Agency/GSF research project, funded by the Federal Republic of Germany, on the physical and isotopic behaviour of soil moisture in the zone of aeration was evaluated at a meeting held in October. On that occasion an agreement was signed for an isotope hydrology project (also funded by the Federal Republic of Germany) commencing in 1983 in Latin America.

Nuclear data

253. The Agency continued to publish CINDA (Computer Index of Neutron Data) and current awareness reports on nuclear and atomic data research; and to provide nuclear data services - primarily to developing countries; in 1982 such services were provided to 40 developing countries. The Agency responded to more than 700 requests, over 10% more than in 1981.

254. Representatives of data centres met in order to maintain co-ordination in the compilation, evaluation and dissemination of numerical data used in nuclear fission and fusion technologies and in applications of radiation and isotopes.

255. Within the framework of three co-ordinated research programmes, the Agency reviewed the accuracy and validity of existing atomic collision data required for fusion research, reviewed improvements in the measurement and evaluation of actinide isotope decay data needed for nuclear materials safeguards and nuclear waste management, and established a comprehensive computer library of evaluated neutron nuclear data for actinide isotopes.

256. With the objective of increasing the expertise of scientists in developing countries who have to perform accurate nuclear measurements and use nuclear techniques, the Agency:

- (a) Conducted an interregional training course on the utilization of neutron generators; and
- (b) Assisted nuclear data training and research programmes in 21 developing countries through the transfer of nuclear data techniques and instrumentation.

[44] GC(XXVI)/664, para. 196.

THE LABORATORIES

Seibersdorf Laboratory

257. The following description of the activities of the Seibersdorf Laboratory is divided into sections corresponding to the Agency programmes which the Laboratory supports.

I. Food and agriculture

258. The use of fertilizers in mixed cropping systems was investigated in a series of field experiments. Also, experiments were carried out with pastures and apple trees to study symbiotic nitrogen fixation.

259. The mutation breeding of wheat and field beans continued, with emphasis on the selection of mutants of high protein yield and quality. Mutant stocks were created for use in training courses and future field work. A laboratory was fitted out for work with chemical mutagens.

260. As part of the Laboratory's support for use of the sterile-insect technique to control certain insect pests, emphasis was placed on more efficient methods for rearing and releasing sterile flies and on genetic techniques for producing male fruit flies only.

261. A laboratory for agrochemical work was set up. It will be used to develop techniques for following the fate of pesticides in agricultural systems, beginning with a study on the persistence of endosulphan in tropical environments.

262. Two training courses on applications of isotopes in agriculture were held.

II. Life sciences

263. The Laboratory's equipment for precision activation analysis was improved and extended. It is being used mainly to support a WHO/Agency research project on trace elements in human milk.

264. The problem of mains supply voltage fluctuations, a common cause of failure in nuclear medicine equipment in developing countries, was investigated and protective devices made and supplied to a number of countries.

265. A start was made on the development of a counting system for nuclear medicine which will be supplied in kit form for assembly in Member States.

266. The Agency's Secondary Standard Dosimetry Laboratory (SSDL) continued its postal dose calibration service, which has been extended to cover photon energies up to 20 MeV. Staff of the Agency's SSDL visited SSDLs in 15 Member States, advising on the installation of equipment and providing training.

III. Physical sciences

267. Six international intercomparisons of radionuclides and trace elements were conducted as part of the Agency's analytical quality control service. Laboratories in 33 Member States took part in one or more of these, the average number of laboratories participating being 40 per intercomparison.

268. Four new reference materials, three of them certified, were added to the list of analytical quality control materials available, which now contains 24 items. The Laboratory supplied 947 aliquots of such materials to 243 institutes.

269. Advisory missions were undertaken to the Democratic People's Republic of Korea and to the United Republic of Cameroon in connection with the analysis of uranium ores.

270. In the Isotope Hydrology Laboratory, 700 water samples were analysed for tritium, 85 for radiocarbon, and 2000 for the stable isotopes deuterium and oxygen-18. Stable isotope standards were distributed to 66 laboratories in Member States. Three fellows from developing countries were trained in analytical procedures.

IV. Safeguards

271. The Safeguards Analytical Laboratory (SAL) analysed 580 samples of uranium and 145 samples containing plutonium or mixtures of uranium and plutonium; also, some 220 samples of spent fuel were analysed by isotopic dilution mass spectrometry.

272. The work load of SAL in 1982 was practically the same as in 1981, representing nearly the maximum use of SAL's capacity. Plans were drawn up for extending the SAL premises and negotiations began for construction of the extension.

273. The United Kingdom donated a mass-spectrometer to SAL for use in analysing samples taken during safeguards inspections.

274. The Electronics Section provided microcomputer systems for the control of SAL's automated uranium titrator and for connecting the output of its electronic balances to an integrated computer system.

International Laboratory of Marine Radioactivity

275. In June 1982, the Board of Governors accepted an offer by the Monegasque authorities of additional space for the Laboratory, and about 350 m² of additional space have since been made available on a temporary basis. New permanent premises for the Laboratory, measuring approximately 2000 m², are to be constructed during 1985.

276. In order to evaluate the impacts of radionuclide releases into the marine environment, the Laboratory continued its investigations on:

- (a) The vertical transport of transuranic and other long-lived radionuclides in the oceanic water column;
- (b) The uptake, distribution and loss of transuranic and other long-lived radionuclides in marine organisms;
- (c) The chemical behaviour of transuranic and natural radionuclides in the marine environment; and
- (d) The methodology for low-level measurements of long-lived radionuclides.

277. The Laboratory continued to organize intercalibrations of measurements of radionuclides in marine environmental samples within the framework of the Agency's analytical quality control programme.

278. Problems relevant to the disposal of radioactive wastes in the deep oceans were pursued through investigation of:

- (a) The geochemical partitioning of transuranic and other long-lived radionuclides in marine sediments;
- (b) The pathways of transuranic and other long-lived radionuclides to marine organisms through contaminated sediments; and
- (c) The geochemical characterization of marine sediments from possible deep-sea dumping sites.

279. In collaboration with a number of national institutions in Member States, the Laboratory initiated a co-ordinated research programme on the behaviour of long-lived radionuclides associated with the deep-sea disposal of radioactive wastes.

280. Investigations of non-nuclear marine pollutants continued to be undertaken with the co-operation and financial support of UNESCO, UNEP, the Mediterranean Action Plan, and the Kuwait Action Plan.

281. Laboratory staff took part in several scientific and technical meetings organized by international organizations and in technical co-operation missions concerning marine environmental monitoring programmes.

282. Several trainees from developing countries received instruction in radiochemical and radiobiological methodologies for marine environmental monitoring and research.

283. In April, members of the Board of Governors visited the Laboratory in order to acquaint themselves more thoroughly with its activities and the plans for providing the Laboratory with larger premises.

INTERNATIONAL CENTRE FOR THEORETICAL PHYSICS

284. The main fields of research and training-for-research in 1982 at the International Centre for Theoretical Physics in Trieste were:

- (a) Physics and energy (nuclear physics and solar energy);
- (b) Physics and the frontiers of knowledge (elementary particles and fundamental theory, physics of biology);
- (c) Physics and technology (condensed-matter physics);
- (d) Applicable mathematics and planning models (fibre bundles and geometry, mathematical ecology);
- (e) Physics of the environment and of natural resources (geomagnetism, ionospheric and magnetospheric physics, atmospheric physics); and
- (f) Physics and development.

Physics and energy

285. The Centre maintained a high level of activity in this component, the year commencing with a winter college on nuclear physics and reactors, consisting of a course on advances in nuclear theory and nuclear data for reactor applications, attended by 92 scientists (71 from developing countries), and one on reactor physics aspects of safety analysis, attended by 94 scientists (73 from developing countries).

286. A topical meeting on nuclear fluid dynamics took place in October.

287. A Séminaire sur l'Energie Solaire (solar energy course), which brought together 69 French-speaking physicists, engineers and technicians, was organized with the help of several French Government departments.

288. In collaboration with the Asociación Centro Internacional de Física, Bogotá, the Centre organized the Third International Symposium and Latin-American School on Non-Conventional Energy, which took place in Colombia in July; 119 scientists from Latin America and other developing areas participated.

Physics and the frontiers of knowledge

289. The research group in elementary particle physics and fundamental theory continued its activities, with a workshop on particle physics attended by 77 scientists, a school and workshop on supergravity and supersymmetry attended by 161 scientists, and a workshop on non-perturbative field theory and quantum chromodynamics attended by 70 scientists.

290. A conference on applications of physics to medicine and biology, with an attendance of 217 persons, was followed by a workshop of the European Molecular Biology Organization dedicated to the functional integration of the cell surface and cytoskeleton control systems; the workshop was organized by the International School for Advanced Studies (SISSA), Trieste, and hosted by the Centre.

291. A summer college in biophysics was attended by 152 scientists.

Physics and technology

292. Twenty-three scientists (20 from developing countries) took part in the work of the condensed-matter physics research group.

293. A nine-week college on amorphous solids and the liquid state, attended by 122 scientists, was followed by a research workshop on condensed-matter physics during which 127 physicists from developing countries and 71 from advanced countries carried out individual or collaborative research projects. A working party studied the mechanical behaviour of solids with the help of support from the Italian National Research Council.

294. Topical meetings included a symposium on the statistical mechanics of adsorption, attended by 101 scientists, and a symposium on semiconductor surfaces and interfaces and semiconductor physics and electronics, organized in collaboration with the International Union of Pure and Applied Physics and attended by 145 physicists. In a further effort to aid scientists in developing countries and within the framework of its regional activities, the Centre organized a course on the theory of condensed matter which was held in Ghana with support from the United Nations Financing System for Science and Technology in Development (UNFSSTD).

Applicable mathematics and planning models

295. A workshop on fibre bundles and geometry attracted 115 mathematicians, over half of them from developing countries.

296. A college on mathematical ecology, a subject in keeping with the Centre's policy of carrying out multidisciplinary projects, was attended by 158 scientists.

