THE ANNUAL REPORT FOR 1980

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INTERNATIONAL ATOMIC ENERGY AGENCY

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CONTENTS

LIST OF ABBREVIATIONS

Agency	International Atomic Energy Agency
AGRIS	Agricultural Information System
BWR	Boiling-water reactor
CEC	Commission of the European Communities
CERN	European Organization for Nuclear Research
CMEA	Council for Mutual Economic Assistance
ECE	Economic Commission for Europe (of the United Nations)
EURATOM	European Atomic Energy Community
FAO	Food and Agriculture Organization of the United Nations
IAEA	International Atomic Energy Agency
ICRP	International Commission on Radiological Protection
IIASA	International Institute for Applied Systems Analysis
ILO	International Labour Organisation
INFCE	International Nuclear Fuel Cycle Evaluation
ISO	International Organization for Standardization
LWR	Light-water reactor
MW(e)	Megawatt (electric)
NEA	Nuclear Energy Agency of the Organisation for Economic Co-operation and Development
NPT	Treaty on the Non-Proliferation of Nuclear Weapons
OECD	Organisation for Economic Co-operation and Development
PWR	Pressurized-water reactor
RCA	Regional Co-operative Agreement for Research, Development and Training Related to Nuclear Science and Technology (INFCIRC/167)
SIDA	Swedish International Development Authority
SWU	Separative work unit
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
UNIDO	United Nations Industrial Development Organization
UNSCEAR	United Nations Scientific Committee on the Effects of Atomic Radiation
VIC	Vienna International Centre
WHO	World Health Organization
WMO	World Meteorological Organization

All sums of money are expressed in United States dollars.

INTRODUCTION

Nuclear power

1. On several occasions during 1980, many of the world's leading statesmen as well as senior officials responsible for energy planning and representatives of countries in all parts of the world reaffirmed that a major and steady expansion of nuclear power was indispensable for future economic well-being. The Heads of State and Governments attending the OECD "Summit Meeting" at Venice in June unanimously declared this to be their view and policy. INFCE had reached the same conclusion in February, and it was also reaffirmed at the World Energy Conference in September. The 26th Congress of the Communist Party of the Soviet Union assigned a leading role to nuclear power in the future expansion of Soviet electricity-generating capacity when approving the current five-year plan. The spokesmen of developing countries reaffirmed their countries' needs at the Second NPT Review Conference at Geneva in August. The World Energy Conference also stressed the indirect as well as the direct importance of nuclear power for the Third World by urging industrialized countries not to compete unnnecessarily with developing countries in the fossil fuel market.

2. The energy supply situation deteriorated during the year, with the f. o. b. price of oil rising by 24% (to $34 a barrel) and that of steam coal by 45%; the price of oil has risen by 180% in the past five years.

3. Many OECD countries nevertheless remained in the paradoxical situation that, while they have little or no fossil fuel of their own and are struggling with growing balance of payment deficits because of the rising cost of imported energy, they are unable to resume the nuclear energy programmes they had previously planned and which their own leaders continue to proclaim vital. In fact, OECD projections for future nuclear power growth fell during 1980 by 30% below those which had been given to INFCE in 1979.

4. This paradox, which has often been analysed, is doubtless due partly to economic factors such as recession, the resulting slow-down in some countries of the rate of growth of electricity demand, inflation, high interest rates and the difficulties which utilities in the United States are experiencing in obtaining new capital. Nevertheless, an overriding factor is still the problem of public acceptance - concern about the safety of nuclear power and the disposal of nuclear waste and the widely differing impacts on the public mind of various kinds of risk. A good illustration of this emerges from the Three Mile Island accident. The Presidential Commission set up to review the causes and results of the accident concluded that the radiation exposure which it caused would "lead to no additional cancer deaths or, if there were any, they would be so few that they could not be detected" amongst the more than two million people living within a 50-mile radius of the plant. In the same population, about 325 000 cancer deaths must be expected from other causes.

5. It would be reasonable to expect that, as the cost of energy rises and as the environmental and health impacts of other forms of energy generation become more widely understood and the prospects of renewable sources more realistically assessed, nuclear energy will begin to resume the growth rate it once had. Some political developments may presage such a trend - for instance, the Swedish nuclear referendum of March 1980 (which reversed an earlier decision not to take any further nuclear power plants into operation), the fact that in Italy two major parties which previously opposed nuclear energy are now reported to regard it as necessary and the support for nuclear power expressed by the new United States Administration.

Nuclear safety and the environment

6. In nuclear safety matters, one of the main events of the year was the Agency's International Conference on Current Nuclear Power Plant Safety Issues from 20 to 24 October in Stockholm. It was attended by some 700 experts and policy-makers from developing and

industrial Member States and by representatives of several international organizations. The general conclusion of the Conference was that there is no factor relevant to safety that limits the use and development of nuclear power.

7. However, the Conference stressed the importance of improving the training of operators and of control equipment so as to ensure that the persons operating a nuclear power plant have full understanding and control of the processes taking place in the plant and are able to ensure that small accidents do not turn into more serious ones. The Conference also underlined the importance of the exchange of information about abnormal events at nuclear power plants.

8. It should again be mentioned that no radiation-induced death and no serious radiation-induced injury took place at any nuclear power plant in 1980 - or in any year since the first nuclear power reactor went critical, in 1956.

Safeguards and NPT

9. By the end of 1980 approximately 98% of the nuclear facilities of which the Agency was aware outside the nuclear-weapon States were under Agency safeguards; in addition, a few facilities in nuclear-weapon States are currently under Agency safeguards. Once again, no diversion of a significant amount of nuclear material was detected and the Agency considered that it was reasonable to conclude that all safeguarded material remained in peaceful nuclear activities or was otherwise adequately accounted for.

10. In fact, by the end of 1980, unsafeguarded nuclear plants were, as far as the Agency is aware, in operation or under construction in only six States apart from the nuclear-weapon States[1]. However, the unsafeguarded facilities being operated or built in four or these six States, as well as those in nuclear-weapon States, are capable of making weapons-grade nuclear material.

11. Developments in the latter part of the year drew attention to the problems of applying safeguards in circumstances of armed conflict. However, it did prove possible to make arrangements for carrying out inspections in the countries concerned.

12. During the year two more non-nuclear-weapon States (Barbados and Turkey) became party to NPT, while Viet Nam indicated that it did not regard itself bound by the decision of the former administration in South Viet Nam and should not be considered a party to the Treaty. The total number of parties thus rose to 110[2]. The number of NPT parties that had safeguards agreements in force increased from 67 to 69.

13. Towards the end of 1980 the Agency designated certain facilities of advanced design for routine inspections under the agreement for the application of safeguards to civil nuclear plants in the United Kingdom. A similar agreement with the United States entered into force on 9 December 1980, the first designations being made early in 1981.

14. The amount of nuclear material under safeguards again increased substantially. The amount of plutonium contained in irradiated fuel rose by 30%, to 78 tonnes (that of separated plutonium, however, decreased from 8 tonnes to 5 tonnes), that of highly enriched uranium increased by 18%, to 13 tonnes, that of low-enriched uranium rose by 18%, to 13 872 tonnes, and that of source material rose by 24%, to 19 097[3] tonnes.

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[1] Of the six States in question, since the end of 1980 Egypt has ratified NPT and Spain has signed safeguards agreements with the Agency covering all its existing nuclear facilities.

[2] As already indicated, Egypt ratified NPT on 26 February 1981, bringing the number up to 111.

[3] In the case of separated plutonium there was a decline because, under substitution arrangements in a nuclear-weapon State, plutonium-containing spent fuel was put under safeguards in the place of separated plutonium that had previously been safeguarded.

15. During the year, two safeguards agreements were concluded with Cuba covering a power reactor and a research reactor being supplied by the Soviet Union; these are the only significant nuclear facilities at present being constructed in that country. Agreements were also concluded with Indonesia, the Libyan Arab Jamahiriya and Senegal.

16. The Agency established its first safeguards field office, in Canada, in September. Also, arrangements were made with Japan for the assignment, on a long-term basis, of inspectors to that country; the arrangements will be reviewed after two years.

Second NPT Review Conference

17. The Second Review Conference of the Parties to NPT met "to examine the operation of the Treaty ten years after its entry into force with a view to assuring that its purposes are being realized" at Geneva from 11 August to 4 September 1980. At the request of the Preparatory Committee for the Conference, the Agency Secretariat had submitted comprehensive documentation on the Agency's activities in connection with Articles III, IV and V of the Treaty. Unlike the first NPT Review Conference, the second one was unable to reach agreement on a final document; this was due chiefly to the absence of consensus on the implementation of Articles I, II and VI of the Treaty.

INFCE

18. The International Nuclear Fuel Cycle Evaluation (INFCE) completed its work at a third plenary conference in Vienna in February 1980, also bringing to an end the considerable staff effort which had been devoted to assisting in and contributing to this major co-operative exercise. The reports of the eight INFCE working groups and the summary and overview report, which were adopted unanimously at the Conference, provide comprehensive and valuable information on all major aspects of the nuclear fuel cycle, confirming also that a growing part of the world's energy needs will have to be met by nuclear power. The INFCE reports, published by the Agency, have already proved to be a valuable reference base for further work, and tools developed for INFCE by the Agency, such as fuel cycle demand calculation codes, are in continued use.

CAS

19. In June 1980 the Board of Governors established a "Committee on Assurances of Supply" (CAS), open to all Member States, to consider and advise the Board on:

(a) ways and means in which supplies of nuclear material, equipment and technology and fuel cycle services can be assured on a more predictable and long-term basis in accordance with mutually acceptable considerations of non-proliferation; and

(b) the Agency's role and responsibilities in relation thereto.

20. CAS held its first (purely organizational) meeting in September, immediately after the twenty-fourth regular session of the General Conference.

International plutonium storage

21. The Expert Group on International Plutonium Storage (IPS) has continued to prepare proposals for an IPS system in implementation of Article XII.A.5 of the Agency's Statute. Progress was made during 1980 both on institutional questions and on the practical aspects of a system.

International spent fuel management

22. The Expert Group on International Spent Fuel Management continued its examination of the potential for international co-operation in the management of spent fuel. Two meetings of the Expert Group and its sub-groups were held during 1980; much of the work on technical and economic issues was completed and good progress was made in identifying key institutional issues.

Physical protection

23. The Convention on the Physical Protection of Nuclear Material was opened for signature at the Headquarters of the Agency and the United Nations on 3 March 1980. By the end of the year, 26 States and one regional organization had signed the Convention and one State had ratified it. It will enter into force on the 30th day after the 21st ratification[4].

Technical assistance and the use of nuclear techniques

24. The total resources available in support of the Agency's technical assistance activities rose from $17.1 million in 1979 to $21.7 million in 1980. The largest increase (45%) was in the funds available from UNDP, which rose from $4.06 million in 1979 to $5.89 million in 1980. An increase of about 24% occurred in the voluntary contributions of Member States for the regular programme - namely from $8.06 million to $9.98 million.

25. The Board of Governors agreed on a target ($13.5 million) for voluntary contributions to be pledged for the Agency's own regular technical assistance programme in 1981 and on indicative planning figures for 1982 and 1983 ($16 million and $19 million respectively).

26. The proportion of technical assistance requests recommended by the Secretariat for inclusion in the Agency's regular programme, for which funds were expected to be available, rose from 69.1% in 1979 to 71.6% in 1980. However, when the footnote-a/ projects made operational by 31 December 1980 are added, these percentages become 79.6% and 88% respectively.[5]

27. The number of training courses organized by the Agency for nuclear power plant operators is diminishing as the requirements of developing countries in this regard are being met. On the other hand, training in safety and safety-related subjects is increasing.

28. Reflecting countries' requests, the proportion of Agency technical assistance devoted to the use of isotopes and radiation in various branches of agriculture, science, industry and medicine was 38% in 1980, compared with 37% in 1979, 44% in 1975 and 51% in 1970.

29. The number of countries participating in the Regional Co-operative Agreement for Research, Development and Training Related to Nuclear Science and Technology (RCA) rose from 10 to 12 with the accession of Bangladesh and Sri Lanka. The main projects being supported under RCA relate to the industrial applications of nuclear techniques, food irradiation, the maintenance of nuclear instruments and isotope applications in hydrology.

30. The number of laboratories participating in the IAEA/WHO Network of Secondary Standards Dosimetry Laboratories increased to 43.

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[4] The position in June 1981 was as follows: 31 States and one regional organization had signed the Convention and two States had ratified it.

[5] 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.

31. Several States submitted requests for assistance to the United Nations Interim Fund for Science and Technology for Development. Although the resources of the Fund are likely to be much less than originally hoped, at least one proposal of interest to the Agency seems likely to receive support - namely a regional project aimed at assisting Latin American countries with industrial applications of non-destructive testing techniques.

32. One of the main developments in the use of nuclear technology in food preservation was the conclusion reached by the Joint FAO/IAEA/WHO Expert Committee on the Wholesomeness of Irradiated Food that no toxicological hazard is caused in any kind of foodstuff by irradiation up to an overall average dose of 10 kGy[6] (1 Mrad[7]) and hence that foods treated in this way no longer need be tested for toxicity (the dose range normally used for food preservation purposes is 0.05-10 kGy).

33. This finding should give significant impulse to the use of irradiation by the food preservation industry. By the end of 1980, the public health authorities in 22 countries had issued unconditional or provisional clearances for 39 foodstuff items or groups of related food products.

34. The Vom project in Nigeria, with financial support from Belgium, the Federal Republic of Germany, Sweden and the United Kingdom, aimed at the control/eradication of a riverine species of the tsetse fly by means of the sterile-insect technique, is making satisfactory progress with strong back-up from the Laboratory at Seibersdorf. The Agency is making arrangements to transfer the current optimum Mediterranean fruit fly rearing technology from the Laboratory at Seibersdorf to Mexico.

35. During 1980, large-scale technical assistance projects relating to agricultural applications of isotopes and radiation in various countries were supported.

36. Australia and the Federal Republic of Germany continued to make special contributions in support of isotope hydrology activities in developing countries. A regional seminar on the use of isotope hydrology techniques in the development of water resources, for countries in the Middle East and the Mediterranean area, was convened by the Agency in Athens.

Controlled thermonuclear fusion

37. In June, under the International Tokamak Reactor (INTOR) project, which is aimed at studying the feasibility of international co-operation, under the aegis of the Agency, in constructing a demonstration fusion reactor, the INTOR Workshop published its first ("Phase-Zero") report, which contains guidelines for a sequence of fusion reactor designs. The Workshop subsequently began preparing its "Phase-One" report, a conceptual design that is due to be completed in July 1981.