Physics of the environment and of natural resources

297. A course and workshop on geomagnetism, the ionosphere and the magnetosphere dealt - inter alia - with radio propagation in the surroundings of the Earth and radio propagation in the tropics; it was sponsored by the Italian Dipartimento per la Cooperazione allo Sviluppo, the International Union of Geodesy and Geophysics, the International Union for Scientific Radio, and the Kuwait Foundation for the Advancement of Sciences.

298. A workshop on monsoon dynamics, held in Bangladesh and supported by UNFSSTD and the Canadian International Development Agency, was attended by 87 participants from both nearby and distant developing countries.

Physics and development

299. The Centre initiated an in-house programme on physics and development, with the aim of increasing scientists' awareness of the role of physics in social and economic development; the programme includes lectures by invited speakers and by scientists already at the Centre for other activities.

Miscellaneous

300. As in previous years, the Centre welcomed about 100 scientists - over half of them from developing countries - wishing to carry out independent

research projects in fields in which there was no scheduled activity or during periods in which scheduled activities in their particular fields were not being carried out.

301. In addition to the countries and institutions already mentioned, the Centre received support from Denmark, the Federal Republic of Germany, Japan, Qatar, the United States, the Swedish Agency for Research Co-operation with Developing Countries, and the Organization of Petroleum Exporting Countries.

Regional activities co-sponsored by the Centre

302. In addition to the courses organized in Bangladesh, Colombia and Ghana, the Centre was co-sponsor of the following:

1. Conference on Physics and Development
Dhaka, Bangladesh
2. Latin-American Conference on Plasma Physics
São Paulo, Brazil
3. Twenty-first International Schladming School
Schladming, Austria
4. First International Course on Geophysics
Bogotá, Colombia
5. Escuela Latino-Americana de Física
Cali, Colombia
6. Seventh International Nathiagali Summer College on Physics and Contemporary Needs
Islamabad, Pakistan
7. Multiciencias 1982
Cuzco, Peru
8. ASPEN International Conference on Teaching Aids in Physics Education
Bangi, Malaysia
9. Third Marcel Grossmann Meeting on the Recent Development of General Relativity
Shanghai, China
10. Conference Constitutive de l'Union Africaine de Physique
Yamoussoukro, Ivory Coast
11. Seminar on Extratropical Cyclones and Instability Lines
Pelotas, Rio Grande do Sul, Brazil
12. Petra School of Physics
Amman, Jordan
13. Conference on Physics Teaching in Arab Countries
Cairo, Egypt

SAFEGUARDS

Safeguards statement for 1982

303. In 1982, as in previous years, the Secretariat, in carrying out the safeguards programme of the Agency, did not detect any anomaly which would indicate the diversion of a significant amount of safeguarded nuclear material - or the misuse of facilities or equipment subject to safeguards under certain agreements - for the manufacture of any nuclear weapon, or for any other military purpose, or for the manufacture of any other nuclear explosive device, or for purposes unknown[45]. With the exception of two cases where the Agency was unable to draw conclusions[46], the Secretariat considers it reasonable to conclude that the nuclear material under Agency safeguards in 1982 remained in peaceful nuclear activities or was otherwise adequately accounted for. This statement should be seen in the light of the following observations:

- (a) The conclusions of the Secretariat are based on extensive inspection activities, which may be illustrated for 1982 as follows - figures for 1981 are given in parentheses. Almost 1700 (1400) inspections were carried out at about 500 (500) nuclear installations in 46 (47) non-nuclear-weapon States and three (three) nuclear-weapon States. More than 60 000 (27 000) nuclear material items of widely varying content were subjected to non-destructive assay (NDA) by the Agency. About 10 (8) million pictures were taken by automatic surveillance systems. More than 6000 (4000) seals were applied and subsequently verified. The Safeguards Analytical Laboratory (SAL) analysed about 870 (890) plutonium and uranium samples, with about 1870 (1810) analytical results being statistically evaluated. Accounting reports concerning about 700 (700) installations were received. An additional 655 000 (345 000) data entries were processed and stored in the Agency's computer;
- (b) The sensitivity of inspection and evaluation activities may be illustrated by the fact that about 406 (230), mostly minor, discrepancies or anomalies were found; all cases were satisfactorily explained upon subsequent appraisal or investigation;
- (c) The level of assurance associated with the Secretariat's findings for a particular installation or State depends - inter alia - on the content of the safeguards agreement concluded with the State

[45] In the case of voluntary-offer agreements with nuclear-weapon (NW) States nuclear material to which safeguards were applied was not withdrawn from safeguards except in conformity with these agreements.

[46] In these two cases there has been significant progress since the end of 1982 and the technical safeguards measures implemented at the plants in question now enable the Agency once more to perform effective verification.

in question, on the co-operation of the State and of the facility operators in it, and on the funds, manpower and equipment available to the Agency. In 1982 the level of assurance continued to improve;

- (d) The findings of the Safeguards Implementation Report (SIR) refer for each facility to the latest available State report, Agency inspection, analysis, etc. relating to that facility.

Safeguards coverage

304. By the end of 1982, safeguards agreements were in force with 90 States (87 in 1981). Safeguards were actually being applied in 50 non-nuclear-weapon States (49 in 1981) and three nuclear-weapon States (also three in 1981), the nuclear activities of the remainder not yet having reached the stage at which reports and verification activities are required under the relevant agreements.

305. The safeguards agreements concluded pursuant to NPT with Bangladesh and Egypt and those concluded pursuant to NPT and the Tlatelolco Treaty with Guatemala and Venezuela entered into force.

306. The safeguards agreement concluded with Colombia pursuant to the Tlatelolco Treaty entered into force.

307. Nauru and Viet Nam became parties to NPT in June 1982, and Uganda in October 1982, bringing the total number of States party to the Treaty to 121, including three nuclear-weapon States. It is expected that negotiations with Viet Nam regarding a safeguards agreement in connection with NPT will start soon.

308. Seventy safeguards agreements concluded pursuant to NPT were in force at the end of 1982. Thirty-eight of the 116[47] non-nuclear-weapon States party to NPT have not yet complied with their obligations under Article III.4 of the Treaty regarding the conclusion of the relevant safeguards agreements with the Agency. None of these 38 States have, as far as the Agency is aware, significant nuclear activities.

309. At the end of 1982, safeguards agreements based on document INFCIRC/66/Rev.2 were in force[48] with the following non-nuclear-weapon States: Argentina, Brazil, Chile, Cuba, the Democratic People's Republic of Korea, India, Israel, Pakistan, South Africa, Spain and Viet Nam. In seven of these States[49] all substantial nuclear activities known to the Agency were covered by provisions of existing safeguards agreements.[50] In the remaining

[47] A safeguards agreement with the Ivory Coast was approved by the Board of Governors on 24 February 1983.

[48] The Agency also applies safeguards under two INFCIRC/66/Rev.2-type agreements to the nuclear facilities in the territory of Taiwan.

[49] Argentina, Brazil, Chile, Cuba, the Democratic People's Republic of Korea, Spain and Viet Nam.

[50] In one of these States one facility under construction will be under IAEA safeguards whenever it processes safeguarded nuclear material.

four States, as in nuclear-weapon States, unsafeguarded nuclear facilities which would be capable of producing weapons-usable material were in operation or under construction.

310. At the end of 1982, there were 440 facilities (422 in 1981) under safeguards or containing safeguarded nuclear material, not counting five (also five in 1981) facilities selected for inspection under the voluntary-offer agreements with nuclear-weapon States. In addition, there were 404 (422) locations outside facilities containing small amounts of nuclear material (see Table 4).

311. The nuclear material under Agency safeguards, excluding that covered by the voluntary-offer agreements with nuclear-weapon States, amounted in 1982 to 6 t (5 t in 1981) of separated plutonium, 10 t (10 t) of highly enriched uranium (HEU), 83 t (71 t) of plutonium contained in irradiated fuel, and almost 42 000 t (37 642 t) of low-enriched uranium (LEU) and source material (natural or depleted uranium and thorium).

Progress during 1982

Safeguards implementation

312. Noticeable progress was achieved in several areas owing to an increase in available manpower, improvements in implementation, better co-ordination in the field and at Headquarters, and better co-operation between States and the Agency. As a result,

- the number of inspections, the application of containment/surveillance (C/S) measures, the number of measurements and the scope of data processing increased considerably. This was achieved with only a modest increase in manpower - an indication of improved efficiency in the utilization of resources;
- the effectiveness of Agency safeguards activities continued to increase in 1982. In addition to more intensive verification activities yielding a higher level of assurance, the number of major facilities for which the inspection goals were attained rose in 1982 by about 12% compared to 1981;
- as compared with 1981 there was a 50% increase in 1982 in the number of inspections where NDA measurements were performed;
- several inspections without advance notice were performed in 1982 after considerable preparatory work by the Agency;
- discussions with two States to improve the safeguards arrangements at three reactors made decisive progress in 1982;
- the installation of bundle counters and surveillance equipment was completed at three on-load-refuelled reactors (OLRs).

Safeguards_development_and_technical_support

313. The programme for the procurement, documentation, maintenance, repair and distribution of routinely deployed instruments continued to meet the increasing requirements in this area. Other services provided on a routine basis included the preparation and examination of seals, the development and examination of surveillance films, the organization of transport and analysis of safeguards samples, and the analysis of gamma-spectrometric data.

- There was an improvement in the analysis of gamma-spectrometric data and a significant increase in the reliability of photo surveillance equipment, which mainly resulted from the establishment of an effective photo repair laboratory and significant inspector effort to diagnose failure in the field.
- A special plutonium-air-transport container (PAT-II), designed to improve the shipment of safeguards samples containing plutonium, became available. However, the use of this container has not yet been licensed by some Member States.

314. A relatively large number of equipment items, most of which were specifically developed in the framework of national programmes in support of IAEA safeguards, were tested and evaluated under operational conditions, in particular:

- neutron coincidence collars for measuring uranium-235 in fresh light-water reactor (LWR) fuel assemblies,
- an active well coincidence counter (AWCC) and special detector heads for high-level neutron coincidence counters (HLNCCs),
- a UF₆ weighing system,
- new film cameras and microprocessor-controlled closed-circuit television (CCTV) surveillance units,
- modified Cherenkov glow measuring devices, capable of operating in ambient lighting,
- fibre optic electronic seals.