38. Following consultations between the Agency and the participating countries (Japan, the Soviet Union, the United States, and the CEC countries, represented by EURATOM), the project has been extended until mid-1982 at a more or less unchanged level of effort and expenditure.

39. The eighth international conference held by the Agency on plasma physics and controlled fusion research took place in Brussels in July 1980. Participants in the conference confirmed the substantial and steady progress being made towards controlled fusion.

International Nuclear Information System (INIS)

40. In order to increase the availability of the INIS data base for on-line searching, the Agency made network arrangements and established telecommunications connections with the European Space Agency, IIASA and commercial communications services.

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[6] kGy = kilogray.

[7] Mrad = megarad.

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

41. The General Assembly noted with satisfaction the Agency's efforts to strengthen its activities in the field of technical assistance, the steady improvement of its safeguards system and the steps taken by the Agency to expand and strengthen its programmes in nuclear safety and enhance its ability to deal with emergencies. It also noted the establishment, in June 1980, of the Committee on Assurances of Supply and urged all Agency Member States that had not done so to ratify the Convention on the Physical Protection of Nuclear Materials.

42. In connection with its decision to set up a preparatory committee for the United Nations Conference for the Promotion of International Co-operation in the Peaceful Uses of Nuclear Energy, which is to be convened in 1983, the Assembly invited the Agency to fulfil its appropriate role within the scope of its responsibilities at all stages of preparation, and during the Conference itself.

43. In adopting resolutions on the implementation of the Declaration on the Denuclearization of Africa, the Assembly demanded that South Africa submit all its nuclear installations to inspection by the Agency and requested the Security Council "to prohibit all forms of co-operation with the racist régime of South Africa in the nuclear field" and the Secretary-General "to give maximum publicity to the report on South Africa's plan and capability in the nuclear field".

44. The Assembly called upon all States and agencies within the United Nations system to cease nuclear and all other collaboration with South Africa and urged all agencies to ensure the participation of the South African liberation movements recognized by the Organization of African Unity in their relevant conferences and meetings.

45. The Assembly reaffirmed its resolution 33/71 on military and nuclear collaboration with Israel, urging an end to all transfers of fissionable material and nuclear technology to Israel, and its resolution 34/89 on Israeli nuclear armament.

The Tlatelolco Treaty

46. The General Assembly once again expressed its regret that France and the United States had not yet ratified Additional Protocol I of the Treaty for the Prohibition of Nuclear Weapons in Latin America.

The Headquarters of the Agency

47. In December, after extensive negotiations between the Agency's Secretariat, representatives of the United Nations/UNIDO and the Austrian authorities, the Board of Governors authorized the Director General to sign four agreements concerning the Agency's occupancy of the Vienna International Centre (VIC). They include an agreement defining the Agency's Headquarters Seat; an agreement under which the Agency will occupy the Headquarters Seat for 99 years at an annual rent of one Austrian schilling; and an agreement to establish a fund that will receive annual contributions from the Agency, the United Nations and the Austrian Government and will be used for meeting the costs of major repairs and replacements needed at the VIC. There will be a ceiling on the annual contributions of the international organizations to the fund.

THE AGENCY'S ACTIVITIES

TECHNICAL ASSISTANCE AND TRAINING

48. The total resources available to carry out the Agency's technical assistance activities in 1980 increased by 27.3% compared with 1979; see Figure 1 for details.

49. The main source of funds for the Agency's regular programme is the voluntary contributions of Member States. The target for 1980 was $10.5 million and the amount actually pledged $9.98 million, or 95%, compared with a target of $8.5 million and pledges of $8.06 million, or 94.8%, in 1979. Other sources of support for Agency technical assistance activities are extrabudgetary contributions, UNDP funds, assistance in kind made available by a number of donor countries, miscellaneous income, including assessed programme costs, and funds from Member States to finance assistance for themselves. The total resources made available for 1980 programmes amounted to $21.7 million, an increase of $4.6 million over 1979. The largest rise was in UNDP funds ($1 833 000 more than in 1979), followed by an increase of $1 745 000 in the voluntary contributions of Member States and miscellaneous income, which taken together constitute "Agency funds". Agency funds constituted about one half of total available resources, a share which has remained fairly constant during recent years.

50. Of the $21.7 million available for 1980, $12.2 million was spent and $4 million was allocated to approved projects that had begun but where the committed funds had not yet been spent. The monetary value of the assistance provided from the resources made available for 1980 and those carried forward from prior years was, at $18.7 million, 20% higher than the $15.6 million provided in 1979. The breakdown of the latter sums can be seen in Table 1.

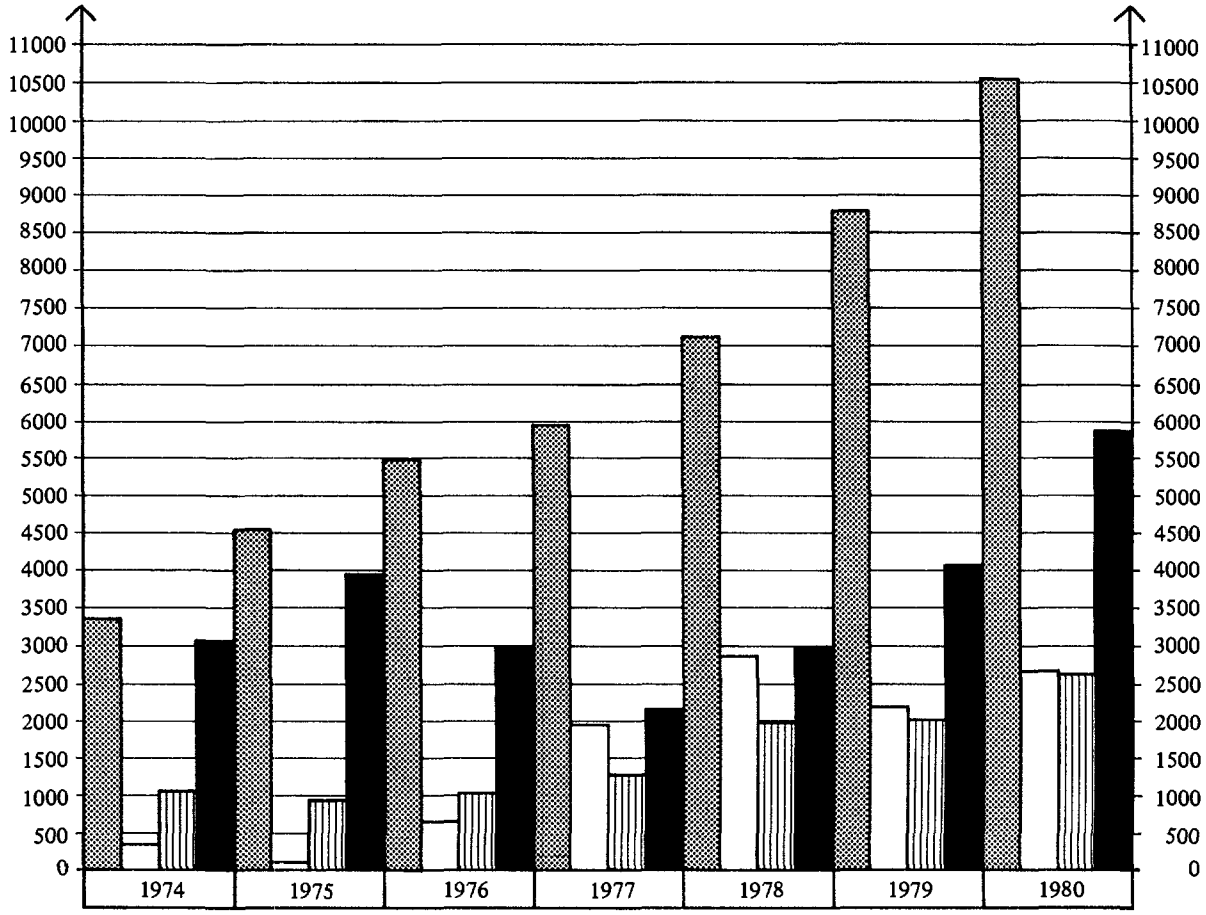
Table 1

Agency technical assistance by source: 1971-1980
(in US dollars)

Year	UNDP funds	Agency funds	Extra-budgetary funds	Assistance in kind	Total
1971	1 838 800	2 124 600	60 000	921 700	4 945 100
1972	2 072 000	2 556 000	85 700	779 000	5 492 700
1973	1 964 300	2 675 900	87 100	1 039 400	5 766 700
1974	3 081 600	2 413 200	170 300	1 077 400	6 742 500
1975	3 941 500	3 423 500	252 900	942 300	8 560 200
1976	3 002 300	3 954 700	358 800	1 021 500	8 337 300
1977	2 144 400	4 997 100	602 400	1 284 300	9 028 400
1978	2 954 000	6 527 500	1 539 200	1 986 800	13 007 500
1979	4 059 600	7 123 900	2 379 700	2 014 800	15 578 000
1980	5 893 400	7 813 700	2 415 800	2 627 700	18 750 600

FIGURE 1

RESOURCES AVAILABLE FOR
AGENCY TECHNICAL ASSISTANCE PROGRAMMES: 1974–1980
(in thousands of dollars)



	1974	1975	1976	1977	1978	1979	1980
Agency funds	3348	4539	5492	5962	7121	8803	10548
Extrabudgetary funds	367	110	648	1966	2853	2199	2666
Assistance in kind	1078	942	1021	1284	1987	2015	2628
UNDP	3082	3942	3002	2144	2954	4060	5893
TOTAL	7875	9533	10163	11356	14915	17077	21735

Agency funds Extrabudegtary funds Assistance in kind UNDP funds

51. The sharpest increase, 45%, took place in assistance financed from UNDP funds. These funds covered 31% of the assistance provided by the Agency in 1980.

52. The volume of the assistance provided in kind increased by 30%, due exclusively to the training received under Type II awards during the year, which was estimated at about $2.4 million or half of the total value of the fellowship training provided in 1980. Growth in assistance furnished from Agency funds was 9.7%, while the volume of that provided from extrabudgetary contributions remained at the high level attained in 1979. Comparable data on the assistance provided by field of activity and type are given in Figure 2. Information on the distribution of Agency assistance is shown in Figure 3 by region and source and in Figure 4 by field and region.

53. As can be seen in Figure 2, expenditure in 1980 on equipment grew by 21% over 1979. The highest increase occurred in the fellowship component of the programme, which rose by almost 23%. Expenditures on expert services went up by 16%.

54. The total number of expert man-months provided in 1980 was nearly the same as in 1979. The problem of the timely provision of expert services remains serious as delays in project implementation occur mainly in this sector. At the end of 1980 there were still 952 man-months to be provided from the Technical Assistance Fund alone. This situation remains a cause for concern, requiring the continuous co-operation and assistance of Member States in locating and making available sufficient qualified experts, especially in agriculture, nuclear safety and reactor technology.

55. Earmarkings for approved assistance to be financed from the Technical Assistance Fund which had not yet been implemented rose by $2 226 000, although $952 000 of this is due to the fact that it was necessary to recalculate the cost of the expert man-months still to be delivered at the end of 1980 on the basis of costs applicable in 1981. Of the still outstanding assistance, only 21% was in respect of approvals dating back more than two years, which indicates a decrease in "old" projects for the second consecutive year.

56. The various measures introduced to redress the imbalance between the type of currencies available among the Agency's resources for technical assistance and the type of currencies needed to implement the regular programme are continuing to be successful. Whereas in 1980 the deficit in convertible currency decreased slightly, from $1 254 000 to $1 203 000, the surplus in non-convertible currency decreased sizably, from $1 462 000 to $542 000. Thus, the overall deficit in the Technical Assistance Fund was $661 000 as at 31 December 1980. It is anticipated that no significant surplus will exist in non-convertible currency by the end of 1981.

57. In this connection, a limited amount of overprogramming, for which support was expressed in the Board of Governors, would tend to result in the use of resources before their value is eroded by inflation. Also, the introduction of up to 10% overprogramming would obviate unnecessary restrictions in the programming of next year's resources when current-year deficits pose no threat to the liquidity of the regular programme.

58. The expenditures met in 1980 from the convertible and non-convertible currencies in the Technical Assistance Fund are shown in Table 2 by region. Unliquidated obligations at the end of 1980 of $3 270 000 in convertible currency and $2 314 000 in non-convertible currency are not reflected in Table 2.

FIGURE 2

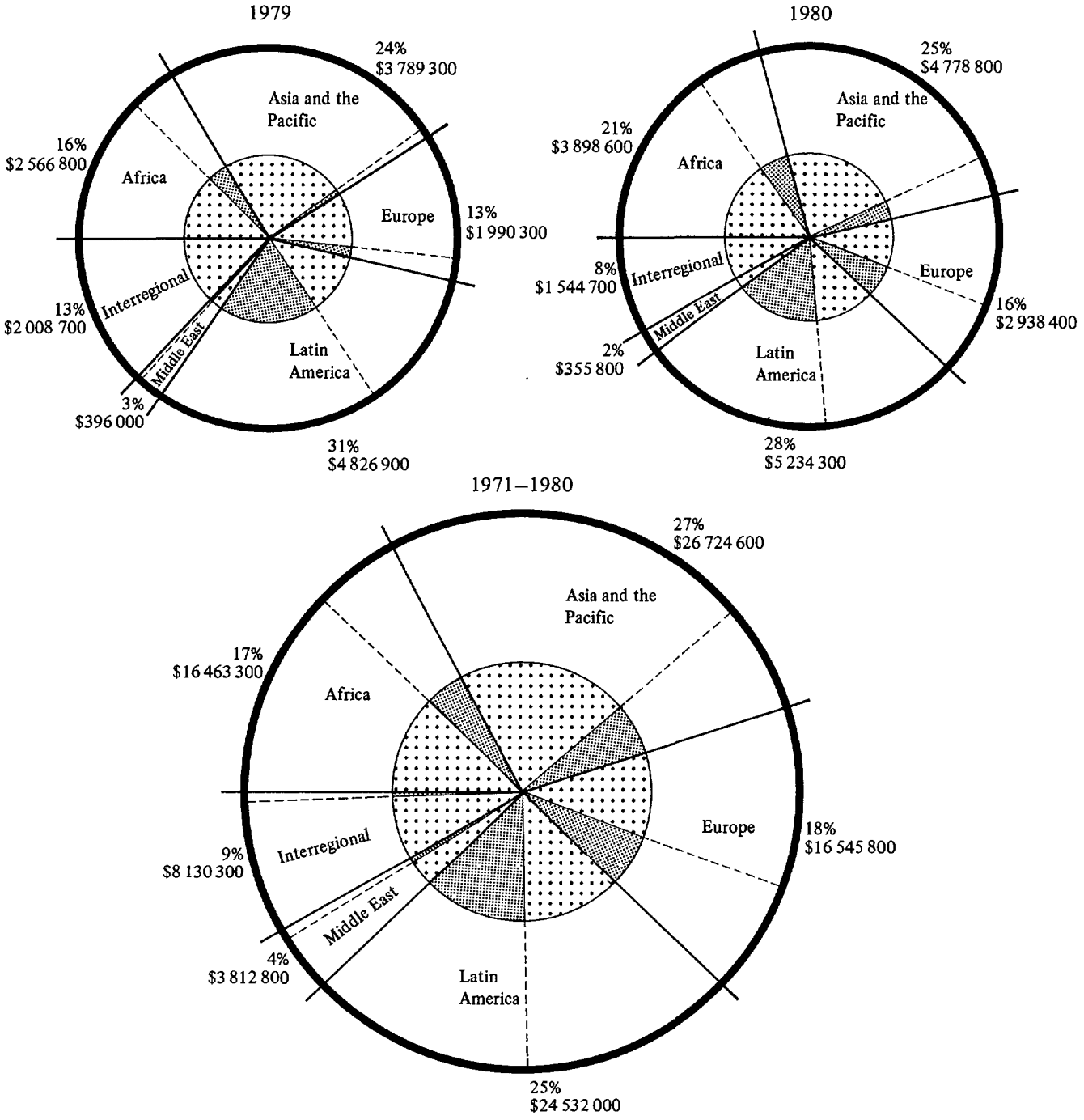
UTILIZATION OF RESOURCES: 1979, 1980 and 1971–1980
(in thousands of dollars)

FIELD OF ACTIVITY		Year	Experts	Equipment	Fellowships	Share of total programme	
			$	$	$	$	%
General atomic energy development		1979	473.9	1 298.8	363.7	2 136.4	13.7
		1980	469.4	873.8	333.2	1 676.4	8.9
Nuclear physics		1979	265.3	700.5	358.8	1 324.6	8.5
		1980	246.5	813.4	443.9	1 503.8	8.0
Nuclear chemistry		1979	62.5	301.4	292.4	656.3	4.2
		1980	61.6	155.2	356.0	572.8	3.0
Prospecting, mining and processing of nuclear materials		1979	619.1	933.2	182.7	1 735.0	11.2
		1980	1 067.5	1 404.6	410.8	2 882.9	15.4
Nuclear engineering and technology		1979	660.3	958.8	1 233.9	2 853.0	18.3
		1980	735.7	1 315.1	1 548.4	3 599.2	19.2
Application of isotopes and radiation in	Agriculture	1979	922.6	1 332.1	1 374.1	3 628.8	23.3
		1980	919.9	1 697.6	1 036.1	3 653.6	19.5
	Medicine	1979	212.1	453.4	411.0	1 076.5	6.9
		1980	300.2	649.2	688.6	1 638.0	8.7
	Biology	1979	14.1	198.5	87.9	300.5	1.9
		1980	24.2	13.1	124.2	161.5	0.9
	Industry and Hydrology	1979	317.6	341.8	164.5	823.9	5.3
		1980	327.9	1 086.5	231.6	1 646.0	8.8
Safety in nuclear energy		1979	414.0	229.8	399.2	1 043.0	6.7
		1980	453.0	155.1	808.3	1 416.4	7.6
Total assistance		1979	3 961.5	6 748.3	4 868.2	15 578.0	100.0
		1980	4 605.9	8 163.6	5 981.1	18 750.6	100.0
Ten-year total		1971-1980	29 119.5	37 962.5	29 126.8	96 208.8	100.0

Distribution of assistance by type			
Type	1979	1980	1971–1980
Experts	25.5%	24.6%	30.3%
Equipment	43.2%	43.5%	39.4%
Fellowships	31.3%	31.9%	30.3%
Total	100.0%	100.0%	100.0%

FIGURE 3

DISTRIBUTION OF TECHNICAL ASSISTANCE BY REGION AND SOURCE
(1979, 1980 and 1971–1980)

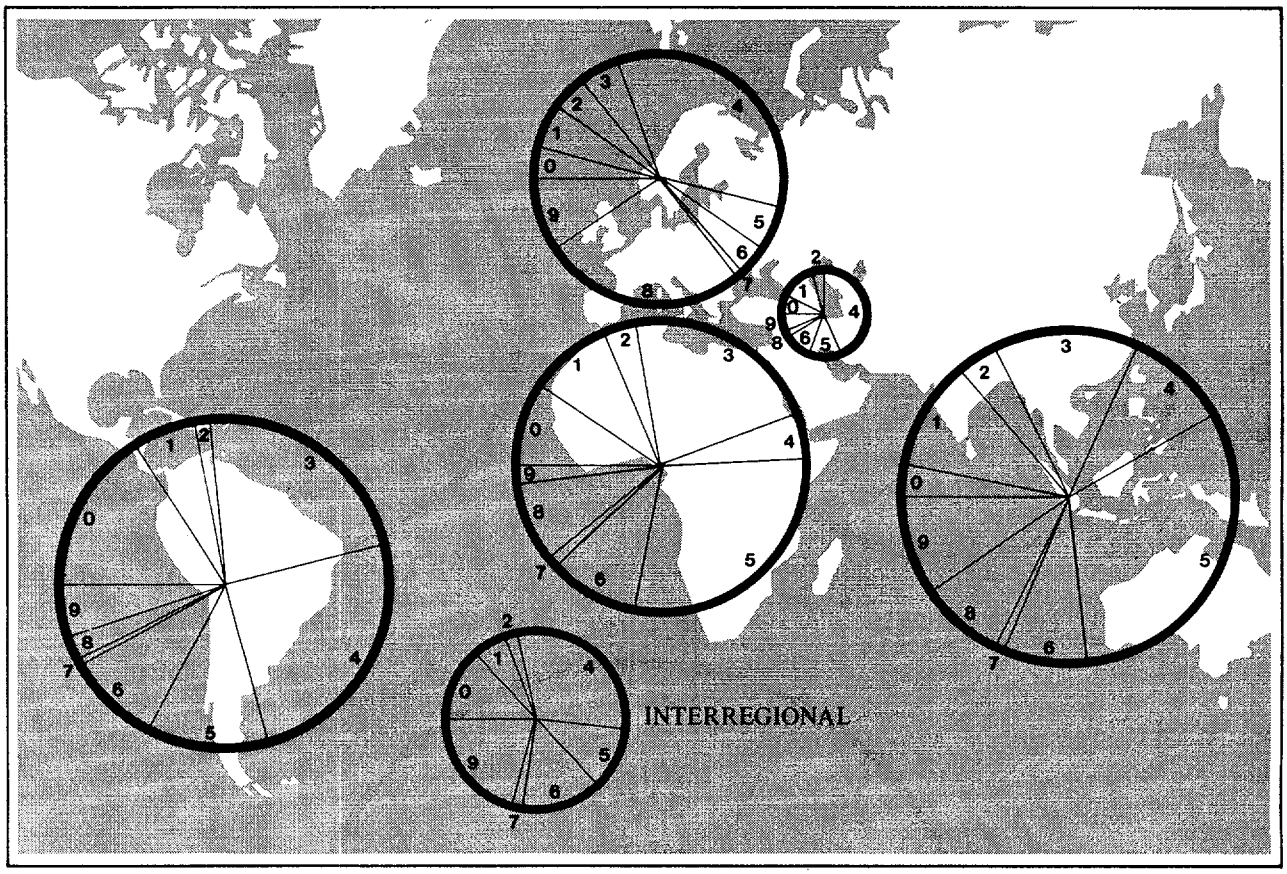


Distribution of technical assistance by source:

	1979	1980	1971-1980
Agency resources	73.9%	68.6%	67.7%
UNDP	26.1%	31.4%	32.3%

FIGURE 4

DISTRIBUTION OF TECHNICAL ASSISTANCE BY FIELD AND REGION: 1980[a]



SUMMARY

Field of activity		Africa %	Asia and the Pacific %	Europe %	Latin America %	Middle East %	Inter-regional %	All regions %
0 – General atomic energy development		9	3	4	16	7	13	9
1 – Nuclear physics		9	11	6	6	14	6	8
2 – Nuclear chemistry		4	4	4	1	5	2	3
3 – Prospecting, mining and processing of nuclear materials		22	14	5	23	–	–	15
4 – Nuclear engineering and technology		5	10	35	25	43	30	19
Application of isotopes and radiation in	5 – Agriculture	29	32	6	12	12	12	19
	6 – Medicine	10	8	4	9	11	14	9
	7 – Biology	1	1	1	–	–	2	1
	8 – Industry and Hydrology	9	8	26	3	2	–	9
9 – Safety in nuclear energy		2	9	9	5	6	21	8
		100%	100%	100%	100%	100%	100%	100%

[a] For each region, the relative monetary value of the technical assistance provided by the Agency is denoted by the size of the circle superimposed over the region on the map. The size of the segments in each circle indicates the share of total assistance given in the various fields of activity.

Table 2

Distribution of the aid provided from the Technical Assistance Fund, by type of currency and region: 1980

Type of currency	Africa		Asia and the Pacific		Europe		Latin America		Middle East		Interregional		All regions
	$1000	%	$1000	%	$1000	%	$1000	%	$1000	$	$1000	%	$1000
Convertible	1522.0	23	1535.8	23	1042.5	16	1233.9	18	175.7	3	1150.7	17	6660.6
Non-convertible	276.9	24	229.2	20	369.1	32	27.7	2	94.4	8	155.8	14	1153.1
TOTAL	1798.9	23	1765.0	23	1411.6	18	1261.8	16	270.1	3	1306.5	17	7813.7

59. Efforts to develop procedures for use in assessing the efficacy of the technical assistance provided by the Agency are continuing. It has become apparent that a clear formulation of the objectives of a project in a Government's request for assistance will make it easier to determine later on whether or not the Agency has made an effective contribution towards realizing the project's goals. Reliable information has to be available during the implementation stage and also following the completion of assistance. Data on implementation are available and post-project data are being compiled on a selective basis; for example, during visits to recipient countries, staff members contact scientists and project staff in order to obtain information needed for the evaluation of Agency-assisted activities. Although this effort is still modest in scope, the experience being gained is starting to yield results.

NUCLEAR POWER AND REACTORS

General

60. As indicated in the Introduction, the year 1980 was marked by a growing recognition, in spite of continued opposition from environmental movements, of the need for nuclear power against a background of ever-increasing oil prices. The International Nuclear Fuel Cycle Evaluation (INFCE), which ended with a final plenary conference in February, and the eleventh World Energy Conference (WEC), in September, unequivocally reaffirmed the need for nuclear power - not only in the industrialized world, but also in some developing countries. Political leaders in Western Europe also confirmed this in clearer terms than before. In some countries, nuclear energy programmes went ahead strongly - for example, in France (where nuclear power is now expected to generate 70% of all electricity by 1990), the Republic of Korea (25% by 1985) and the Soviet Union (14% by 1985). In Sweden, the nuclear power programme was endorsed in a referendum on 23 March, which means that 45% of the country's electricity will be of nuclear origin in 1985.

61. There were very few new plants ordered in OECD countries, largely owing to lower electricity demand forecasts. In the United States, several further orders were cancelled or postponed and no new orders were placed. It would, however, seem that this was due to a reluctance to enter into large investment commitments in a general climate of uncertainty about final costs, regulatory requirements and future electricity needs, rather than to uncertainty about the ability of nuclear power to provide energy cheaply and safely.

Nuclear power growth

62. During 1980 the total installed nuclear capacity in the world increased by about 11%, from 123 GW(e) at the end of 1979 to 136 GW(e) at the end of 1980. This increase, however, was due primarily to increases in only three countries - France, Sweden and the Soviet Union, with capacity growths of about 89%, 49% and 15% respectively.

63. As shown in Table 3 and Figure 5, at the end of the year, 253 nuclear power reactors were in operation, representing 2100 reactor-years of operating experience; 230 nuclear power reactors, with a total capacity of 212 GW(e), were under construction, which will bring the total installed capacity in the world to 348 GW(e); 118 reactors were planned or had been ordered, representing an additional capacity of about 109 GW(e). During the period under review, 19 reactors - with a total capacity of 18.6 GW(e) - were ordered in France, the Federal Republic of Germany, Japan, the Republic of Korea, Romania and the United Kingdom; 12 orders for reactors - with a total capacity of 13 GW(e) - were either cancelled or postponed in the United States (see Table 4).

64. The 1980 balance between new orders and cancellations was somewhat better than that of 1979, when the total amount of nuclear power plant capacity on order decreased by 10 GW(e) - eight new orders and 16 cancellations[8] or postponements.

65. Looking further ahead (see Table 5), nuclear power is expected to account for 310 GW(e), or 11% of the world's electricity-generating capacity, by 1985 (the plants on which this estimate is based are either already in operation or under construction) and for about 450 GW(e), or about 13%, by 1990. As nuclear power provides base-load electricity, its share in the amount of electricity actually generated is likely to be higher than its share of installed capacity, reaching 17% in 1985 and 18% in 1990 (see Table 6).

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[8] Only 14 cancellations were known at the time the Annual Report for 1979 (GC(XXIV)/627) was prepared.