Safeguards equipment specially designed for use in 600-MW(e) CANDU reactors was installed and operational testing initiated. In 1982 five new equipment items reached the routine-use stage. Procedures for routine use of K-edge densitometers and electromanometers were formulated, tested and introduced, and a programme for monitoring the performance of safeguards equipment was developed.

315. Further progress was achieved in designing specific safeguards approaches for inspection activities, in particular:

- Special attention was given to developing and improving safeguards approaches for sensitive facilities such as reprocessing, HEU and

mixed-oxide (MOX) fuel fabrication and ultracentrifuge uranium-235 enrichment plants. For these enrichment plants a "limited-frequency unannounced-access" concept was specially developed for the application of safeguards at process steps involving commercially sensitive information;

- The development of safeguards approaches for heavy-water production plants continued, a report on standardized safeguards procedures at PWRs was issued and work on standardization of safeguards procedures for other types of nuclear facilities continued.

In addition, further progress was achieved in the development of guidelines for designing nuclear facilities in such a way as to make the application of safeguards easier and in the development of advanced safeguards methods such as near-real-time material accountancy. Development of a safeguards effectiveness assessment methodology (SEAM) continued.

Safeguards information treatment and evaluation

316. Marked improvements were made in computerized safeguards data processing with regard to timeliness, quality and user-orientation, meeting essential needs for the timely evaluation of State reports and inspection data.

- By the end of 1982 the IAEA Safeguards Information System (ISIS) data base contained about two million records (accounting, design, inspection and other data). The quality of data in the data base was further improved.
- The routine preparation of computerized book inventory statements and of data on nuclear material in transit was undertaken in 1982.
- The recommendations for the improvement of reporting procedures were officially issued to 35 individual States and EURATOM. This led to greater efficiency in nuclear material accounting in international transit.

317. The processing of inspection reports and the preparation of statements to States pursuant to safeguards agreements based on INFCIRC/153 (Corrected) and on INFCIRC/66/Rev.2 continued to improve.

- 1642 inspection reports and 1275 inspection statements were reviewed.
- Quality assurance checks on the inspection report data relating to seals and surveillance were routinely carried out.
- At the end of 1982, a new computerized inspection reporting system for item facilities became operational for testing in parallel with the existing semi-manual system. In 1983 the system will be extended, after a test period, to bulk-handling facilities (BHF's).
- Computerized data were more extensively used for statistical, management and evaluation purposes; computer-assisted evaluation procedures were developed and used in preparing the SIRs for 1981 and 1982.

318. Data evaluation and quality control continued to be an important activity associated with the evaluation of inspection results.

- Data evaluation services were provided to the Divisions of Operations, in particular in connection with NDA data, with sampling plans for the examination of seals, and with inspection data from five reprocessing plant campaigns.
- A project for the computerized evaluation of verification using random statistical sampling plans was established for three BHF's.

Support by outside expert groups

319. A number of advisory group and similar meetings took place in 1982.

- The Standing Advisory Group on Safeguards Implementation (SAGSI) held two series of meetings, the main purpose of which was to consider the Group's advice to the Director General relating to a nuclear fuel cycle oriented study of safeguards approaches.
- Advisory groups and consultants' groups considered the evaluation of the quality of safeguards NDA measurements, and C/S instrumentation.
- The safeguards utilization of instrumentation installed at reprocessing plants and the application of isotopic correlation techniques were considered at research co-ordination meetings.

Co-operation between States and the Agency

320. Co-operation between States and the Agency continued to improve in 1982.

- The Agency continued to provide assistance to Member States in matters connected with the organization of SSACs.
- Committees and other regular forms of contact contributed to the solution of implementation problems.
- The joint team concept for implementing safeguards at major facilities in Member States of EURATOM continued to be applied with satisfactory results.
- Extensive R&D support continued to be provided by Australia, Canada, the Federal Republic of Germany, Japan, the Soviet Union, the United Kingdom and the United States. The programme for R&D co-operation with EURATOM continued successfully.

The Agency's resources

Manpower

321. The limited manpower available for inspection work remains an important problem. There was only a modest 5% increase in 1982 in the available

inspector man-years. However, the improved utilization of the available manpower, including the contribution of the field office and the resident inspector group, enabled the Agency to produce 6307 man-days of inspection at facilities (5061 man-days in 1981) - an increase of 25%.

- The number of staff in the field office in Canada and resident in Japan was increased, resulting in a more efficient utilization of inspection manpower in those areas.
- The programme of training for new inspectors and refresher courses for experienced inspectors continued.
- The first stage of the reorganization of the Department carried out in autumn 1982 resulted in an improved capability for co-ordinating safeguards implementation activities.

Equipment

322. The availability of equipment for performing NDA and implementing C/S measures improved to a certain extent. At the end of 1982, 21 types of safeguards equipment were on the list of items approved for routine use in inspections; five new equipment items, some of them specifically developed to support Agency safeguards implementation, progressed into the routine implementation stage during the year. The Agency continues to rely on the support of Member States in providing laboratories, experienced staff and test facilities for equipment that fulfils the needs of the Agency and meets the practical constraints within which the Agency must operate. A detailed study of the Agency's needs in regard to equipment was undertaken to cover the period from 1983 to 1988.

Table 2

States having significant nuclear activities
(at the end of the year indicated)

	Number of States		
	1980	1981	1982
NNW States with safeguards applied under NPT and/or Tlatelolco agreements	35	36	39
NNW States with safeguards applied under INFCIRC/66/Rev.2 agreements ^{a/}	13	12	11
Sub-total (NNW States in which safe- guards measures were implemented)	48	48	50
NNW State without safeguards agreement in force	1	1	0
Total number of NNW States with significant nuclear activities	49	49	50
NW States party to NPT	3	3	3
Other NW States	2	2	2
Total number of States with significant nuclear activities	54	54	55

^{a/} Some States with INFCIRC/66/Rev.2 agreements which have not yet been suspended, although NPT agreements have entered into force, are listed as falling under NPT agreements only.

Table 3

Approximate quantities of nuclear material subject to Agency safeguards except that covered by voluntary-offer agreements with NW States^{a/}

Type of nuclear material	Quantity of material (t)		Quantity in SQ
	in NNW States	in NW States ^{b/}	
Plutonium ^{c/} contained in irradiated fuel	78	5	10 370
Separated plutonium	5	1	738
HEU (equal to or greater than 20% uranium-235)	10	0 ^{d/}	270
LEU (less than 20% uranium-235)	16 000	782	5 300
Source material ^{a/} (natural or depleted uranium and thorium)	25 000	0	1 900
TOTAL			18 578

^{a/} This table does not include material within the terms of sub-paragraphs 34(a) and (b) of INFCIRC/153 (Corrected) - in essence, yellow cake. The material in question is not subject to inspection by the Agency.

^{b/} Excluding material in facilities selected for inspection under voluntary-offer agreements with NW States.

^{c/} The quantity includes an estimated 37 t (4700 SQ) of plutonium in irradiated fuel, which is not reported to the Agency under the reporting procedures agreed to (the non-reported plutonium is contained in irradiated fuel assemblies to which item accountancy and C/S measures are applied).

^{d/} Small quantities of HEU rounding to zero.

Table 4

Nuclear installations in NNW States^{a/} under safeguards or containing safeguarded nuclear material at the end of 1982

Installation category	Number of installations			
	INFCIRC/153 ^{b/}	INFCIRC/66/Rev.2	Total ^{c/}	
A. Power reactors	117	26	143	(130)
B. Research reactors and critical assemblies	151	26	177	(176)
C. Conversion plants	4	2	6	(4)
D. Fuel fabrication plants	32	7	39	(38)
E. Reprocessing plants	4	2	6	(6)
F. Enrichment plants	4	0	4	(4)
G. Separate storage facilities	21	2	23	(20)
H. Other facilities	41	1	42	(40)
I. Other locations	380	24	404	(422)
Totals	754	90	844	(840)

^{a/} As indicated in the title of the table only installations in NNW States are included.

^{b/} Covering safeguards agreements pursuant to NPT and/or Tlatelolco Treaty.

^{c/} Numbers for 1981 are indicated in parentheses for comparison.

Table 5

Situation on 31 December 1982 with respect to the signing of, the ratification of, or accession or succession to NPT by non-nuclear-weapon States and to the conclusion of safeguards agreements between the Agency and these States in connection with NPT

Non-nuclear-weapon States which have signed, ratified, acceded to or succeeded to NPT ^{a/}	Date of ratification, accession or succession ^{a/}	Safeguards agreement with the Agency	INFCIRC
(1)	(2)	(3)	(4)
Afghanistan	4 February 1970	In force: 20 February 1978	257
Antigua and Barbuda	1 November 1981		
Australia	23 January 1973	In force: 10 July 1974	217
Austria	27 June 1969	In force: 23 July 1972	156
Bahamas	10 July 1973		
Bangladesh	27 September 1979	In force: 11 June 1982	301
Barbados	21 February 1980		
Belgium	2 May 1975	In force: 21 February 1977	193
Benin	31 October 1972		
Bolivia ^{b/}	26 May 1970	Signed: 23 August 1974	
Botswana	28 April 1969		
Bulgaria	5 September 1969	In force: 29 February 1972	178
Burundi	19 March 1971		
Canada	8 January 1969	In force: 21 February 1972	164
Cape Verde	24 October 1979		
Central African Republic	25 October 1970		
Chad	10 March 1971		
China, Republic of	27 January 1970		-
Colombia ^{e/}			
Congo	23 October 1978		
Costa Rica ^{b/}	3 March 1970	In force: 22 November 1979	278
Cyprus	10 February 1970	In force: 26 January 1973	189
Czechoslovakia	22 July 1969	In force: 3 March 1972	173
Democratic Kampuchea	2 June 1972		
Democratic Yemen	1 June 1979		
Denmark ^{c/}	3 January 1969	In force: 21 February 1977	193
Dominican Republic ^{b/}	24 July 1971	In force: 11 October 1973	201
Ecuador ^{b/}	7 March 1969	In force: 10 March 1975	231
Egypt	26 February 1981	In force: 30 June 1982	302
El Salvador ^{b/}	11 July 1972	In force: 22 April 1975	232
Ethiopia	5 February 1970	In force: 2 December 1977	261
Fiji	14 July 1972	In force: 22 March 1973	192
Finland	5 February 1969	In force: 9 February 1972	155
Gabon	19 February 1974	Signed: 3 December 1979	
Gambia	12 May 1975	In force: 8 August 1978	277
German Democratic Republic	31 October 1969	In force: 7 March 1972	181
Germany, Federal Republic of	2 May 1975	In force: 21 February 1977	193
Ghana	5 May 1970	In force: 17 February 1975	226
Greece ^{f/}	11 March 1970	Accession: 17 December 1981	193
Grenada	19 August 1974		
Guatemala ^{b/}	22 September 1970	In force: 1 February 1982	299
Guinea-Bissau	20 August 1976		
Haiti ^{b/}	2 June 1970	Signed: 6 January 1975	
Holy See	25 February 1971	In force: 1 August 1972	187
Honduras ^{b/}	16 May 1973	In force: 18 April 1975	235
Hungary	27 May 1969	In force: 30 March 1972	174
Iceland	18 July 1969	In force: 16 October 1974	215
Indonesia	12 July 1979	In force: 14 July 1980	283
Iran, Islamic Republic of	2 February 1970	In force: 15 May 1974	214
Iraq	29 October 1969	In force: 29 February 1972	172
Ireland	1 July 1968	In force: 21 February 1977	193
Italy	2 May 1975	In force: 21 February 1977	193
Ivory Coast	6 March 1973	Approved by the Board, Feb. 1983	
Jamaica ^{b/}	5 March 1970	In force: 6 November 1978	265
Japan	8 June 1976	In force: 2 December 1977	255