Table 3

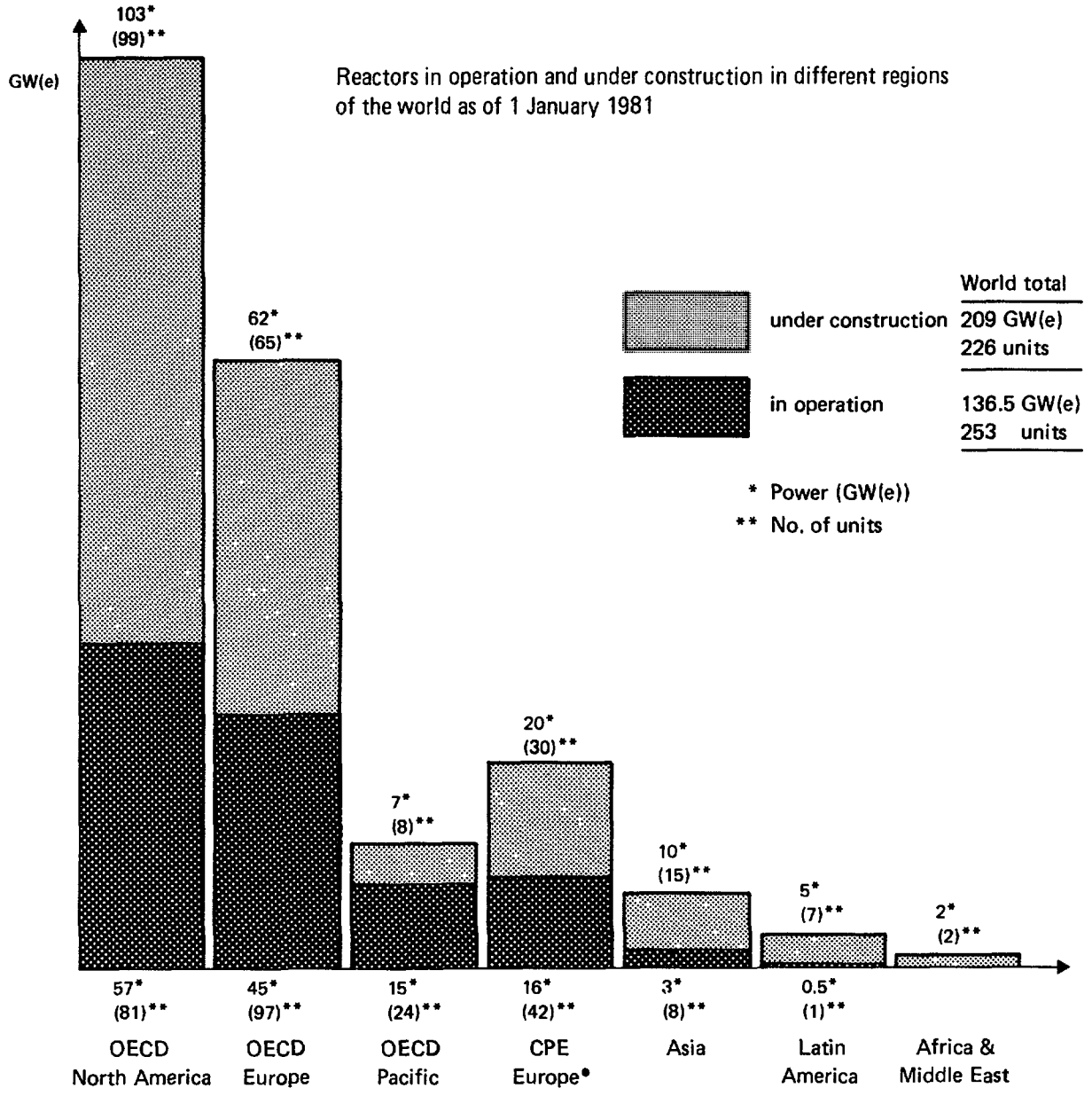
Nuclear power reactors in operation or under construction
at the end of 1980

Country[a]	In operation		Under construction[b]		Electricity supplied by nuclear power reactors in 1980 (estimate)	
	Number of units	Total MW(e)	Number of units	Total MW(e)	TWh(e)	% share of total
Argentina	1	335	1	600	2.18	4.7
Belgium	3	1 664	4	3 807	11.0	21.3
Brazil			3	3 116		
Bulgaria	2	816	2	828	5.7	13.8
Canada	11	5 494	14	9 751	35.70	10.1
China, Republic of	2	1 208	4	3 716	6.30	12.9
Cuba			1	408		
Czechoslovakia	2	800	6	2 520	4.09	5.8
Finland	3	1 740	1	420	6.68	17.1
France	23	15 409	29	30 230	58.0	23.6
German Democratic Republic	5	1 694	4	1 644	8.99	8.6
Germany, Federal Republic of	14	8 606	10	10 636	43.0	11.1
Hungary			2	816		
India	4	809	4	880	2.77	3.5
Italy	4	1 382	3	1 966	2.47	1.3
Japan	24	14 994	8	6 745	79.09	13.8
Korea, Republic of	1	564	6	4 953	3.25	6.8
Mexico			2	1 308		
Netherlands	2	498			3.28	5.6
Pakistan	1	125			0.07	2.0
Philippines			1	620		
South Africa			2	1 842		
Spain	3	1 073	7	6 258	4.95	6.2
Sweden	8	5 515	4	3 931	25.4	27.1
Switzerland	4	1 940	1	942	13.66	28.4
Union of Soviet Socialist Republics	33	12 616	15	13 680	73.0	4.7
United Kingdom	33	6 980	10	6 840	32.39	12.1
United States of America	70	51 550	85	93 319	251.94	11.3
Yugoslavia			1	632		
World total	253	135 812	230	212 048	673.91	8.0

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 Iran has been interrupted.

FIGURE 5



• European countries with centrally planned economies (includes Yugoslavia).

Table 4

Orders and postponements of nuclear plants during 1980

	Orders and letters of intent sent during 1980		Cancellations and postponements during 1980	
	Number of reactors	Power (GW(e))	Number of reactors	Power (GW(e))
OECD North America	-	-	12	13
OECD Europe	12	12	-	-
OECD Pacific	4	4	-	-
CPE Europe[a/]	1	0.6	-	-
Asia	2	2	-	-
Latin America	-	-	-	-
Total	19	18.6	12	13

a/ CPE = Countries with centrally planned economies ("CPE Europe" includes Yugoslavia). Only one report was received of a new order in one of these countries - namely, a power reactor in Romania (0.6 GW(e)); however, it is understood that in several others - including Czechoslovakia, the German Democratic Republic, Poland and the Soviet Union - decisions were taken to go ahead with the construction of new nuclear power plants.

Table 5

Estimates of total and nuclear electricity-generating capacity by main country groups (unit: GW(e))

Country group	1980			1985			1990		
	Total	Nuclear	%	Total[b]	Nuclear	%	Total[b]	Nuclear	%
1. OECD North America	710	57	8	890	130	15	1065	150	14
2. OECD Europe	440	45	10	580	105	18	735	150	20
3. OECD Pacific	180	15	8	255	25	10	340	50	15
4. CPE Europe[a]	370	16	4	545	35	6	745	75	10
5. Asia	130	3	2	235	10	4	400	20	5
6. Latin America	100	0.3	0.3	130	3	2	180	10	6
7. Africa and Middle East	65			80	2	3	120	3	3
World total	1995	136	7	2715	310	11	3585	458	13
Industrialized countries[c]	1700	133	8	2270	295	13	2885	425	15
Developing countries[d]	295	3	1	445	15	3	700	33	5

a/ CPE = Countries with centrally planned economies ("CPE Europe" includes Yugoslavia).

b/ Average of high and low estimates.

c/ "Industrialized countries" comprises the countries in groups 1-4 plus South Africa.

d/ "Developing countries" comprises the countries in groups 5-7 less South Africa.

Table 6

Estimates of total electricity generation and of the contribution of nuclear power by main country groups (unit: TWh)

Country group	1980			1985			1990		
	Total	Nuclear	%	Total[a]	Nuclear	%	Total[a]	Nuclear	%
World total	8340	674	8	11 290	1905	17	15 115	2700	18
Industrialized countries[b]	7045	659	9	9 425	1815	19	12 125	2535	21
Developing countries[c]	1295	15	1	1 865	90	5	2 990	165	6

a/ Average of high and low estimates.

b/ "Industrialized countries" comprises the countries in groups 1-4 in Table 5 plus South Africa.

c/ "Developing countries" comprises the countries in groups 5-7 in Table 5 less South Africa.

66. These estimates reflect very different degrees of planned reliance on nuclear power. The French programme will provide half of France's electricity by 1985 and 70% by 1990, a fourfold increase over the present level, and in a number of West European countries (for example, Belgium, Sweden and Switzerland) nuclear power will meet one third to one half of electricity requirements by 1990. The official target of the Japanese Government calls for 51-53 GW(e) of nuclear capacity by 1990, nearly 22% of Japan's total electricity-generating capacity at that time and more than a tripling of the present capacity. It is expected that in Canada and the United States nuclear capacity will approximately triple by 1990, accounting for 14% of total electricity-generating capacity by that time. The CMEA countries are also continuing to give high priority to nuclear power, aiming at 64-80 GW(e) by 1990 - a fourfold increase. Of this capacity, approximately 50 GW(e) would be in the Soviet Union; large increments in Czechoslovakia and the German Democratic Republic are also foreseen.

67. The longer-term picture is less encouraging. Construction is expected to begin on 10 GW(e) of plant in 1981 and on 52 GW(e) in 1982; however, construction is expected to begin on only 12 GW(e) in each of the following two years (1983 and 1984) and on only 5 GW(e) annually thereafter. This decline reflects chiefly the lack of future commitments in the United States and certain West European countries. If present trends are not reversed, a general slow-down in nuclear power programmes must therefore be expected after 1990. Since the energy supply situation is likely to be worse rather than better by that time, this could have the gravest consequences for the world's economy and especially for the economic outlook of the OECD and the developing countries.

68. Table 6 shows that nuclear power accounted for only 1% of electricity generation in developing countries in 1980 and that its share is expected to rise to 6% by 1990 (compared with 21% in the industrial countries). Ten developing countries have already introduced nuclear power or are about to do so (Argentina, Brazil, Cuba, Egypt, India, the Republic of Korea, Mexico, Pakistan, the Philippines and Taiwan)[9]. Only a few additional developing countries are likely to join this number during the next decade.

[9] This enumeration 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.

69. The prospects in various countries may be summarized as follows:

(a) Of the OECD countries, Belgium, Canada, France, the Federal Republic of Germany, Japan, Sweden, Switzerland, the United Kingdom and the United States either have a significant nuclear power programme or are already obtaining a fairly high percentage of their electricity through nuclear power generation (e.g. 24% in France and 27% in Sweden);

(b) Most East European countries have recently embarked on major nuclear programmes, and there are plans to increase the present 16 GW(e) of nuclear power capacity in Eastern Europe by a factor of 4 to 5 during this decade;

(c) In the developing world, prospects for nuclear power are limited to rather few countries for the time being. One of the major difficulties faced by many developing countries is that most standard nuclear power plants currently available on the market are of larger capacity than can at present be utilized in those countries' electricity grid systems. A number of medium-size power reactors have been successfully and economically operated in Member States for many years. Some interesting conceptual designs for smaller plants were published during 1979-80. Studies are being made of their economics and of possible locations for use.

70. The main reported fuel cycle developments were in Japan, which confirmed plans for the construction of a large commercial reprocessing plant (1200 tons/year), and an enrichment plant (3 million SWU/year), both to be completed in the period 1990-92, and in Argentina, which contracted for a heavy-water production plant (250 tons/year). Another development to be noted is that the EURODIF enrichment plant at Tricastin (France) increased its capacity during 1980 to 6.1 million SWU/year from 2.3 million SWU/year.

Nuclear power costs

71. The further rise of oil prices, which reached approximately US $35 a barrel at the end of 1980, continued to make oil clearly uneconomic as fuel for the large-scale base-load generation of electricity. Agency studies show that, for 600-1200 MW(e) nuclear plants as compared with oil-fired plants, the higher capital costs of nuclear plants can be recovered through fuel cost savings in as little as two to five years of operation depending on plant size, capacity factor and the rate of fixed charges on capital.

72. Although less dramatic results are obtained when comparing the costs of power from nuclear and coal-fired plants, for 1200 MW(e) plants the fuel cost savings would still permit the higher capital costs of nuclear plants to be recovered in about ten years of operation at 70% plant factor.

Uranium resources and production

73. During 1980, uranium exploration was very successful in some countries, especially Australia, Brazil and Canada, but uranium prices dropped sharply (from about US $40/lb U_3O_8 at the beginning of 1980 to US $28/lb U_3O_8 at the end of the year) and obliged some operators to reduce or halt production.

74. The joint NEA/IAEA Steering Group and Working Party on Uranium Resources endeavoured to improve the definition of their data base and the methods used in collecting information from all participating countries.

75. Eleven research and development working groups, under the joint sponsorship of NEA and the Agency, were engaged in improving the methods and equipment used in uranium exploration; a working group on uranium extraction will periodically publish up-to-date information on such methods and equipment.

76. The Agency was providing technical assistance in uranium exploration and production to 23 developing countries through 30 projects supported from Agency or UNDP funds.

Fuel performance and technology

77. The Agency's International Working Group on Fuel Performance and Technology focused on further increasing the safety of nuclear power plant operation by developing models of fuel performance, by studying pellet/cladding interactions and the behaviour of fuel under abnormal conditions and by promoting quality control in fuel fabrication.

78. The Agency continued to assist Argentina, Brazil, Indonesia and Romania in establishing technology for the fabrication of nuclear fuel, including methods and procedures for quality assurance and control.

Spent fuel management

79. The Agency continued to collect and analyse information on the experience in various countries of storing LWR spent fuel in water-filled pools. The preliminary data, covering over 80% of all operating storage facilities, indicate that no storage operation has caused a significant release of radioactivity or exposure of personnel.

80. Significant advances have been made in increasing the interim capacities of storage facilities at reactor sites through the use of compact storage racks and of neutron-absorbing materials. It is estimated that these measures may increase the storage capacity at some LWR sites by a factor of two to three, ensuring sufficient capacity for up to ten years.

81. Technologies for storage facilities "away from the reactor" are being studied and some have advanced to the demonstration phase. The main effort is being devoted to various technologies for storing spent fuel in - for example - the open air, shipping casks, underground facilities and air-cooled vaults. It is expected that several of these technologies may be in use away from the reactor before 1985.

Nuclear power programme implementation

82. The Agency continued to help with manpower training and in creating the infrastructure needed by developing countries for their nuclear power programmes. A guidebook on manpower development was published for use as a reference in estimating manpower requirements. Information contained in it served as background for advisory missions to five Member States, which received advice also on infrastructure requirements such as administrative organization and industrial support for nuclear power programmes.

83. The Agency's nuclear power training programme continued with eight interregional training courses, held in France, the Federal Republic of Germany, Spain and the United States. By the end of 1980, a total of 950 trainees had participated in these courses, which began in 1975.

84. The Agency organized a seminar on quality assurance, in the Republic of Korea, and one on nuclear power (for executive-level officials in developing countries), in Vienna - in conjunction with the 1980 regular session of the General Conference.

85. Problems of nuclear power plant operation in small electric grids are of concern to operators in developing countries not only because of the cost and reliability aspects, but also because of the safety implications of frequent fluctuations in plant output. As a follow-up to the seminar held in November 1979 at Kalpakkam, India[10], preparatory work was done on a guidebook on plant/grid interactions.

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[10] GC(XXIV)/627, para. 68.

Reliability of nuclear power plants

86. World Energy Conference data indicate that the "unavailability" of nuclear units has generally been similar to that of fossil-fuel plants in the same size range - namely, about 30-35%. The average load factor of nuclear plants decreased, however, in 1979 to 61.3% (data from 176 operating plants) after a rising trend during the period 1976-78, in which an average load factor of 67% had been achieved. Decreases in load factor, which were especially pronounced in the United States, were due above all to planned outages, mainly for safety-related maintenance and repairs and for plant system tests, and to power limitations required by regulatory authorities after the Three Mile Island accident (in the case of PWRs and BWRs of 600 MW(e) or more, for example, 18.8% and 5.9% respectively of total down-time in 1979 was due to such power limitations, as against 5.1% and 0.1% in 1978).

87. The International Working Groups on the Reliability of Reactor Pressure Components and on Nuclear Power Plant Control and Instrumentation formulated programmes for the period 1981-83 that will concentrate more on safety-related subjects and on disseminating the information generated to all interested power reactor operators.

Advanced reactors

88. One of the conclusions of INFCE was that the large-scale deployment of fast breeder reactors by major industrial countries could stabilize the price of uranium, making it likely that the thermal reactor would continue to be economically viable for the benefit of countries with developing nuclear power programmes. However, fast breeder deployment could not have an appreciable impact on uranium demand before the first quarter of the next century.

89. Experience with the operation of fast breeder reactors continued to be encouraging during 1980. The BN-350 in the Soviet Union, the Phénix in France, the Prototype Fast Reactor (PFR) in the United Kingdom and the KNK II in the Federal Republic of Germany performed satisfactorily, and the BN-600 in the Soviet Union and the Fast Flux Test Facility (FFTF) in the United States went into operation. Construction of the first commercial breeder reactor, the Super-Phénix in France, continued according to schedule, and it is expected that the plant will be completed in 1983.

90. The International Working Group on Gas-Cooled Reactors (formerly the International Working Group on High-Temperature Reactors) paid particular attention during the year to experience with the operation of high-temperature reactors and to their licensing requirements.

NUCLEAR SAFETY AND ENVIRONMENTAL PROTECTION

General

91. The main event of the year was the International Conference on Current Nuclear Power Plant Safety Issues at Stockholm in October, which was attended by some seven hundred experts and policy makers from Member States and international organizations. The general conclusion of the Conference was that there are no factors related to safety that limit the use and development of nuclear power. It was, however, clear that safety could be improved by giving more attention to the "man-machine interaction", i.e. the relationship of the operator to the plant, and by devoting more effort to developing equipment and training personnel to ensure that small accidents do not turn into more serious ones. The Conference also stressed the importance of international exchange of information about abnormal events at nuclear power plants.

92. The Agency continued its programme of reviewing information, preparing guides and encouraging research on the safe handling, treatment and disposal of radioactive waste, with three symposia, 11 technical committees and advisory groups, six co-ordinated research meetings and various consultants' meetings on the subject. Radiological protection of workers and the public also continued to receive high priority. The Agency issued a code of practice on the basic requirements for personnel monitoring and held an international training course at Argonne, in the United States, on assessing the environmental impact of nuclear power plants. It sent a technical assistance mission to Niger to evaluate and advise upon the application of radiation protection rules in the mining and milling of uranium. In co-operation with UNEP, ECE, UNSCEAR and WHO, the Agency helped prepare reports on the comparative assessment of the environmental impacts of various forms of energy.

93. It should again be mentioned that the nuclear industry's record of having avoided any radiation-induced death or serious radiation-induced injury at any nuclear power plant remains intact.

Radiological safety

Basic Safety Standards

94. In December, agreement was reached with WHO, ILO and NEA on the final text of the revision of the Agency's Basic Safety Standards for Radiation Protection (Safety Series No. 9). These are based largely on ICRP recommendations published in 1977 and further refined since then. The standards are intended to serve as broad guidelines for the competent authorities of Member States and have been written in such a form that they can serve as a basis for regulations for the protection of workers and the public.

Emergency assistance

95. Early in 1980 the Agency issued a manual ("Planning for Off-Site Response to Radiation Accidents in Nuclear Facilities") that examines the approaches and problems involved in setting up emergency procedures outside the nuclear power plant site and incorporates the many lessons learned by non-nuclear as well as nuclear industries. The Agency also arranged for participants from developing countries to attend a training course in the United States on the actions to be taken in response to radiological emergencies and prepared a programme for helping Member States to evaluate existing emergency plans and develop new ones.

Safe transport

96. Preparations are being made for a revision in 1983 of the Agency's Regulations for the Safe Transport of Radioactive Materials (Safety Series No. 6), which most national and international regulatory authorities have adopted.

Risk assessment

97. The Agency continued to work on refining methods for obtaining and analysing information about public attitudes to the risks involved in various energy systems and on the comparison of risks from the entire fuel cycles of these systems. The joint IAEA/IIASA project continued with risk-benefit studies of various energy systems, particular emphasis being placed on developing countries. The results of work previously carried out have now been presented at five international conferences and in ten scientific publications.

Nuclear safety

NUSS (Nuclear Safety Standards) programme

98. The Senior Advisory Group (SAG) for NUSS prepared a report on the future of the programme, taking into account the Three Mile Island accident. The SAG also recommended a final list of documents consisting of the five codes of practice and a total of 58 safety guides. By the end of 1980 the Agency had published the five codes of practice and 24 of the safety guides, nine of the latter during 1980 itself, while a further 27 safety guides were at various stages of preparation.

Advisory services and training

99. The Agency devoted much effort to assisting Member States in implementing the NUSS codes and guides. Jointly with ISO it held a seminar on the selection and implementation of safety standards for nuclear power plants; the participants discussed the various standards now available, concentrating on the implementation of the NUSS documents. Missions were sent to Hungary and the Syrian Arab Republic to assist them in using the NUSS documents. The Agency arranged for safety evaluations of the Lemoniz nuclear power plant in Spain, the Angra dos Reis plant in Brazil and the Krsko plant in Yugoslavia and a siting evaluation for a nuclear power plant in Morocco. Three international training courses and two regional training courses were held on various aspects of nuclear safety.

Safety research

100. The Agency is developing plans for improving the international co-ordination of research on the safety of thermal reactors, where the Agency could provide a means for promoting co-operation between regional bodies.

Waste management

Handling and treatment of radioactive wastes

101. The Agency published or completed reports on:

- Handling of radioactive waste at nuclear power plants
- Separation and disposal of krypton-85
- Factors relevant to the decommissioning of nuclear power plants
- Radioiodine removal at nuclear facilities
- Practices and options for the confinement of uranium mill tailings
- Treatment of solid waste
- Management of spent ion-exchange resins and of waste from uranium refining facilities
- Decontamination of operating nuclear power plants.

102. Reports are in preparation on the conditioning of low- and intermediate-level waste concentrates and on the retention of gaseous waste at nuclear power plants under normal and accident conditions.

103. The Agency held a symposium, with NEA, on the management of gaseous radioactive waste from nuclear facilities and one, with CEC, on the handling of alpha-contaminated waste.

104. Research on the hazards involved has indicated the limited value of the separation of actinides from active waste and their transmutation into other elements.

Underground disposal of radioactive waste

105. Technical reports and guidelines are being prepared on the following aspects of underground disposal:

- Generic, regulatory and safety assessment activities
- Siting of waste repositories
- Design, construction, operation and shut-down and surveillance of repositories.

106. Seven reports were issued or completed giving guidance on regulatory aspects of underground disposal and on various underground disposal methods, in particular for shallow-ground disposal. The reports also describe methods for making a general safety assessment of underground disposal and for investigating sites for repositories of solid waste in both deep geological formations and in shallow ground.

Environmental aspects of nuclear energy

107. Reference has already been made to co-operation with UNEP, ECE, UNSCEAR and WHO in a comparison of the environmental aspects of nuclear and other energy sources. The Agency terminated the co-ordinated research programme on the behaviour of radium in aquifers and water-ways and started a follow-up programme on the environmental migration of radium and other contaminants present in wastes from the mining and milling of radioactive ores.

108. The Agency also began a review of the oceanographic model which was used in defining, in 1976, radioactive waste unsuitable for dumping in the deep sea; under the London Convention on the Prevention of Marine Pollution, the Agency is responsible for the definition.

109. Work is in progress on guidelines for packaging radioactive waste for sea disposal and for setting the upper limits to the small quantities of radioactive waste which may be dumped into the sea under a general permit as issued by national authorities for the dumping of normal, non-radioactive wastes. Together with NEA, the Agency held a symposium in October on the impact of radionuclide releases into the marine environment.

FOOD AND AGRICULTURE

General

110. The joint FAO/IAEA programme is designed to help developing Member States to use isotope and radiation techniques in research and in practical applications so as to increase agricultural production, improve the quality of food, reduce losses in harvested food and minimize the pollution of food and of the environment. It covers plant breeding and genetics, the fertility of soils, irrigation practices and the production of crops, the control of insects and other pests, studies of chemical residues and pollution, research aimed at improving the health and productivity of animals, and the preservation of food.

111. During 1980, support was given to nearly 100 technical assistance projects in more than 40 developing Member States. More than 250 laboratories and other institutes took part in 25 co-ordinated research programmes financed by the Agency, and in several cases also supported by the Federal Republic of Germany and Sweden. The Agency sent advisory and assistance missions to Bangladesh, Ghana, India, Indonesia and Thailand.

Improving crop production

112. Participants in the co-ordinated research programme on the biological fixation of nitrogen developed better methods (involving the use of nitrogen-15 as a tracer) for field measurements of the amount of atmospheric nitrogen being taken up by plants. It is expected that increased nitrogen fixation by plants will reduce the need for artificial fertilizers, which are among the most expensive inputs used by farmers.

113. A seminar organized by FAO, the Agency and the Association for Radiation and Environmental Research (GSF) of the Federal Republic of Germany reviewed the use of isotope techniques in studying the extent to which nitrogen residues from fertilizers are retained by soils and the extent to which they must be regarded as pollutants. It was shown that mobile nitrogen compounds in the root zone of plants derive both from soil nitrogen and from fertilizers; it was also shown that the extent of losses of fertilizer nitrogen and soil nitrogen from the soil depends on agricultural practices. It is hoped that improved agricultural practices developed on the basis of these studies will reduce the nitrogen pollution of streams, lakes and water sources.

114. The Agency launched new co-ordinated research programmes:

(i) to develop practices for the management of fertilizers and water in systems that combine legume and non-legume crops such as sorghum and cowpeas;

(ii) to determine the effects of herbicides and similar chemicals on nitrogen in fertilizers and in the soil and the management of such nitrogen.

115. An FAO/IAEA/SIDA interregional training course on the use of isotope and radiation techniques in studies of soil-plant relationships was held at Seibersdorf, near Vienna.

116. The Agency extended assistance to Bangladesh, Brazil, Iceland, Indonesia, Malaysia, Peru, Thailand and Venezuela in projects dealing with various aspects of mutation plant breeding.

Insect control

117. The Agency continued to assist Mexico in its campaign against the Mediterranean fruit fly (medfly), in which sterile insects are released within the framework of an integrated pest management programme (i. e. a programme involving the combined use of various methods of pest control). The Agency gave advice on the mass rearing, sterilization and packaging

of insects and on quality control. The mass-rearing facilities at Tapachula, Mexico, are now producing an average of 500 million medflies each week.[11]

118. The Vom project in Nigeria, which is also supported by Belgium, the Federal Republic of Germany, Sweden and the United Kingdom, is now carrying out field as well as laboratory tests aimed at controlling and, if possible, eradicating riverine tsetse flies by means of the sterile-insect technique [12].

119. Institutes in nine Member States are taking part in a co-ordinated research programme on the use of isotopes and radiation in integrated pest management.

Animal production and health

120. The Agency is now assisting developing Member States to use nuclear techniques in research on means to increase milk and meat production, improve the performance of draught animals, enhance reproduction and minimize losses by disease. The co-ordinated research programme on methods for detecting mineral imbalances in livestock has been completed; it helped to develop practical methods for detecting iron and selenium deficiencies. [13]

121. The Agency has continued the co-ordinated research programmes on animal reproduction using radioimmunoassay techniques, which typically involves the labelling of hormones with radionuclides, and on the detection and control of tick-borne diseases. Within the framework of the Regional Co-operative Agreement (RCA), the Agency is carrying out a co-ordinated research programme designed to improve the use and productivity of domestic buffalo in Asia. It has started a programme on the nutrient value and use of low-quality roughages and agro-industrial by-products (for example bagasse and molasses) as potential feedstuffs for cattle.

Protection of the environment

122. The Agency has completed a co-ordinated research programme on the impact of insecticides on edible oils. This has shown that it is of great importance to continue examining the problems that may arise from the use of new pesticides. By using radio-labelled pesticides, it was possible to compare the efficiency of various processes for removing pesticide residues from raw oil.

123. At a joint meeting of the participants in the co-ordinated research programmes on pesticide residues in soil and in water, there was agreement on the need for standardized techniques and for a common experiment with a single labelled pesticide by the participants in both the soil and the water programme.

124. The Agency started co-ordinated research programmes on:

(i) the impact of pesticides used in dipping and spraying livestock (particular attention will be paid to pesticide residues in meat and milk); and

(ii) the production of methane from agricultural wastes and similar biological materials.

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[11] GC(XXIV)/627, para. 96.

[12] Ibid., para. 97.

[13] Ibid., para. 104.

Food preservation

125. An important development took place at the end of the year, when a joint FAO/IAEA/WHO expert committee on the wholesomeness of irradiated food reached the conclusion that no toxicological hazard is caused by irradiating any food up to an overall average dose of 10 kGy (1 Mrad), which is at present the highest dose used in the most important food irradiation applications. Hence, foodstuffs treated in this way no longer have to be tested for toxicity. The public health or other authorities concerned in 22 countries have by now given unconditional or provisional clearances for 39 items of food and groups of related food products. Since 1976, the year when the joint expert committee had met previously, eight countries had granted clearances for 19 food products.

126. The Government of Japan agreed to sponsor, for three years, an RCA project on the irradiation of food. The International Facility for Food Irradiation Technology (IFFIT) at Wageningen, Netherlands, held a general training course on food irradiation technology and helped in the long-term training of seven scientists from developing Member States.

127. An FAO/IAEA symposium on combination processes in food irradiation was held in Colombo, Sri Lanka. Participants discussed the basic and applied research aspects of irradiation combined with heating, freezing, chemical preservation etc. and agreed that food irradiation constitutes a valuable addition to other methods of food preservation.