(1)	(2)	(3)	(4)
Jordan	11 February 1970	In force: 21 February 1978	258
Kenya	11 June 1970		
Korea, Republic of	23 April 1975	In force: 14 November 1975	236
Kuwait ^{e/}			
Lao People's Democratic Republic	20 February 1970		
Lebanon	15 July 1970	In force: 5 March 1973	191
Lesotho	20 May 1970	In force: 12 June 1973	199
Liberia	5 March 1970		
Libyan Arab Jamahiriya	26 May 1975	In force: 8 July 1980	282
Liechtenstein	20 April 1978	In force: 4 October 1979	275
Luxembourg	2 May 1975	In force: 21 February 1977	193
Madagascar	8 October 1970	In force: 14 June 1973	200
Malaysia	5 March 1970	In force: 29 February 1972	182
Maldives	7 April 1970	In force: 2 October 1977	253
Mali	10 February 1970		
Malta	6 February 1970		
Mauritius	25 April 1969	In force: 31 January 1973	190
Mexico ^{b/}	21 January 1969	In force: 14 September 1973	197
Mongolia	14 May 1969	In force: 5 September 1972	188
Morocco	27 November 1970	In force: 18 February 1975	228
Nauru	7 June 1982		
Nepal	5 January 1970	In force: 22 June 1972	186
Netherlands ^{d/}	2 May 1975	In force: 21 February 1977	193
New Zealand	10 September 1969	In force: 29 February 1972	185
Nicaragua ^{b/}	6 March 1973	In force: 29 December 1976	246
Nigeria	27 September 1968		
Norway	5 February 1969	In force: 1 March 1972	177
Panama	13 January 1977		
Papua New Guinea	25 Jan 1982		
Paraguay ^{b/}	4 February 1970	In force: 20 March 1979	279
Peru ^{b/}	3 March 1970	In force: 1 August 1979	273
Philippines	5 October 1972	In force: 16 October 1974	216
Poland	12 June 1969	In force: 11 October 1972	179
Portugal	15 December 1977	In force: 14 June 1979	272
Romania	4 February 1970	In force: 27 October 1972	180
Rwanda	20 May 1975		
St. Lucia	28 December 1979		
Samoa	17 March 1975	In force: 22 January 1979	268
San Marino	10 August 1970	Approved by the Board, Feb.1977	
Senegal	17 December 1970	In force: 14 January 1980	276
Sierra Leone	26 February 1975	Signed: 10 November 1977	
Singapore	10 March 1976	In force: 18 October 1977	259
Solomon Islands ^{d/}	17 June 1981		
Somalia	5 March 1970		
Sri Lanka	5 March 1979	Signed: 5 July 1980	
Sudan	31 October 1973	In force: 7 January 1977	245
Suriname ^{b/}	30 June 1976	In force: 2 February 1979	269
Swaziland	11 December 1969	In force: 28 July 1975	227
Sweden	9 January 1970	In force: 14 April 1975	234
Switzerland	9 March 1977	In force: 6 September 1978	264
Syrian Arab Republic	24 September 1969		
Thailand	7 December 1972	In force: 16 May 1974	241
Togo	26 February 1970		
Tonga	7 July 1971	Approved by the Board, Feb.1975	
Trinidad and Tobago ^{e/}			

(1)	(2)	(3)	(4)
Tunisia	26 February 1970		
Turkey	17 April 1980	In force: 1 September 1981	295
Tuvalu	19 January 1979		
Uganda	20 October 1982		
United Republic of Cameroon	8 January 1969		
Upper Volta	3 March 1970		
Uruguay ^{b/}	31 August 1970	In force: 17 September 1976	157
Venezuela ^{b/}	26 September 1975	In force: 11 March 1982	300
Viet Nam	14 June 1982		
Yemen Arab Republic ^{e/}			
Yugoslavia	3 March 1970	In force: 28 December 1973	204
Zaire	4 August 1970	In force: 9 November 1972	183

a/ The information reproduced in columns (1) and (2) was provided to the Agency by the depositary Governments of NPT, and an entry in column (1) does not imply the expression of any opinion on the part of the Secretariat concerning the legal status of any country or territory or of its authorities, or concerning the delimitation of its frontiers.

b/ The relevant safeguards agreement was concluded in connection with both NPT and the Tlatelolco Treaty.

c/ The NPT safeguards agreement with Denmark (INFCIRC/176), in force since 1 March 1972, has been replaced by the agreement of 5 April 1973 between the non-nuclear-weapon States of EURATOM, EURATOM and the Agency (INFCIRC/193) but still applies to the Faroe Islands.

d/ An agreement had also been concluded in respect of the Netherlands Antilles (INFCIRC/229). This agreement entered into force on 5 June 1975.

e/ The following States had signed NPT but not yet ratified it: Colombia, on 1 July 1968; Kuwait, on 15 August 1968; Trinidad and Tobago, on 22 August 1968; and the Yemen Arab Republic, on 23 September 1968.

f/ The application of Agency safeguards in Greece under the agreement INFCIRC/166, provisionally in force since 1 March 1972, was suspended on 17 December 1981, at which date Greece acceded to the agreement of 5 April 1973 (INFCIRC/193) between the non-nuclear-weapon States of EURATOM, EURATOM and the Agency.

g/ The Agency was notified on 11 November 1982.

Table 6

Agreements providing for safeguards, other than those
in connection with NPT,
approved by the Board as of 31 December 1982

Party(ies) ^{a/}	Subject	Entry into force	INFCIRC
(While the Agency is a party to each of the following agreements, only the State(s) party to them is (are) listed.)			
(a) Project Agreements			
Argentina	Siemens SUR-100	13 March 1970	143
	RAEP Reactor	2 Decemoer 1964	62
Chile	Herald Reactor	19 December 1969	137
Finland ^{b/}	FiR-1 Reactor	30 December 1960	24
	FINN sub-critical assembly	30 July 1963	53
Greece ^{b/}	GRR-1 Reactor	1 March 1972	163
Indonesia ^{b/}	Additional core-load for TRIGA Reactor	19 December 1969	136
Iran, Islamic Republic of ^{b/}	UTRR Reactor	10 May 1967	97
Japan ^{b/}	JRR-3	24 March 1959	3
Malaysia ^{c/} /United States	TRIGA-II Reactor	22 September 1980	287
Mexico ^{b/}	TRIGA-III Reactor	18 December 1963	52
	Siemens SUR-100	21 December 1971	162
	Laguna Verde Nuclear Power Plant	12 February 1974	203
Pakistan	PRR Reactor	5 March 1962	34
	Booster rods for KANUPP	17 June 1968	116
Peru ^{c/}	Research Reactor and fuel therefor	9 May 1978	266
Philippines ^{b/}	PRR-1 Reactor	28 September 1966	88
Romania ^{b/}	TRIGA Reactor	30 March 1973	206
Spain	Coral-I Reactor	23 June 1967	99
Turkey ^{b/}	Sub-critical assembly	17 May 1974	212
Uruguay ^{b/}	URR Reactor	24 September 1965	67
Venezuela ^{b/}	RV-1 Reactor	7 November 1975	238
Yugoslavia ^{b/}	TRIGA-II Reactor	4 October 1961	32
	Krško Nuclear Power Plant	14 June 1974	213
Zaire ^{b/}	TRICO Reactor	27 June 1962	37
(b) Unilateral submissions			
Argentina	Atucha Power Reactor Facility	3 October 1972	168
	Nuclear material	23 October 1973	202
	Embalse Power Reactor Facility	6 December 1974	224
	Equipment	22 July 1977	250
	Nuclear material, material, equipment and facilities	22 July 1977	251
	Atucha II Nuclear Power Plant	15 July 1981	294
	Heavy water plant	14 October 1981	296
	Heavy water	14 October 1981	297
	Nuclear material	8 July 1982	303
Chile	Nuclear material	31 December 1974	256
	Nuclear material	22 September 1982	304
Cuba	Nuclear research reactor and fuel therefor	25 September 1980	298
	Nuclear power plant and nuclear material	5 May 1980	281
Democratic People's Republic of Korea	Research Reactor and nuclear material for this reactor	20 July 1977	252
India	Nuclear material, material and facilities	17 November 1977	260
Pakistan	Nuclear material	2 March 1977	248
Spain	Nuclear material	19 November 1974	218
	Nuclear material	18 June 1975	221
	Vandellos Nuclear Power Plant	11 May 1981	292
	Four nuclear facilities	11 May 1981	291
United Kingdom	Nuclear material	14 December 1972	175
Viet Nam	Research reactor and fuel therefor	12 June 1981	293