128. In 1980, four private enterprises and three governmental institutions placed orders for nine pilot and commercial food irradiation facilities.

General

129. As in the past, the Agency's work in this area was designed to help Member States:

(i) to standardize and improve the quality control of diagnostic and therapeutic applications of radiation, radioisotopes and nuclear instruments;

(ii) to develop techniques for the study and control of parasitic diseases in man; and

(iii) to apply nuclear and allied techniques in environmental research and radiation biology.

130. During 1980, the Agency supported more than 50 technical assistance projects in more than 40 Member States. About 110 laboratories and other institutions took part in 14 co-ordinated research programmes.

Medical applications of radionuclides

131. The Agency continued to assist developing countries in the maintenance of nuclear instruments (such as well scintillation counters, scanners and gamma cameras)[14], and, under various programmes, provided help to 15 countries in Asia and Latin America for improving maintenance procedures.

132. The Agency also continued its work aimed at improving the quality of radioimmunoassays and other in vitro assays in developing countries. [15] Some 80 laboratories took part in a comparison of the assay of thyroid-related hormones, and about 40 of them are participating in a programme to improve quality control through better data processing. The Agency, the German Democratic Republic and Poland jointly organized a training course on in vitro assay techniques.

133. Emphasis was placed on quality control practices also in in vivo nuclear medicine; this topic was stressed at an Agency symposium in Heidelberg, Federal Republic of Germany, on medical radionuclide imaging and is the subject of a regional technical assistance programme in Latin America.

134. The Agency supported work on the determination of trace elements of biomedical significance in human milk and the human kidney cortex.

Dosimetry

135. Recently, dosimetry laboratories in the Republic of Korea and Switzerland joined the IAEA/WHO network of Secondary Standard Dosimetry Laboratories (SSDLs), which now comprises 43 member laboratories.[16] A regional calibration mission visited six African countries. Twenty-two SSDLs participated in a special postal dose intercomparison conducted by the Dosimetry Laboratory as a service to the IAEA/WHO network. The calibration of measurements made at the Agency's Dosimetry Laboratory was confirmed with the help of primary standard laboratories in Hungary and the United Kingdom and of the International Bureau of Weights and Measures.

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[14] GC(XXIV)/627, para. 114.

[15] Ibid, para. 115.

[16] Ibid, para. 118.

136. The Agency undertook pilot intercomparison studies with a view to selecting suitable dosimetry systems as a first step in setting up a service for the international standardization and intercomparison of high-dose irradiation (high-dose radiation is used in industrial irradiation facilities such as plants for the sterilization of medical products and for food irradiation). [17] The Agency continued to support ten research projects in this field.

Radiation biology

137. The Agency continued to study and promote new methods for estimating the health hazards of chemical and physical pollutants from various sources of energy.

138. As a first step, support is being given, through a co-ordinated research programme, to work on defining a concept for doses received from various agents; one result of this work has been a report on radiobiological equivalents of chemical pollutants. The Agency continued to support studies designed to lead to the immunological control of parasitic diseases such as malaria and schistosomiasis; training in the development of vaccines against parasitic diseases was given at a course organized with the co-operation of the United States National Institute of Health. Support was also given to Member States in Asia and the Far East for research on the use of radiation sterilization procedures suitable for locally produced medical supplies such as surgical dressings, sutures and antibiotic ointments.

139. The Agency began a co-ordinated research programme on the possible use of high linear energy transfer (high-LET) radiation in cancer therapy (particularly for killing cancer cells that are localized in low-oxygen environments).

Health-related environmental research

140. Work on the use of nuclear techniques for studying the impact of trace metals on the environment and on persons occupationally exposed to such elements is continuing[18], as is the project under the Regional Co-operative Agreement (RCA) for studying human exposure to heavy metals [19].

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[17] GC(XXIV)/627, para. 120.

[18] Ibid, para. 124.

[19] Ibid, para. 125.

PHYSICAL SCIENCES

Physics

141. The "Phase Zero" report on the International Tokamak Reactor (INTOR)[20] was published in June 1980 and received widespread support from scientists in Member States dealing with research on controlled thermonuclear fusion. The INTOR Workshop began work on "Phase One" of the project - i.e. the preparation of a conceptual design for the reactor, which is scheduled for July 1981.

142. The 1981 International Conference on Plasma Physics and Controlled Nuclear Fusion Research took place in Brussels in July. The papers did not indicate any spectacular breakthroughs, but confirmed the substantial and steady progress made in all approaches to controlled fusion and the fact that the tokamak is the most advanced approach to this goal. The next conference will take place at Baltimore, Maryland, United States, in September 1982.

143. The Agency began studies, under a co-ordinated research programme, on the use of Mössbauer spectroscopy in mineralogy, soil sciences and ceramics technology, particularly by small laboratories in developing countries.

144. The research reactor support programme continued to give special attention to the use of low-enriched instead of highly enriched uranium in research reactor cores[21] and published a guidebook on the technical aspects of converting cores to use low-enriched fuel. The Agency sent missions to Chile, Indonesia, the Philippines, Portugal, the Republic of Korea, Turkey and Yugoslavia to advise on such conversions.

145. The Agency also convened a regional seminar on the use of research reactors and neutron generators in developing countries and distributed a directory, in microfiche format, of research reactors in Member States.

Industrial applications and chemistry

146. In August 1980, after approval by UNDP, the Agency began work on preparing the final "Project Document" for the proposed large-scale industrial demonstration programme[22] in Asia and the Pacific region for the use of nuclear techniques in the rubber, wood, paper, steel and mining industries.

147. Under co-ordinated research programmes, work was continued on:

(a) The chemical thermodynamics of actinide elements and their compounds;

(b) Standard procedures for solvent extraction chemistry;

(c) Chemical and isotopic standards for the analysis of nuclear fuels;

(d) The production of radioisotopes for medical purposes;

(e) The development of new and more specific radiopharmaceuticals;

(f) The use of low-power research reactors to produce radionuclides; and

(g) Radiation-modified polymers for biochemical and biomedical applications.

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[20] GC(XXIV)/627, para. 126.

[21] Ibid, para. 129.

[22] Ibid, para. 130.

Isotope hydrology

148. Together with other United Nations organizations, the Agency provided assistance to 20 Member States in the use of isotope techniques for assessing their water resources. It also assisted India, Jordan and Mexico to install analytical facilities for isotope hydrology. The world-wide survey of isotopes in rainfall and other forms of precipitation, which the Agency and WMO have been carrying out since 1961, is being integrated into the WMO/UNEP Global Environmental Monitoring System (GEMS). It continues to provide basic data for the use of isotope techniques in water resource studies in many Member States.

149. The Federal Republic of Germany provided funds for a joint research project of the Agency and the Federal German Association for Radiation and Environmental Research (GSF) on the physical and isotopic behaviour of moisture in soils, especially in arid regions. Progress made under the RCA project on isotope hydrology (which Australia is funding) was reviewed in Seoul in October.

150. The Agency convened a regional seminar in Athens, in September, to aquaint senior hydrologists from the Middle East and the Mediterranean region with the potential uses of isotope hydrology techniques in the development of water resources.

Nuclear data

151. The nuclear data services offered by the Agency increased by 7% over 1979; the Agency distributed 37 568 numerical data sets and 179 processing codes in response to 404 requests. The Agency continued to grant research contracts and supply target materials for nuclear data measurement experiments in developing countries.

152. Under two co-ordinated research programmes designed to improve knowledge of the nuclear characteristics of heavy isotopes, the Agency produced 15 evaluations of reaction data and published an updated list of decay data for 128 heavy radioisotopes.

153. The Agency started an interregional technical assistance project for the training of nuclear scientists in developing countries using the expertise available in the nuclear data field.

154. The Agency published CIAMDA, a new index to atomic and molecular collision data relevant to fusion, and continued the publication of CINDA [23] and of the quarterly "International Bulletin on Atomic and Molecular Data for Fusion".

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[23] GC (XXIV)/627, para. 136.

THE LABORATORIES

Seibersdorf Laboratory

Agricultural and Medical Applications Laboratories

155. These laboratories continued to carry out routine analyses, undertake research and provide in-service training in support of the research contracts, technical assistance and analytical quality control programmes. The main topics dealt with were:

(a) The fixation of nitrogen by plants; [24]

(b) The fate of residual fertilizer nitrogen in soils and plants and how it is affected by crop rotation and other agricultural practices [25];

(c) The mutation breeding of wheat and field beans, with a view to increasing protein contents and yields and to improving quality; [26]

(d) The rearing and aerial release of sterile Mediterranean fruit flies and tsetse flies (support of projects in Mexico and Nigeria); [27]

(e) Trace elements in human milk (support of a joint research programme with WHO); [28]

(f) The monitoring of cadmium in the human kidney cortex [28] (analytical quality control services for WHO and UNEP).

Chemistry

156. During 1980, 450 institutes in 50 Member States ordered about 800 samples of reference materials for analytical quality control purposes from the Laboratory, an increase of 30% in the number of samples compared with 1979.

157. The Laboratory conducted four intercomparisons of determinations of radionuclides and trace elements; 105 institutes in 29 Member States took part.

158. Services to technical assistance and safeguards included 3000 determinations on 800 samples, compared with 529 determinations on 270 samples in 1979.

Electronics and measurement

159. Early in 1980 the former Metrology and Electronics Sections were amalgamated; the work of the new Section is confined to the provision of internal laboratory services. The Laboratory prepared 200 liquid sources and 241 solid sources of 16 different radionuclides for the calibration of radiation equipment and experiments.

Dosimetry

160. The Dosimetry Laboratory, which began working in its new premises at Seibersdorf, distributed 120 sets of thermoluminescent dose capsules to radiotherapy institutes throughout

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[24] See para. 112 above.

[25] See para. 113 above.

[26] See para. 116 above.

[27] See paras 117 and 118 above.

[28] See para. 134 above.

the world as part of the IAEA/WHO postal dose service for improving the quality of radiation measurements when cobalt-60 is used in the treatment of cancer.

Safeguards Analytical Laboratory (SAL)

161. Full operation of SAL began in July 1979, under an Austrian licence which will be transferred to the Agency. During 1980, more than 80% of its capacity was used for providing services to safeguards. The number of requests for destructive analyses - especially of samples containing plutonium and other spent fuel materials - increased significantly.

162. SAL analysed 465 samples of uranium and 106 samples containing plutonium or mixed uranium-plutonium; it also analysed, by isotopic dilution mass spectrometry, 212 samples from reprocessing plants. SAL continued to support other safeguards work in measurement, evaluation and development.

International Laboratory of Marine Radioactivity

163. The Laboratory continued its studies of radioactivity in the marine environment. These studies include investigations of:

(a) the uptake, tissue distribution and loss of transuranic and fission-product elements in many marine organisms;

(b) the behaviour of the natural alpha-radiation-emitting radionuclide polonium-210 in marine organisms;

(c) the geochemical behaviour of transuranic elements, with emphasis on physical and chemical transport mechanisms; and

(d) the rates at which man-made pollutants are transported by marine organisms.

164. A programme change was made so as to begin work related to the disposal of low-, medium- and high-level radioactive wastes in the deep oceans. The Laboratory carried out exercises with Member States to improve the quality of data on environmental radioactivity. Several trainees received instruction, at Monaco, in radiochemical and radiobiological procedures.

165. Investigations of non-nuclear pollutants were undertaken with the co-operation and financial support of UNEP, UNESCO and the United States National Science Foundation.

166. The main fields of research and training-for-research were:

(a) Physics and energy (nuclear physics, solar energy);

(b) Physics and the frontiers of knowledge (elementary particles and fundamental theory);

(c) Physics and technology (condensed matter physics);

(d) Applicable mathematics (boundary value problems, complex analysis);

(e) Physics of natural resources and the environment; and

(f) Regional activities.

Physics and energy

167. During the first quarter of 1980, the Centre held a nuclear physics workshop, a meeting on heavy-ion physics, a training course on nuclear theory and its applications and a training course on the operational physics of power reactors. During the last quarter, the Centre held a second seminar on solar energy; this was co-sponsored by the French Ministries of Co-operation and of Foreign Affairs and was specially designed to be of benefit to scientists from francophone countries.

Physics and the frontiers of knowledge

168. Research on elementary particle physics and fundamental theory continued. In July, at the seventh Trieste conference on particle physics, the most recent progress in this field was reviewed.

Physics and technology

169. Besides the continuation of research, in April, May and June the Centre held a "Spring College" on the physics of polymers, liquid crystals and low-dimensional solids. This was followed by the customary workshop on the physics of condensed matter, during which a symposium was held (in co-operation with the International Union for Pure and Applied Physics) on amorphous silicon physics and its applications.

Applicable mathematics

170. The Centre and the newly established International School for Advanced Scientific Studies, in Trieste, jointly organized a two-week workshop on non-linear boundary value problems. In July, 195 scientists, of whom almost two thirds were from developing countries, took part in the Centre's summer seminar on complex analysis; this was a follow-up to the mathematics courses held each year since 1972.

Physics of natural resources and the environment

171. The Centre, in collaboration with the International School for Advanced Scientific Studies, held a meeting in May on earthquake processes and premonitory phenomena, a subject of great topical interest. The Centre's autumn course was dedicated to the physics of flow in oceans, the atmosphere and deserts.

Regional activities

172. The Centre co-sponsored the following projects in 1980 in support of regional co-operation for the benefit of scientists from developing countries:

(a) Fourteenth Central American course in physics (Panama);

(b) Advanced school of physics (Yogyakarta, Indonesia);

(c) Indo-French school on recent advances in computer techniques, meteorology, bio-mechanics and applied systems (New Delhi);

(d) Fifth international summer college on physics and contemporary needs (Nathiagali, Pakistan);

(e) International symposium on solar energy utilization (London, Ontario, Canada);

(f) Ninth international conference on the few-body problem (Eugene, Oregon, United States of America).

Support received

173. The Centre received support in cash and/or in kind from the host Government, the Governments of Denmark, France, the Federal Republic of Germany, Japan, Sweden and the United States, the Organization of American States, WMO, UNEP, the United Nations University, the United Nations Sudano-Sahelian Office, CERN, the International Union of Geodesy and Geophysics, the Italian region of Friuli-Venezia Giulia and the "Consorzio per l'incremento degli studi e delle ricerche" of the University of Trieste.