Party(ies) ^{a/}	Subject	Entry into force	INFCIRC
(c) Tlatelolco Treaty			
Colombia	All nuclear material	22 December 1982	
Mexico ^{b/}	All nuclear material, equipment and facilities	6 September 1968	118
Panama	All nuclear material		
(d) Agreements concluded with nuclear-weapon States on the basis of voluntary offers			
France	Nuclear material in facilities submitted to safeguards	12 September 1981	290
United Kingdom	Nuclear material in facilities designated by the Agency	14 August 1978	263
United States	Nuclear material in facilities designated by the Agency	9 December 1980	288
(e) Other agreements			
Argentina/United States of America		25 July 1969	130
Australia ^{b/} /United States of America		26 September 1966	91
Austria ^{b/} /United States of America		24 January 1970	152
Brazil/Germany, Federal Republic of ^{b/}		26 February 1976	237
Brazil/United States of America		31 October 1968	110
Colombia/United States of America		9 December 1970	144
India/Canada ^{b/}		30 September 1971	211
India/United States of America		27 January 1971	154
Iran, Islamic Republic of ^{b/} /United States of America		20 August 1969	127
Israel/United States of America		4 April 1975	249
Japan ^{b/} /Canada ^{b/}		20 June 1966	85
Japan ^{b/} /France		22 September 1972	171
Japan/United States of America		10 July 1968	119
Japan ^{b/} /United Kingdom		15 October 1968	125
Korea, Republic of/United States of America		5 January 1968	111
Korea, Republic of ^{b/} /France		22 September 1975	233
Pakistan/Canada		17 October 1969	135
Pakistan/France		18 March 1976	239
Philippines ^{b/} /United States of America		19 July 1968	120
Portugal ^{b/} /United States of America ^{b/}		19 July 1969	131
South Africa/United States of America		26 July 1967	98
South Africa/France		5 January 1977	244
Spain/Germany, Federal Republic of ^{b/}		29 September 1982	305
Spain/United States of America		9 December 1966	92
Spain/Canada ^{b/}		10 February 1977	247
Sweden ^{b/} /United States of America		1 March 1972	165
Switzerland ^{b/} /United States of America ^{b/}		28 February 1972	161
Turkey/United States of America		5 June 1969	123
Venezuela/United States of America		27 March 1968	122
(f) The Agency also applies safeguards under two agreements (INFCIRC/133 and INFCIRC/158) to the nuclear facilities in the territory of Taiwan.			

^{a/} An entry in this column does not imply the expression of any opinion whatsoever on the part of the Secretariat concerning the legal status of any country or territory or of its authorities or concerning the delimitation of its frontiers.

^{b/} Application of Agency safeguards under this agreement has been suspended in the State indicated as the State has concluded an agreement in connection with NPT.

^{c/} The requirement for the application of safeguards under this agreement was satisfied by the application of safeguards pursuant to the agreement concluded by the State in connection with NPT.

Table 7

Nuclear facilities under Agency safeguards or containing safeguarded material on 31 December 1982

A. Nuclear power reactors

State ^{a/}	Abbreviated name of installation	Location	Subsidiary arrangements in force
Argentina	Atucha NPS	Lima	x
	Embalse PR	Embalse	-b/
Austria	Tullnerfeld	Zwentendorf	x
Belgium	BR3-CEN	Mol	x
	DOEL-1	Doel	x
	DOEL-2	Doel	x
	DOEL-3	Doel	-b/
	SEMO-1	Tihange	x
	SEMO-2	Tihange	-b/
Brazil	Angra-1	Angra dos Reis	x
Bulgaria	Kozloduy-I, Unit 1	Kozloduy	x
	Kozloduy-I, Unit 2	Kozloduy	x
	Kozloduy-II, Unit 1	Kozloduy	-b/
	Kozloduy-II, Unit 2	Kozloduy	-b/
Canada	Bruce A, Unit 1	Tiverton	x
	Bruce A, Unit 2	Tiverton	x
	Bruce A, Unit 3	Tiverton	x
	Bruce A, Unit 4	Tiverton	x
	Bruce B, Unit 1	Tiverton	-b/
	Bruce B, Unit 2	Tiverton	-b/
	Bruce B, Unit 3	Tiverton	-b/
	Bruce B, Unit 4	Tiverton	-b/
	Douglas Point	Tiverton	x
	Gentilly-1	Gentilly	x
	Gentilly-2	Gentilly	-b/
	NPD G.S.	Rolphton	x
	Pickering-1	Pickering	x
	Pickering-2	Pickering	x
	Pickering-3	Pickering	x
	Pickering-4	Pickering	x
	Pickering-5	Pickering	x
	Pickering-6	Pickering	x
	Pickering-7	Pickering	x
	Pickering-8	Pickering	x
Point Lepreau G.S.	Point Lepreau	-b/	
Czechoslovakia	A1	Bohunice	x
	V-1, Unit 1	Bohunice	x
	V-1, Unit 2	Bohunice	x
Finland	Loviisa-1	Loviisa	x
	Loviisa-2	Loviisa	x
	TVO-1	Olkiluoto	x
	TVO-2	Olkiluoto	x

State ^{a/}	Abbreviated name of installation	Location	Subsidiary arrangements in force
German Democratic Republic	Bruno Leuschner-I, Unit 1	Greifswald	x
	Bruno Leuschner-I, Unit 2	Greifswald	x
	Bruno Leuschner-II, Unit 1	Greifswald	x
	Bruno Leuschner-II, Unit 2	Greifswald	x
	Rheinsberg PWR	Rheinsberg	x
Germany, Federal Republic of	AVR	Jülich	-b/
	GFK-MZFR	Eggenstein-Leopoldshafen	x
	GKN	Neckarwestheim	x
	KKB	Brunsbüttel	x
	KKG	Grafenrheinfeld	-b/
	KKI	Onu	x
	KKK	Geesthacht-Krümmel	-b/
	KKS	Stade	x
	KKP-1	Philippsburg	x
	KKU	Stadland	x
	KNK	Eggenstein-Leopoldshafen	x
	KRB	Gundremmingen	x
	KWL	Lingen	x
	KWW	Würgassen	x
	KWO	Obrigheim	x
RWE-BIBLIS-A	Biblis	x	
RWE-BIBLIS-B	Biblis	x	
VAK-KAHL	Grosswelzheim	x	
Hungary	PAKS-I, Unit 1	Paks	x
India	RAPS Unit 1	Rajasthan	x
	RAPS Unit 2	Rajasthan	x
	TAPS Unit 1	Tarapur	x
	TAPS Unit 2	Tarapur	x
Italy	ENEL	Borgo-Sabatino	x
	ENEL	San Venditto	x
	ENEL	Caorso	x
	FERMI	Trino-Vercellese	x
Japan	Fugen	Tsuruga-Fukui	x
	Fukushima Dai-Ichi-1	Okuma-Fukushima	x
	Fukushima Dai-Ichi-2	Okuma-Fukushima	x
	Fukushima Dai-Ichi-3	Okuma-Fukushima	x
	Fukushima Dai-Ichi-4	Okuma-Fukushima	x
	Fukushima Dai-Ichi-5	Okuma-Fukushima	x
	Fukushima Dai-Ichi-6	Okuma-Fukushima	x
	Fukushima Dai-Ni-1	Naraha-Fukushima	x
	Fukushima Dai-Ni-2	Naraha-Fukushima	-b/
	Genkai-1	Kyushu	x
	Genkai-2	Kyushu	x
	Hamaoka-1	Hamaoka-cno	x
	Hamaoka-2	Hamaoka-cho	x
	Ikata-1	Nishiuwa-gun	x
	Ikata-2	Nishiuwa-gun	x
	JPDR	Tokai-Mura	x

State ^{a/}	Aboreviated name of installation	Location	Subsidiary arrangements in force	
Japan (cont'd)	Minama-1	Minama-Fukui	x	
	Mihama-2	Minama-Fukui	x	
	Minama-3	Minama-Fukui	x	
	N.S. Mutsu	Minato-Machi Mutsu	x	
	Ohi-1	Ohi-cho, Fukai-ken	x	
	Ohi-2	Ohi-cho, Fukai-ken	x	
	Shimane	Kashima-cho	x	
	Takahama-1	Takanama	x	
	Takahama-2	Takahama	x	
	Tokai-1	Tokai-Mura	x	
	Tokai-2	Tokai-Mura	x	
Tsuruga	Tsuruga	x		
Korea, Republic of	Kori-1	Pusan	x	
	Kori-2	Pusan	-b/	
	Wolsung-1	Ulsan	x	
Mexico	Laguna Verde 1	Alto Lucero	-b/	
	Laguna Verde 2	Alto Lucero	-b/	
Netherlands	GKN	Dodewaard	x	
	PZEM	Borssele	x	
Pakistan	KANUPP	Karachi	x	
South Africa	Koeberg-1	Cape Town	x	
	Koeberg-2	Cape Town	x	
Spain	Almaraz-1	Almaraz	x	
	Almaraz-2	Almaraz	x	
	Asco-1	Asco	x	
	Asco-2	Asco	x	
	Cofrentes	Cofrentes	x	
	José Cabrera	Almonazid de Zorita	x	
	Lemoniz-1	Lemoniz	x	
	Lemoniz-2	Lemoniz	x	
	Santa María de Garona	Santa Maria de Garona	x	
	Vandellos	Vandellos	-b/	
Sweden	Barsebäck I	Malmö	-b/	
	Barsebäck II	Malmö	-b/	
	Forsmark I	Uppsala	-b/	
	Forsmark II	Uppsala	-b/	
	Oskarshamn I	Oskarshamn	x	
	Oskarshamn II	Oskarshamn	x	
	Ringhals I	Göteborg	x	
	Ringhals II	Göteborg	x	
	Ringhals III	Göteborg	-b/	
	Ringhals IV	Göteborg	-b/	
	Switzerland	KKB-I	Beznau	x
		KKB-II	Beznau	x
		KKG	Gösgen-Däniken	x
KKM		Mühleberg	x	
United States	Rancho Seco	Herald	x	
	Trojan	Rainier	x	
Yugoslavia	Krško	Krško	x	