SAFEGUARDS

General

174. In 1980, 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 under certain agreements - for the manufacture of any nuclear weapon, or to further any other military purpose, or for the manufacture of any other nuclear explosive device. In the light of the report which the Director General submitted to the Board on the implementation of safeguards in 1980, it is reasonable to conclude again that nuclear material under Agency safeguards remained in peaceful nuclear activities or was otherwise adequately accounted for.

175. The considerations which led to this conclusion and certain observations to which it is subject are set forth in the Safeguards Implementation Report for 1980.

Increased safeguards coverage

176. During 1980, two further non-nuclear-weapon States (Barbados and Turkey) became party to NPT, bringing the total number of non-nuclear-weapon States parties to the Treaty to 110[29]. Three further non-nuclear-weapon States (Indonesia, the Libyan Arab Jamahiriya and Senegal) brought their NPT safeguards agreements into force. The total number of non-nuclear-weapon States with such agreements in force at the end of the year thus rose to 69[29].

177. Of the remaining 41 non-nuclear-weapon States parties to the Treaty, three had significant nuclear activities. Of these, two (Turkey and Venezuela[30]) had begun, but not yet completed, the procedures for bringing their agreements with the Agency into force[31]. All nuclear activities of which the Agency is aware in these three countries were, however, covered by safeguards under non-NPT safeguards agreements.

178. In 1980, safeguards agreements were in force with 11 non-nuclear-weapon States which were not party to NPT - namely, Argentina, Brazil, Chile, Colombia, Cuba, the Democratic People's Republic of Korea, India, Israel, Pakistan, South Africa and Spain. In six of these States all substantial nuclear activities, present or future, of which the Agency was aware were covered by a series of individual safeguards agreements. In the remaining five States and in a sixth State, which had signed but not yet ratified NPT, unsafeguarded nuclear facilities were in operation or under construction[32]. In four of the six States, as in nuclear-weapon States, the unsafeguarded facilities were capable of producing weapons-grade material.

179. During 1980, as in 1979, safeguards were applied in France, the United Kingdom and the United States of America to nuclear material which was subject to safeguards under agreements with third countries and which had been returned or transferred to those three States. The subsidiary arrangements to the agreement with the United Kingdom and EURATOM under which the Agency may apply safeguards to all source or fissionable

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[29] On 25 July 1980, the Socialist Republic of Vietnam was deleted from the list of non-nuclear-weapon States parties to NPT and the safeguards agreement concluded in connection with the Treaty was terminated (INFCIRC/219/Mod. 1).

[30] The safeguards agreement concluded with Venezuela was signed on 23 June 1978.

[31] The third party was the "Republic of China".

[32] The six States were India, Israel, Pakistan, South Africa, Spain and Egypt. Two safeguards agreements covering the facilities in Spain which had not yet been submitted to safeguards were approved by the Board in February 1981. Egypt became party to NPT on 26 February 1981.

material in facilities or parts thereof within the United Kingdom subject only to exclusions for national security reasons entered into force on 1 August 1980. Subsequently, the Agency designated the fast breeder reactor and fast breeder fuel reprocessing plant at Dounreay for routine inspections. The similar agreement concluded with the United States entered into force on 9 December 1980[33] and the agreement based upon a voluntary offer by France is still in the process of ratification.

180. By the end of 1980, safeguards agreements were in force with 86 States. Safeguards were actually being applied in 51 States, the nuclear activities of the remainder not yet having reached the stage at which reports and verification activities are required under the relevant agreements.

181. As in 1979, by far the major part (92% of the total plutonium and 94% of the total uranium) of the nuclear material under safeguards was in States that had submitted all their peaceful nuclear activities to safeguards as a consequence of their being party to NPT or to NPT and the Tlatelolco Treaty.

182. The number of installations under safeguards increased during 1980 from 700 to 774 (see Table 7). The quantities of nuclear material under safeguards changed during 1980 as follows: separated plutonium decreased by 38% to 5 tonnes; plutonium contained in spent fuel rose by 30% to 78 tonnes; low-enriched uranium rose by 18% to 13 872 tonnes; and source material rose by 24% to 19 097 tonnes (see Table 8). The quantity of highly enriched uranium under safeguards remained at 11 tonnes.

Fulfilment of NPT obligations

183. It should be noted that 36 of the non-nuclear-weapon States parties to NPT have failed to comply with the time limits set by Article III. 4 of the Treaty for the conclusion of the relevant safeguards agreement with the Agency; these States are listed in Table 11.

184. As far as the Agency is aware, there is no nuclear material or nuclear activity in any of these States that would require the practical application of safeguards, with the exception of one State in which the activity was covered by a non-NPT safeguards agreement. In one or two cases, the submission of reports on the export of nuclear source material was required. The Agency has repeatedly drawn the attention of the States concerned to the fact that they have not complied with the relevant deadlines. In the case of 31 States, the conclusion of the safeguards agreement is more than five years overdue; in the case of the following 21 States, it is more than ten years overdue:

Bolivia
Botswana
Burundi
Central African Republic
Chad
Guatemala
Haiti
Kenya
Lao People's Democratic Republic
Liberia
Mali
Malta
Nigeria
San Marino
Somalia
Syria
Togo
Trinidad and Tobago
Tunisia
United Republic of Cameroon
Upper Volta

Safeguards information treatment

185. The Agency continued to operate the current data processing system (PSI-2) and to test the new, advanced international safeguards information system (ISIS). Safeguards staff successfully tested the function of parts of the new system.

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[33] In 1981, the Agency designated the Exxon Fuel Fabrication Plant at Richland, Washington, and two power reactors, at Sacramento, California, and Prescott, Oregon.

186. During 1980, the data base of ISIS increased to a total of about 1 050 000 records. About 400 000 new accounting, inspection and other records were evaluated and loaded into the ISIS data base and about 16 000 queries were run through it. All Divisions in the Department of Safeguards obtained access to it through computer terminals, under strict security procedures.

187. The Agency installed and tested an improved version of ADABAS (Adaptable Data Base Management System).

188. Numerous data evaluation services were provided to inspectors - for instance, for:

- calibrating standards,
- calibrating tanks,
- preparing inspection sampling plans,
- evaluating destructive and non-destructive measurements made by inspectors,
- evaluating data collected during verifications of physical inventories,
- applying isotopic correlation techniques.

189. The Agency held the customary annual seminar to assist Member States in preparing and providing accounting reports. Twenty-eight countries sent participants.

Safeguards development and technical support

190. The Agency continued to give special attention to developing and improving safeguards approaches for "sensitive" facilities, such as facilities handling and processing plutonium and highly enriched uranium and uranium enrichment plants. It also began work on developing an approach for safeguarding plants that produce heavy water, which were coming under safeguards for the first time.

191. The development of a methodology for evaluating the effectiveness of safeguards on light-water reactors was completed. Further progress was made in developing methods for other types of plant and in working out guidelines for designing nuclear facilities in such a way that safeguards can be applied more effectively.

192. The standardization of procedures for the application of safeguards at light-water reactors was continued and work began on standardized procedures for other types of facilities.

193. The Agency continued to assist Member States in establishing and maintaining their national systems of accounting for and control of nuclear material. It conducted a training course with 26 participants from 19 countries and issued a document setting out guidelines for national systems (IAEA/SG/INF/2).

194. During 1980, the Agency processed and issued metallic safeguards seals at an average rate of about 600 a month and provided development and maintenance services for about 150 surveillance systems (cameras and video recorders) installed in safeguarded facilities throughout the world. As a result of better installation and maintenance procedures, the reliability of this equipment continued to improve.

195. Further tests were carried out in the field on equipment for the non-destructive analysis of samples taken by inspectors, and the Agency continued to train inspectors in the use of such equipment.

196. Advisory groups were convened on the quality of non-destructive analysis measurement data, on containment and surveillance and on the automation of non-destructive analysis instrumentation. The International Working Group on the Application of Safeguards to Reprocessing Plants continued its work on a report to be issued in 1981. Research co-ordination meetings were held on isotope correlation techniques and on safeguards applications of installed instruments in reprocessing plants.

197. The formalized support programmes of Canada, the Federal Republic of Germany and the United States, which were initiated before 1980, continued to provide valuable assistance in improving the effectiveness of safeguards. Additional support was provided by Australia, the Union of Soviet Socialist Republics and the United Kingdom.

198. Preliminary discussions concerning additional formalized support programmes were conducted with the Governments of Australia, Japan, the Union of Soviet Socialist Republics and the United Kingdom and with EURATOM, which have indicated their willingness to co-operate with the Agency in improving safeguards.

199. The support programmes dealt with subjects such as

- The non-destructive measurement of nuclear material and irradiated fuel by means of "active neutron interrogation" equipment;

- Optical and television equipment for verifying the identity of irradiated fuel stored under water;

- Automated instrumentation for determining the nuclear material content of irradiated fuel by "passive radiation" measurements.

200. Work continued on Remote Continual Verification (RECOVER), which is being developed in the United States and is designed to permit the Agency to interrogate safeguards equipment by normal telephone communications between Agency Headquarters and the plant where it is installed and to check whether it is functioning normally (or, in the case of seals, whether there has been any interference). The system is now being tested between Headquarters and remote plants throughout the world.

Table 7

Nuclear installations under Agency safeguards or containing safeguarded material

Nuclear installations	End of 1980[a]					
	NPT		Non-NPT		Total	
Facilities						
Power reactors	103	(94)	24	(23)	127	(117)
Research reactors and critical assemblies	147	(140)	28	(31)	175	(171)
Conversion plants	3	(4)	1	(0)	4	(4)
Fuel fabrication plants	31	(28)	7	(5)	38	(33)
Reprocessing plants	4	(4)	3	(1)	7	(5)
Enrichment plants	4	(4)	0	(0)	4	(4)
Separate storage facilities	15	(14)	6	(5)	21	(19)
Other facilities	40	(40)	0	(0)	40	(40)
	347	(328)	69	(65)	416	(393)
Other locations	340	(289)	18	(18)	358	(307)
Total	687	(617)	87	(83)	774	(700)

a/ The figures in brackets indicate the status at the end of 1979.

Table 8

Quantities (in tonnes) of nuclear material under Agency safeguards, except that covered by agreements implementing the voluntary offers of two nuclear-weapon States[a/]

	1975	1976	1977	1978	1979	1980
Plutonium						
(a) Separated	2	3	6	7	8	5[b/]
(b) Contained in irradiated fuel	15	23	30	44	60	78[b/]
Total	17	26	36	51	68	83
Uranium enriched to 20% or more	4	5	11	11	11	11
Uranium enriched to less than 20%	3 091	3 613	7 849	10 495	11 714	13 872[b/]
Source materials (natural or depleted uranium and thorium	4 440	5 336	12 234	13 150	15 399	19 097

a/ Apart from this exception, the table includes all nuclear material safeguarded under agreements concluded pursuant to NPT (other than material referred to in sub-paragraphs 34(a) and (b) of INFCIRC/153) and all nuclear material safeguarded under agreements concluded pursuant to INFCIRC/66/Rev. 2.

b/ In one nuclear-weapon State, irradiated fuel has again been placed under safeguards instead of separated plutonium that had been temporarily substituted for it.

Table 9

Agreements in force in connection with NPT, the Tlatelolco Treaty and voluntary offers made by nuclear-weapon States[a, c]

NPT	52
NPT and Tlatelolco Treaty	12
NPT and Additional Protocol I of Tlatelolco Treaty	1
Tlatelolco Treaty	1
Agreements concluded with nuclear-weapon States on basis of voluntary offers	2
	68

Table 10

Agreements in force other than those included in Table 9[c]

Project agreements	25
Unilateral submissions	15
Trilateral agreements	31
	71[b]

a/ The 65 agreements in force with non-nuclear-weapon States under NPT and the Tlatelolco Treaty covered all relevant nuclear material in 69 States (seven non-nuclear-weapon States had jointly concluded a single agreement with the Agency; two of these States had previously concluded individual agreements that were still in force). The application of the agreement concluded pursuant to the Tlatelolco Treaty only has been suspended.

b/ The application of safeguards under 31 of these agreements was in suspense with regard to the States which had concluded other agreements for the application of Agency safeguards.

c/ As indicated in para. 180, many of the non-nuclear-weapon States for which safeguards agreements were in force had no significant nuclear activities. The States in which safeguards were actually being applied were: Argentina, Australia, Austria, Belgium, Brazil, Bulgaria, Canada, Chile, "Republic of China", Colombia, Czechoslovakia, Democratic People's Republic of Korea, Denmark, Finland, France, German Democratic Republic, Federal Republic of Germany, Greece, Hungary, India, Indonesia, Iran, Iraq, Ireland, Israel, Italy, Japan, Republic of Korea, Libyan Arab Jamahiriya, Luxembourg, Mexico, Netherlands, Norway, Pakistan, Peru, Philippines, Poland, Portugal, Romania, South Africa, Spain, Sweden, Switzerland, Thailand, Turkey, United Kingdom, United States, Uruguay, Venezuela, Yugoslavia, Zaire.

Table 11

Non-nuclear-weapon States parties to NPT which on 31 December 1980 had not yet complied with Article III. 4 of the Treaty stipulating the last date for the entry into force of the safeguards agreement to be concluded with the Agency

Bahamas	Liberia
Benin	Mali
Bolivia	Malta
Botswana	Nigeria
Burundi	Panama
Central African Republic	Rwanda
Chad	San Marino
Congo	Sierra Leone
Democratic Kampuchea	Somalia
Democratic Yemen	Sri Lanka
Gabon	Syrian Arab Republic
Grenada	Togo
Guatemala	Tonga
Guinea-Bissau	Tunisia
Haiti	Tuvalu
Ivory Coast	United Republic of Cameroon
Kenya	Upper Volta
Lao People's Democratic Republic	Venezuela

Table 12

Situation on 31 December 1980 with respect to the signing of, the ratification of, or accession 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 or acceded to NPT[a] (1)	Date of ratification or accession[a] (2)	Safeguards agreement with the Agency (3)	INFCIRC (4)
Afghanistan	4 February 1970	In force: 20 February 1978	257
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		
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
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[e, f]			
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	11 March 1970	Provisionally in force: 1 March 1972	166
Grenada	19 August 1974		
Guatemala[b]	22 September 1970	Signed: 20 July 1978	
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	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		
Jamaica[b]	5 March 1970	In force: 6 November 1978	265
Japan	8 June 1976	In force: 2 December 1977	255
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

(1)	(2)	(3)	(4)
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
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		
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
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]			
Tunisia	26 February 1970		
Turkey	17 April 1980		
Tuvalu	19 January 1979		
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	Signed: 23 June 1978	
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 seven 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; Egypt, 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] Egypt ratified NPT on 26 February 1981.