B. Research reactors and critical assemblies

State ^{a/}	Abbreviated name of installation	Location	Subsidiary arrangements in force
Argentina	RA-1	Constituyentes	x
	RA-2	Constituyentes	x
	RA-3	Ezeiza	x
	RA-4	Rosario	x
	RA-6	Bariloche	-b/
Australia	HIFAR	Lucas Heights	x
	MOATA	Lucas Heights	x
	CF	Lucas Heights	x
Austria	ASTRA	Seibersdorf	x
	SAR	Graz	x
	Triga II	Vienna	x
Belgium	BR1-CEN	Mol	x
	BR2-CEN	Mol	x
	BRO2	Mol	x
	CEN-Venus	Mol	x
	Thetis	Gent	x
Brazil	IEAR-1	São Paulo	x
	RIEN-1	Rio de Janeiro	x
	Triga-CDTN	Belo Horizonte	x
Bulgaria	IRT-2000	Sofia	x
Canada	McMaster	Hamilton	x
	NRX	Chalk River	x
	NRU	Chalk River	x
	PTR	Chalk River	x
	Slowpoke-AECL	Ottawa	x
	Slowpoke-Dalhousie Univ.	Halifax	-b/
	Slowpoke-Ecole Polytechnique	Montreal	x
	Slowpoke-Saskatchewan	Saskatoon	-b/
	Slowpoke-Toronto University	Toronto	x
	Slowpoke-Univ. of Alberta	Edmonton	-b/
	WR-1	Pinawa	x
ZED-2	Chalk River	x	
Chile	La Reina	Santiago	x
	Lo Aguirre	Santiago	x
Colombia	IAN-R1	Bogotá	x ^{c/}
Czechoslovakia	LR-O	Rez	x
	SR-OB	Vochov	x
	SR-OD	Vochov	x
	VVR-S	Rez	x
Democratic People's Republic of Korea	Critical assembly	Nyonphyon	x
	IRT-DPRK	Nyonphyon	x
Denmark	DR-1	Roskilde	x
	DR-3	Roskilde	x

State ^{a/}	Abbreviated name of installation	Location	Subsidiary arrangements in force	
Egypt	Nuclear Research Centre	Inshas	x	
Finland	Triga II	Otaniemi	x	
German Democratic Republic	RAKE	Rosendorf	x	
	RRR	Rosendorf	x	
	Training Reactor AKR	Dresden	x	
	Training research reactor	Zittau	x	
	WWR-S M	Rosendorf	x	
Germany, Federal Republic of	FMRB	Braunschweig	x	
	FRF-2	Frankfurt	x	
	FRM	Garching	x	
	GFK-FR-2	Eggenstein-Leopoldshafen	x	
	GFK-SNEAK	Eggenstein-Leopoldshafen	x	
	GKSS-FRG1	Geesthacht	x	
	GKSS-FRG2	Geesthacht	x	
	KFA-FRJ1	Jülich	x	
	KFA-FRJ2	Jülich	x	
	KFA-ITR	Jülich	x	
	KFA-NEA	Jülich	x	
	KWU Hot Cell	Karlstein	x	
	SUR 100	Garching	x	
	SUR 100	Darmstadt	x	
	SUR 100	Stuttgart	x	
	SUR 100	Hamburg	x	
	SUR 100	Kiel	x	
	SUR 100	Ulm	x	
	SUR 100	Eggenstein-Leopoldshafen	x	
	SUR 100	Bremen	x	
	SUR 100	Furtwangen	x	
	SUR 100	Aachen	x	
	SUR 100	Hannover	x	
	Triga	Mainz	x	
	Triga II	Heidelberg	x	
	Triga	Hannover	x	
	Triga	Neunerberg	x	
		BER-2	Berlin (West)	x
		SUR 100	Berlin (West)	x
	Greece	GRR-1	Attiki	-b/
	Hungary	Training reactor	Budapest	x
		WWR-S M	Budapest	x
		ZR-4	Budapest	x
ZR-6		Budapest	x	
Indonesia	Gama	Yogyakarta	x	
	PPTN	Bandung	x	
Iran, Islamic Republic of	TSPRR	Teneran	x	
Iraq	IRT-5000	Baghdad Tuwaitha	x	
	Tamuz-2	Baghdad Tuwaitha	-b/	

State ^{a/}	Abbreviated name of installation	Location	Subsidiary arrangements in force
Israel	IRR-1	Soreq	x
Italy	AGN-201	Palermo	x
	CESNEF-L54	Milan	x
	ESSOR	Ispra	x
	RANA	Santa Maria di Galeria	x
	RB-1	Montecuccolino	x
	RB-2	Montecuccolino	x
	RB-3	Montecuccolino	x
	RITMO	Santa Maria di Galeria	x
	RTS-1	San Piero a Grado	x
	TAPIRO	Santa Maria di Galeria	x
	Triga-RC1	Santa Maria di Galeria	x
	Triga-2	Pavia	x
Japan	DCA	Oarai-Machi	x
	FCA	Tokai-Mura	x
	HTR	Kawasaki-sni	x
	JMTR	Oarai-Machi	x
	JMTR-CA	Oarai-Machi	x
	JOYO	Oarai-Machi	x
	JRR-2	Tokai-Mura	x
	JRR-3	Tokai-Mura	x
	JRR-4	Tokai-Mura	x
	Kinki University R.R.	Kowake	x
	KUCA	Kumatori-cho	x
	KUCA	Kumatori-cho	x
	KUCA	Kumatori-cho	x
	KUR	Kumatori-cho	x
	Musasni College R.R.	Kawasaki	x
	NSRR	Tokai-Mura	x
	NAIG-CA	Kawasaki-ku	x
	Rikkyo University R.R.	Nagasaka	x
	SHE	Tokai-Mura	x
	TCA	Tokai-Mura	x
	TODAI	Tokai-Mura	x
	TTR	Kawasaki-shi	x
Korea, Republic of	Triga II	Seoul	x
	Triga III	Seoul	x
	Kyung-Hee Univ.	Seoul	x
Libyan Arab Jamaniriya	IRT-TAJURA	Tajura	x
Malaysia	Puspati	Bangi, Selangor	<u>-b/</u>
Mexico	Triga	Ocoyoacac	x
	SUR 100	Mexico City	x
Netherlands	BARN	Wageningen	x
	HOR	Delft	x
	HFR	Petten	x
	LFR	Petten	x

State ^{a/}	Abbreviated name of installation	Location	Subsidiary arrangements in force
Norway	HBWR-Halden	Halden	x
	JEEP-II	Kjeller	x
Pakistan	PARR	Rawalpindi	x
Peru	RP-O	Lima	x
Philippines	PRR-1	Diliman, Quezon City	x
Poland	Agata	Swierk	x
	Anna	Swierk	x
	Ewa	Swierk	x
	Maria	Swierk	x
	Maryla	Swierk	x
Portugal	RPI	Sacavem	x
Romania	RP-01	Margurele	x
	Triga II	Pitesti-Colibasi	x
	VVR-S	Margurele	x
South Africa	SAFARI-1	Pelindaba	x
Spain	ARBI	Bilbao	x
	ARGOS	Barcelona	x
	CORAL-1	Madrid	x
	JEN-1 and JEN-2	Madrid	x
Sweden	R2	Studsvik	x
	R2-O	Studsvik	x
	RO	Studsvik	x
Switzerland	AGN 201P	Geneva	x
	AGN 211P	Basel	x
	Crocus	Lausanne	x
	Proteus	Würenlingen	x
	Sapnir	Würenlingen	x
Thailand	TRR-1	Bangkok	x
Turkey	TR-1	Istanbul	x
	ITU-TRR	Istanoul	x
Uruguay	Lockheed	Montevideo	x
Venezuela	RV-I	Altos de Pipe	x ^{d/}
Yugoslavia	RA	Vinča	x
	RB	Vinča	x
	Triga II	Ljubljana	x
Zaire	Triga-Zaire	Kinshasa	x

C. Conversion plants, including pilot plants with an annual throughput or inventory exceeding one effective kilogram

State ^{a/}	Abbreviated name of installation	Location	Subsidiary arrangements in force
Argentina	UO ₂ Conversion Plant	Cordoba	<u>-b/</u>
Canada	ENL	Port Hope	x
	ENL	Port Hope	x
Japan	Japan Nuclear Fuel Conversion Co. Ltd.	Tokai-Mura	x
	PNC Pilot Conversion Plant	Ningyo	<u>-b/</u>

D. Fuel fabrication plants, including pilot plants with an annual throughput or inventory exceeding one effective kilogram

State ^{a/}	Abbreviated name of installation	Location	Subsidiary arrangements in force
Argentina	Atucha Fuel Fabrication Plant	Ezeiza	<u>-b/</u>
	Fuel Fabrication Plant (CANDU)	Ezeiza	<u>-b/</u>
	Pilot Fuel Fabrication Plant (HEU)	Constituyentes	x
Belgium	Belgonucléaire-BN-MOX FBFC	Dessel	x
		Dessel	x
Brazil	Fuel Fabrication Plant Resende	Resende	<u>-b/</u>
Canada	CGE	Peterborough	x
	CGE	Toronto	x
	Combustion Engineering	Moncton	x
	CRNL Metallurgy	Chalk River	x
	CRNL Workshop	Chalk River	x
	CRNL Workshops	Chalk River	x
	ENL	Port Hope	x
	Noranda Metal	Montreal	x
	WCL	Varenes	x
	WCL	Port Hope	x
Denmark	Metallurgy	Roskilde	x
Germany, Federal Republic of	ALKEM	Wolfgang	<u>-b/</u>
	Exxon	Lingen	x
	NUKEM	Wolfgang	x
	RBU-1	Wolfgang	x
	RBU-2	Karlstein	x
India	NFC	Hyderabad	x
Iraq	ERLFF	Baghdad Tuwaitha	<u>-b/</u>
Italy	Comb. Nuc.	Pollicoro	x
	COREN	Saluggia	x
	Fabnuc	Bosco Marengo	x
	IFEC	Saluggia	x
Japan	JNF	Yokosuka	x
	MAPI Ohmiya	Ohmiya	x
	MNF	Tokai-Mura	x
	NFI (Kumatori-1)	Kumatori, Osaka	x
	NFI (Kumatori-2)	Kumatori, Osaka	x
	NFI (Tokai) Fuel Fabrication	Tokai-Mura	x
	NFI (Takayama-R&D)	Takayama	x
PPFF	Tokai-Mura	x	
Spain	Planta Metall. Juan Vigon Res. C.	Madrid	x
Sweden	ASEA - ATOM	Västeras	x
United States	Exxon Fuel Fabrication Plant	Ricnland	x

E. Chemical reprocessing plants including pilot plants with an annual throughput or inventory exceeding one effective kilogram

State ^{a/}	Abbreviated name of installation	Location	Subsidiary arrangements in force
Germany, Federal Republic of	WAK	Eggenstein-Leopoldshafen	x
India	PREFRE	Tarapur	x
Italy	EUREX ITREC-Trisaia	Saluggia Rotondella	x x
Japan	Tokai Reprocessing Plant	Tokai-Mura	x
Spain	Juan Vigon Research Centre	Madrid	x

F. Enrichment plants, including pilot plants with an annual throughput or inventory exceeding one effective kilogram

State ^{a/}	Abbreviated name of installation	Location	Subsidiary arrangements in force
Germany, Federal Republic of	Uranit	Jülich	- <u>b/</u>
Japan	PNC Pilot Enrichment Plant	Ningyo	- <u>b/</u>
Netherlands	URENCO Ultra-Centrifuge	Almelo Almelo	- <u>b/</u> - <u>b/</u>

G. Separate storage facilities

State ^{a/}	Abbreviated name of installation	Location	Subsidiary arrangements in force
Argentina	Store of Embalse fuel at Atucna	Atucna	- <u>b/</u>
Belgium	BN UF ₆ store	Dessel	- <u>b/</u>
	Eurochemic	Mol	x
	Overpelt	Olen	x
Canada	Bruce A	Tiverton	x
	Bruce B	Tiverton	- <u>b/</u>
	CRNL	Chalk River	x
	Pickering	Pickering	x
	WNRE	Pinawa	x
Czechoslovakia	A1	Bohunice	x
Denmark	Risø Store	Roskilde	x
France	COGEMA Storage Pond	La Hague	x
Germany, Federal Republic of	Braunkonle	Wesseling	x
	Bundeslager	Wolfgang	- <u>b/</u>
	Urananlage	Birkenfeld	x
	Lageranlage-Thorium	Hamm	- <u>b/</u>
Iraq	Separate storage facility	Baghdad Tuwaitha	- <u>b/</u>
Italy	AGIP	Bosco Marengo	x
	Ispra Central Storage	Ispra	x
Japan	KUFFS	Kyoto	- <u>b/</u>
Mexico	Temporary Storage for CLV Fuel	Alto Lucero	- <u>b/</u>
Pakistan	Storage at Government depot	Karachi Malir	x
Portugal	Instalacao de Armazenagens	Sacavem	x
Switzerland	Diorit Storage	Würenlingen	x
United Kingdom	Windscale PU-storage	Windscale	x
	Windscale Storage Pond	Windscale	x
United States	CP-5 Research Reactor facility	Argonne	x

H. Other facilities

State ^{a/}	Abbreviated name of installation	Location	Subsidiary arrangements in force
Australia	Research Laboratory	Lucas Heights	x
Belgium	BCMN	Geel	x
	BN	Mol	<u>-b/</u>
	CEN-Labo	Mol	x
	PULAB	Mol	x
Canada	CRNL Chemistry	Chalk River	x
	CRNL Fuel Engineering	Chalk River	x
	CRNL Health Science	Chalk River	x
	CRNL Physics	Chalk River	x
	CRNL Workshops	Chalk River	x
	WNRE	Pinawa	x
Czechoslovakia	Nuclear Fuel Inst. (UJB)	Zbraclau	x
	Research Laboratories	Rez	x
Denmark	Hotcell Plant	Roskilde	x
German Democratic Republic	Uran Technikum	Rossendorf	<u>-b/</u>
Germany, Federal Republic of	GFK-Hotcell	Eggenstein-Leopoldshafen	x
	GFK/IHCH	Eggenstein-Leopoldshafen	x
	GFK/IMF3	Eggenstein-Leopoldshafen	x
	KFA-Lab	Jülich	<u>-b/</u>
	Transuran	Eggenstein-Leopoldshafen	x
Hungary	Institute of Isotopes	Budapest	x
Italy	CNEN-LAB. TEC.	Santa Maria di Galeria	x
	CNEN-LAB.PU.	Santa Maria di Galeria	x
	Joint Research Centre	Ispra	<u>-b/</u>
Japan	JAERI-Oarai R&D	Oarai-Machi	x
	JAERI-Tokai R&D	Tokai-Mura	x
	NERL, University of Tokyo	Tokai-Mura	x
	NFD	Oarai-Machi	x
	NRF Neutron Radiation Facility	Sakura-Mura	x
	PNC Tokai R&D	Tokai-Mura	x
	PNC-Oarai R&D	Oarai-Machi	x
Netherlands	ECN+JRC	Petten	x
	Kema Lab.	Arnhem	x
	ZWO-Lab-Iso	Amsterdam	<u>-o/</u>
Norway	Research laboratories	Kjeller	x
Poland	Institute of Nuclear Research	Świerk	x
	Miscellaneous locations combined in one material balance area	Various	x
Romania	Demfuel	Pitesti-Colibasi	x

State ^{a/}	Abbreviated name of installation	Location	Subsidiary arrangements in force
Sweden	Central storage fresh fuel	Studsvik	x
	Central Hot Laboratory	Studsvik	x
Switzerland	Fed. Inst. of Reactor Research	Würenlingen	x

a/ An entry in this column does not imply the expression of any opinion whatsoever on the part of the Secretariat concerning the legal status of any country or territory or of its authorities, or concerning the delimitation of its frontiers.

b/ Under negotiation.

c/ Concluded pursuant to the Colombia/United States of America/Agency safeguards agreement (INFCIRC/144).

d/ Concluded pursuant to the Venezuela/United States of America/Agency safeguards agreement (INFCIRC/122).

Note: The Agency also was applying safeguards in the territory of Taiwan at six nuclear power stations, six research reactors/critical assemblies, one uranium pilot conversion plant, one fuel fabrication plant and one research and development facility.

INFORMATION AND TECHNICAL SERVICES

Scientific journals

323. Twelve regular issues of "Nuclear Fusion" were published, with sales somewhat higher than in 1981. The articles and papers in these issues involved authors and/or referees from more than 100 laboratories in 25 Member States.

324. The fourth edition of the "Nuclear Fusion" supplement "World Survey of Major Activities in Controlled Fusion Research" was published. It covers 200 laboratories in 33 Member States - including 11 developing countries.

325. A sub-committee of the Board of Editors of "Nuclear Fusion" was established in September and took up work already started on the development of a fusion thesaurus.

International Nuclear Information System (INIS)

326. Sixty-seven Member States and 14 international organizations were participating in INIS as of 31 December 1982, and their combined input to the data base exceeded 72 000 documents for the year. Two countries (Peru and Venezuela) that had been INIS members for some years submitted input during 1982 for the first time. By the end of 1982, the INIS bibliographic file exceeded 718 000 items and the file of non-commercial documents (technical reports, theses, etc.) available for sale in microfiche form exceeded 160 000 items.

327. The annual consultative meeting of INIS liaison officers was held in Vienna in May. Two workshops for experienced indexers and users were held; one, for Western Europe, took place in the Federal Republic of Germany and one, for Eastern Europe, in the Soviet Union. The exchange of experience which took place indicated the usefulness of such workshops in bringing to light areas in the operation of INIS which might be improved.

328. The Centre Services Unit, an organizational entity established within the INIS Section in 1981, helped to streamline the services provided for INIS Centres and to plan training activities. The INIS/ISIS computer software package used for searching the INIS tapes by means of small computers was installed by Agency staff on the computer of the INIS Centre in Baghdad. A training kit for instruction in or the self-teaching of procedures for the preparation of input to INIS was completed and was tested at Headquarters and at two national INIS Centres.

329. Work on the compilation of a new multilingual subject-indexing dictionary based on the "Thesaurus" was completed.[51] The machine-readable files of the English, French, German and Russian versions of the dictionary were merged and processed for photocomposition by using computer software developed by the International Centre for Scientific and Technical Information, Moscow; the Spanish translation was completed by the INIS Centre in Spain, ready for merging with the files in Vienna. The Russian translation of the "Thesaurus" prepared by the INIS Centre of the Soviet Union was issued.

[51] GC(XXVI)/664, para. 261.

330. Revised editions of several volumes in the INIS Reference Series were prepared, including "Authority List for Corporate Entries and Report Number Prefixes" (IAEA-INIS-6), "INIS Character Set Representation and Coding Rules" (IAEA-INIS-7), "Authority List for Journal Titles" (IAEA-INIS-11), the "Thesaurus" (IAEA-INIS-13) - with German and Russian versions - and "Manual for On-Line Retrieval" (IAEA-INIS-17).

331. By the end of last year, 35 Member States were using the direct on-line access to the INIS and AGRIS data bases; connect time for external users totalled 1650 hours, an increase of about 16% over 1981. The format of the on-line data base was restructured in order to increase the flexibility and efficiency of on-line searching.

332. An indication of the value that Member States attach to INIS is the fact that two Member States (Canada and the Federal Republic of Germany) requested magnetic tape copies of the complete INIS data base, which has now been loaded on computers and is being used in providing retrieval services in those two countries. Also, Saudi Arabia ordered a complete set, in microfiche form, of all the non-conventional literature available from INIS (over 170 000 microfiches).

Table 8

INIS statistics

	<u>1981</u>	<u>1982</u>
Number of records added to the data base	70 788	72 690
Number of microfiches distributed	480 000	406 000
Number of full microfiche subscriptions	35	33
Number of participating Member States	67	67
Number of participating international organizations	14	14
Direct access usage (connect hours)	1 418	1 650

Library services

333. During 1982 the Library's book collection grew by 4300 volumes to reach a total of about 64 000; the journal collection grew by 280 titles to a total of about 3000. The Library answered 9300 reference questions and lent out about 17 000 books and 430 films.

334. Alterations involving the removal of partitions were completed, permitting the move of certain library services to locations where they can function more effectively.