Table 13

Agreements providing for safeguards, other than those in connection with NPT, approved by the Board as of 31 December 1980

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 December 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[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
Peru[c]	Booster rods for KANUPP	17 June 1968	116
	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	Sub-critical assembly	17 May 1974	212
Uruguay[b]	URR Reactor	24 September 1965	67
Venezuela	RV-1 Reactor	7 November 1975	238
Yugoslavia[b]	TRIGA-II Reactor	4 October 1961	32
	KRSKO 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
Chile	Nuclear material	31 December 1974	256

Party(ies)[a]	Subject	Entry into force	INFCIRC
China, Republic of	Taiwan Research Reactor Facility	13 October 1969	133
Cuba	Nuclear research reactor and fuel therefor	25 September 1980	
	Nuclear power plant and nuclear material	5 May 1980	281
DemocraticPeople'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
United Kingdom	Nuclear material	14 December 1972	175
(c) Tlatelolco Treaty			
Colombia	All nuclear material		
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		
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	
(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
China, Republic of/United States of America		6 December 1971	158
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
Indonesia/United States of America		6 December 1967	109
Iran[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

Party(ies)[a]	Entry into force	INFCIRC
Japan[b]/France	22 September 1972	171
Japan/United States of America	10 July 1968	119
Japan[b]/United Kingdom	15 October 1968	125
Japan[b]/Australia[b]	28 July 1972	170
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/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

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 14

Nuclear facilities under Agency safeguards or containing safeguarded material under agreements in force as of 31 December 1980

A. Research reactors and critical assemblies

State[a]	Abbreviated name	Location	Type	Capacity MW(th)	In operation	Subsidiary arrangements in force
Argentina	RA-1	Constituyentes	Tank	0.07	x	x
	RA-2	Constituyentes	MTR	0.00	x	x
	RA-3	Ezeiza	MTR	5.00	x	x
	RA-4	Rosario	SUR-100	0.00	x	x
Australia[b]	HIFAR	Lucas Heights, N.S.W.	Tank	11.00	x	x
	MOATA	Lucas Heights, N.S.W.	Argonaut	0.01	x	x
	CF	Lucas Heights, N.S.W.	Critical assembly	0.00	x	x
Austria[b]	SAR	Graz	Argonaut	0.01	x	x
	Triga II	Vienna	Pool	0.25	x	x
	ASTRA	Seibersdorf	Pool	12.00	x	x
Belgium[b]	BR1-CEN	Mol	Tank	4.00	x	x
	BR2-CEN	Mol	Tank	100.00	x	x
	Thetis	Gent	Pool	0.15	x	x
	BRO2	Mol	Tank	0.00	x	x
	CEN-Venus	Mol	Tank	0.00	x	x
Brazil	IEAR-1	São Paulo	Pool	5.00	x	x
	UMG	Belo Horizonte	Triga I	0.10	x	x
	RIEN-1	Rio de Janeiro	Argonaut	0.01	x	x
Bulgaria[b]	IRT-2000	Sofia	Pool	2.00	x	x
Canada[b]	NRX	Chalk River, Ont.	NRX	30.00	x	x
	NRU	Chalk River, Ont.	NRU	125.00	x	x
	WR-1	Pinawa, Manitoba	Organic-cooled	60.00	x	x
	McMaster	Hamilton, Ont.	Pool-type	2.5	x	x
	Slowpoke - Toronto	Univ. of Toronto	Pool-type	0.02	x	x
	AECL, Chem. Comp.	Ottawa, Ont.	Pool-type	0.02	x	x
	PTR	Chalk River, Ont.	Pool-type	0.00	x	x
	ZED-2	Chalk River, Ont.	Pool-type	0.00	-	x
	ZEEP	Chalk River, Ont.	Tank	0.00	-	x
	Slowpoke - Halifax	Dalhousie Univ.	Pool-type	0.02	x	- [e]
	Ecole Polytechnique	Montreal	Pool-type	0.02	x	x
	Slowpoke - Edmonton	Univ. of Alberta	Pool-type	0.02	x	- [e]
Chile	La Reina	Santiago	Herald	5.00	x	x
	Lo Aguirre	Santiago	MTR	10.00	x	x
China, Republic of	THOR	Hsin-chu	Pool	1.00	x	x
	TRR	Huaitzupu	NRX	40.00	x	x
	ZPRL	Lung-Tan	Pool	0.01	x	x
	THAR	Hsin-chu	Argonaut	0.01	x	x
	MER	Hsin-chu	Mobile Educational Reactor	0.00	x	x
	WBRL	Lung-Tan	Tank	0.1	-	x
Colombia	IAN-R1	Bogotá	Pool	0.02	x	x
Czechoslovakia[b]	SR-OD	Vochov	Critical assembly	0.00	x	x
	SR-OB	Vochov	Exponential assembly	0.00	x	x
	VVR-S	Rez	Tank	4.5	x	x
	TR-O	Rez	Critical assembly	0.00	x	x
Democratic People's Republic of Korea	IRT-DPRK	Nyonpyon	Pool	4.00	x	x
	Critical assembly	Nyonpyon	Pool	0.10	x	x
Denmark[c]	DR-1	Roskilde	Homogeneous	0.00	x	x
	DR-3	Roskilde	Tank	10.00	x	x
Finland[b]	Triga II	Otaniemi	Tank	0.25	x	x

State[a]	Abbreviated name	Location	Type	Capacity MW(th)	In operation	Subsidiary arrangements in force
German Democratic Republic[b]	WWR-S(M)	Rossendorf	Tank	10.00	x	x
	RRR	Rossendorf	Argonaut	0.00	x	x
	RAKE	Rossendorf	Tank	0.00	x	x
	Training Reactor AKR	Dresden	Tank	0.00	x	x
	Training and research reactor	Zittau	Tank	0.00	x	x
Germany, Federal Republic of[b]	FRM	Garching	Pool	4.00	x	x
	GKSS-FRG1	Geesthacht	Pool	5.00	x	x
	GKSS-FRG2	Geesthacht	Pool	15.00	x	x
	GFK-FR-2	Karlsruhe	Tank	45.00	x	x
	KFA-FRJ1	Jülich	Pool	10.00	x	x
	KFA-FRJ2	Jülich	Tank	43.00	x	x
	Triga	Mainz	Triga I	0.10	x	x
	Triga II	Heidelberg	Triga II	0.25	x	x
	FMRB	Braunschweig	Tank	1.00	x	x
	Triga	Hanover	Triga II	0.25	x	x
	Triga	Neuherberg	Triga II	1.00	x	x
	GFK-SNEAK	Karlsruhe	Critical assembly	0.00	x	x
	SUR 100	Garching	Solid-homogeneous	0.10	x	x
	SUR 100	Darmstadt	Solid-homogeneous	0.10	x	x
	SUR 100	Stuttgart	Solid-homogeneous	0.10	x	x
	SUR 100	Hamburg	Solid-homogeneous	0.10	x	x
	SUR 100	Kiel	Solid-homogeneous	0.10	x	x
	SUR 100	Ulm	Solid-homogeneous	0.10	x	x
	SUR 100	Karlsruhe	Solid-homogeneous	0.10	x	x
	SUR 100	Bremen	Solid-homogeneous	0.10	x	x
	SUR 100	Furtwang	Solid-homogeneous	0.10	x	x
	SUR 100	Aachen	Solid-homogeneous	0.10	x	x
	KFA-ITR	Jülich	Critical assembly	0.00	x	x
	FRF-2	Frankfurt	Triga	1.0	x	x
	SUR 100	Hanover	Solid-homogeneous	0.1	x	x
	KFA-NEA	Jülich	Critical assembly	0.00	x	x
	BER-2	Berlin (West)	Aqueous Homogeneous	5.00	x	x
	SUR 100	Berlin (West)	Solid-homogeneous	0.10	x	x
Greece[b]	GRR-1	Athens	Pool	5.00	x	x
	N.T.U.	Athens	Graphite	0.00	x	x
Hungary[b]	WWR-S(M)	Budapest	Tank	5.00	x	x
	ZR-4	Budapest	Critical assembly	0.00	x	x
	ZR-6	Budapest	Critical assembly	0.00	x	x
	Training reactor	Budapest	Tank	0.01	x	x
Indonesia[b]	PPTN	Bandung	Triga II	1.00	x	x
	Gama	Yogyakarta	Triga II	0.25	x	x
Iran[b]	TSPRR	Teheran	Pool	5.00	x	x
Iraq[b]	IRT-2000	Baghdad Tuwaitha	Pool	2.00	x	x
	Tamuz-1	Baghdad Tuwaitha	Pool	40.00	-	- [e]
	Tamuz-2	Baghdad Tuwaitha	Pool	0.5	x	- [e]
Israel	IRR-1	Soreq	Pool	5.00	x	x
Italy[b]	Triga 1-RC1	Casaccia	Triga I	1.00	x	x
	AGN-201	Palermo	Solid-homogeneous	0.00	x	x
	CESNEF-L54	Milan	Aqueous Homogeneous	0.01	x	x
	ESSOR	Ispra	Tank	40.00	x	x
	RTS-1-S.	Pisa	Pool	5.00	x	x
	RANA	Casaccia	Pool	0.01	x	x
	RITMO	Casaccia	Pool	0.00	x	x
	TAPIRO	Casaccia	Fast neutron	0.00	x	x
	Triga-2	Pavia	Triga II	0.25	x	x
	RB-1	Montecuccolino	Graphite	0.00	x	x
	RB-2	Montecuccolino	Argonaut	0.01	x	x
	RB-3	Montecuccolino	Tank(D_2O)	0.01	x	x

State[a/]	Abbreviated name	Location	Type	Capacity MW(th)	In operation	Subsidiary arrangements in force
Japan[b/]	DCA	Oarai-Machi	Critical assembly	0.00	x	x
	FCA	Tokai-Mura	Critical assembly	0.00	x	x
	HTR	Kawasaki-shi	Pool	0.10	x	x
	JMTR	Oarai-Machi	Tank	50.00	x	x
	JMTR-CA	Oarai-Machi	Critical assembly	0.00	x	x
	JOYO	Oarai-Machi	EBR	50.00	x	x
	JRR-2	Tokai-Mura	Tank	10.00	x	x
	JRR-3	Tokai-Mura	Tank	10.00	x	x
	JRR-4	Tokai-Mura	Pool	3.50	x	x
	Kinki University	Kowake	UTR-B	0.00	x	x
	KUR	Kumatori-cho	Pool	5.00	x	x
	NSRR	Tokai-Mura	Triga (pulse)	0.30	x	x
	Musashi College of Technology	Kawasaki	Triga II	0.10	x	x
	NAIG-CA	Kawasaki-ku	Critical assembly	0.00	x	x
	Rikkyo University	Nagasaka	Triga II	0.10	x	x
	SHE	Tokai-Mura	Critical assembly	0.00	x	x
	TCA	Tokai-Mura	Critical assembly	0.00	x	x
	TODAI	Tokai-Mura	Fast Neutron Source Reactor	0.00	x	x
	TTR	Kawasaki-shi	Pool	0.10	x	x
	KUCA	Kumatori-cho	Critical assembly	0.00	x	x
	KUCA	Kumatori-cho	Critical assembly	0.00	x	x
	KUCA	Kumatori-cho	Critical assembly	0.00	x	x
Korea, Republic of[b/]	KRR - TRIGA II	Seoul	Triga II	0.10	x	x
	KRR - TRIGA III	Seoul	Triga III	2.00	x	x
	Kyung-Hee Univ.	Seoul	Tank	0.00	x	x
Libyan Arab Jamahiriya[b/]	IRT-TAJURA	Tajura	IRT	10.00	-	- [e/]
Mexico[d/]	Centro Nuclear de Mexico	Ocoyoacac	Triga III	1.00	x	x
	Training reactor facility	Mexico City	SUR 100	0.00	x	x
Netherlands[b/]	LFR	Petten	Argonaut	0.01	x	x
	HOR-THS	Delft	Pool	2.00	x	x
	BARN	Wageningen	Graphite	0.10	x	x
	HFR	Petten	Tank	45.00	x	x
Norway[b/]	JEEP-II	Kjeller	Tank	2.00	x	x
	HBWR	Halden	HBWR	25.00	x	x
Pakistan	PARR	Rawalpindi	Pool	5.00	x	x
Peru[d/]	RP-O	Lima	Tank	0.00	x	x
Philippines[b/]	PRR-1	Diliman, Quezon City	Pool	1.00	x	x
Poland[b/]	EWA	Świerk	Tank	8.00	x	x
	Maryla	Świerk	Critical assembly	0.00	x	x
	Anna	Świerk	Critical assembly	0.00	x	x
	Agata	Świerk	Critical assembly	0.00	x	x
	Maria	Świerk	Tank	30.00	x	x
Portugal[b/]	RPI	Sacavem	Tank	1.00	x	x
Romania[b/]	VVR-S	Margurele	Tank	10 00	x	x
	Triga II	Pitesti-Colibasi	Tank	14.00	x	x
	RP-01	Margurele	Tank	0.00	-	x
South Africa	SAFARI-1	Pelindaba	Tank	20.00	x	- [e/]
Spain	JEN-1 and JEN-2	Madrid	Pool	3.00	x	x
	CORAL-1	Madrid	Fast cricital assembly	0.00	x	x
	ARBI	Bilbao	Argonaut	0.01	x	x
	ARGOS	Barcelona	Argonaut	0.01	x	x
Sweden[b/]	R2	Studsvik	Tank	50.00	x	x
	R2-O	Studsvik	Pool	0.00	x	x
	R-O	Studsvik	Pool	0.00	x	x

State[a/]	Abbreviated name	Location	Type	Capacity MW(th)	In operation	Subsidiary arrangements in force
Switzerland[b/]	Proteus	Würenlingen	Fast thermal critical assembly	0.00	x	x
	Saphir	Würenlingen	Pool	5.00	x	x
	Crocus	Lausanne	Pool	0.00	x	x
	AGN201P	Geneva	Solid-homogeneous	0.00	x	x
	AGN211P	Basel	Pool	0.00	x	x
Thailand[b/]	TRR-1	Bangkok	Pool	2.00	x	x
Turkey	TR-1	Istanbul	Pool	1.00	x	x
	TR-2	Istanbul	Triga II	0.25	x	x
Uruguay[d/]	RU-1	Montevideo	Lockheed	0.10	x	x
Venezuela	RVI	Altos de Pipe	Pool	3.00	x	x
Yugoslavia[b/]	Triga II	Ljubljana	