335. Further progress was made in the computerization of Library procedures, and the automated loan system was completed, tested and put into operation.

Computer services

336. Overall computer usage was 30% higher in 1982 than in 1981 even though safeguards usage was 15% less. An IBM 3081 was installed in August, in time to avoid an announced 10% price increase, and is providing excellent service.

337. Installed word-processing hardware doubled to over 50 work-stations, and more than 150 new users were trained; this has led to increased productivity and to cost savings in correspondence and document production. Also, the use of computer-aided graphics (i.e. the portrayal of data in graph and other forms with the help of computers) increased significantly.

Publishing and printing services

338. The net income to the Agency from the sale of Agency publications (including INIS and CINDA publications) was \$1.19 million in 1982, compared with \$1.08 million in 1981 and \$1.26 million in 1980.

339. The printing services provided to the United Nations and UNIDO yielded an income of approximately \$1.25 million in 1982, compared with \$895 197 in 1981.

A D M I N I S T R A T I O N

Legal affairs

Regional co-operation

340. The Regional Co-operative Agreement (RCA) for Research, Development and Training Related to Nuclear Science and Technology, concluded in 1972 and extended for a period of five years in 1977[52], was extended for a further period of five years with effect from 12 June 1982[53]. By the end of 1982, the RCA as thus extended was in force for the Agency and the following 13 Member States in Asia and the Pacific region: Australia, Bangladesh, India, Indonesia, Japan, the Republic of Korea, Malaysia, Pakistan, the Philippines, Singapore, Sri Lanka, Thailand and Viet Nam.

341. In October, the Government of Viet Nam notified the Director General of its acceptance of the Agreement Establishing the Asian Regional Co-operative Project on Food Irradiation[54] within the framework of RCA. By the end of 1982, the Agreement was in force for the Agency and the following 11 Member States: Bangladesh, India, Indonesia, Japan, the Republic of Korea, Malaysia, Pakistan, the Philippines, Sri Lanka, Thailand and Viet Nam.

Advisory services

342. As a follow-up to the advisory services provided to Chile in 1981, which resulted in the passing of a law on nuclear safety and nuclear third-party liability in October 1982, advice was given on the elaboration of regulations for the licensing of activities involving radioactive materials and nuclear installations and for the physical protection of nuclear materials.

343. Also, advice was given to Uruguay on the framing of legislation concerning radiation protection and nuclear safety and on related organizational and regulatory matters.

Physical protection

344. By the end of 1982, 33 States and one regional organization had signed the Convention on the Physical Protection of Nuclear Material[55] and six States had ratified it. Pursuant to Article 19 of the Convention, 21 ratifications are required for its entry into force.

[52] The text of the RCA is reproduced in document INFCIRC/167 and that of the first extension agreement in document INFCIRC/167/Add.8.

[53] The second extension agreement, of 1 April 1982, is reproduced in document INFCIRC/167/Add.11.

[54] Reproduced in document INFCIRC/285.

[55] Reproduced in document INFCIRC/274/Rev.1. There were three ratifications in 1982 - see para. 270 of document GC(XXVI)/664.

International spent fuel management

345. The Expert Group on International Spent Fuel Management completed its work in July 1982. Experts from 24 Member States and three international organizations took part in the Group's work, which started in 1979 and the purpose of which was to examine the potential for international co-operation in the management of spent fuel from nuclear reactors. An essential finding was that, for a number of countries, international co-operation might offer advantages over strictly national approaches as regards the economic and management aspects of spent fuel storage. The necessary groundwork on international aspects of shared storage arrangements was done by the Group, and the conceptual work performed by it would facilitate the consideration of co-operative arrangements among interested parties.

International plutonium storage

346. In October 1982, the Expert Group on International Plutonium Storage (IPS) completed its work, which was started in 1978. The purpose of the Group's study, in which experts from 34 Member States and one international organization took part, was to examine the technical and operational aspects of establishing an IPS system within the framework of the Agency, including the harmonization of IPS procedures with existing safeguards. In its final report, the Expert Group identified three alternative approaches to procedures for implementing an IPS system and provided supporting material on international plutonium stores and possible institutional arrangements.

Fuel supply arrangements

347. On 20 December 1982 the Agency and the Governments of the United States of America and Yugoslavia amended the fourth supply agreement, concluded between them on 16 January 1980, in connection with the Agency's assistance to Yugoslavia for the transfer of enriched uranium from the United States for a research reactor in Yugoslavia[56]. The amendment provides for the transfer to Yugoslavia, through the Agency, of approximately 5098 grams of low-enriched uranium.

Host country arrangements

348. An agreement between the Agency and Austria was concluded on 1 March 1982 for the inclusion of the Agency's laboratories at Seibersdorf in the Headquarters of the Agency. The agreement includes provisions regarding operational safety.

Privileges and immunities

349. The Agreement on the Privileges and Immunities of the Agency[57] was accepted by two more Member States - namely, Cuba and Jordan. By the end of 1982, 52 Member States were parties to the Agreement.

[56] The text of the fourth supply agreement is reproduced in document INFCIRC/32/Add.4, part I.

[57] Reproduced in document INFCIRC/9/Rev.2.

Vienna International Centre

350. Last year was a further year of consolidation at the VIC, where efforts were made to apply strict measures aimed at economy of maintenance and operation.

351. Numerous energy-saving measures recommended by engineering consultants were introduced and, thanks to these measures, it was possible to absorb the energy consumption resulting from additional office automation.

352. The operation and maintenance of heating, ventilation and other facilities, previously in the hands of an outside contractor, were taken over by in-house staff of UNIDO, with a consequent substantial reduction in costs.

353. By the end of 1982, most repairs of construction faults had been completed by the constructors.

Personnel

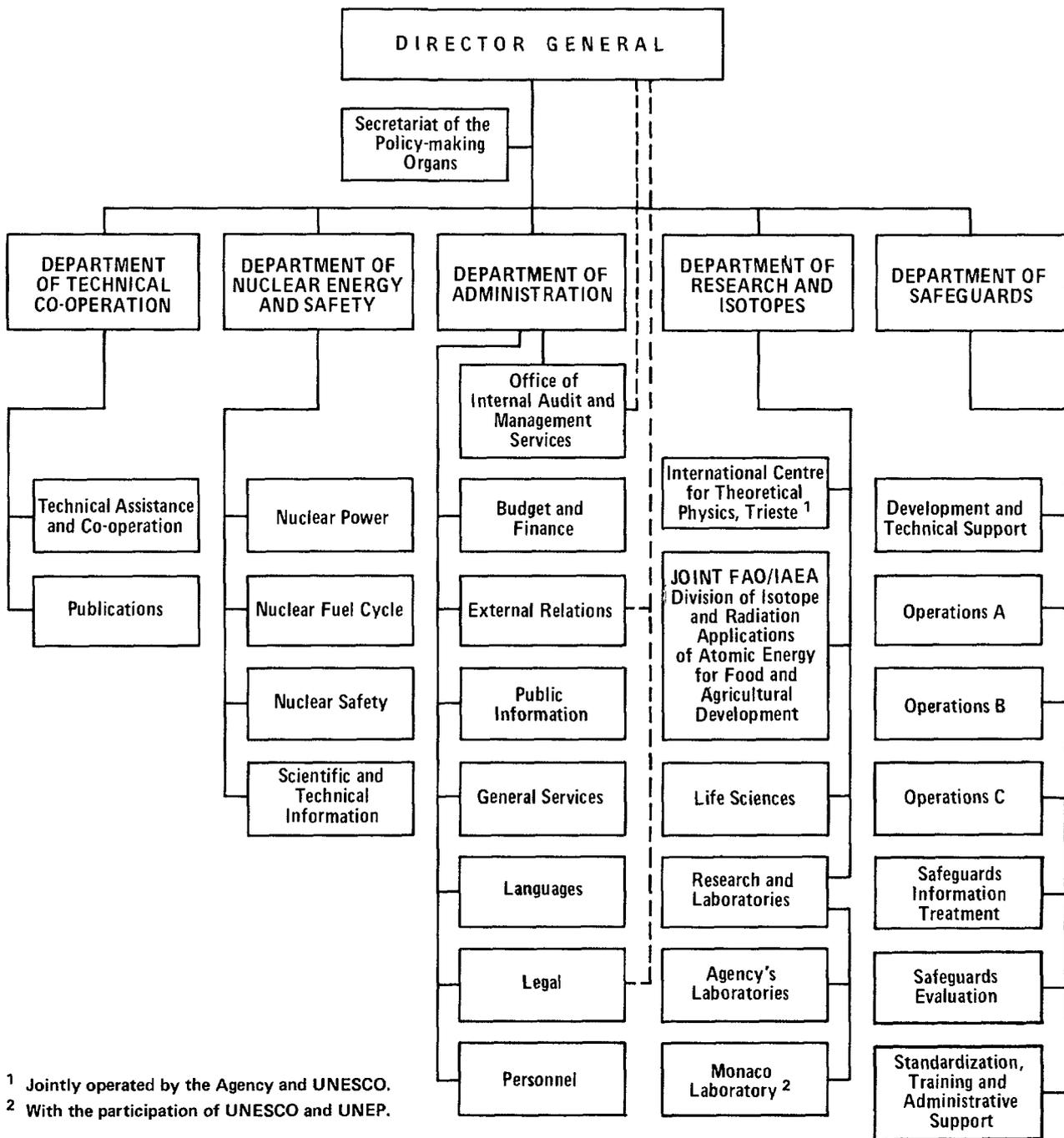
354. In 1982, 195 staff members left the Agency and 253 were appointed. Of the new staff members, 96 were in the Professional and higher categories.

355. At the end of 1982, the Secretariat had 1718 staff members - 610 in the Professional and higher categories, 973 in the General Service category and 135 in the Maintenance and Operatives Service category[58]. Among the staff in posts subject to geographical distribution, 72 nationalities were represented.

356. The following organizational chart shows the structure of the Secretariat.

[58] These figures consist of filled manning-table posts (1369), staff charged to manning-table posts (114), to temporary assistance fund (90), to consultancy funds (9), staff on reimbursement basis (123) and staff on secondment (13).

ORGANIZATIONAL CHART *



[*] This organizational chart was approved and became effective only in 1983.

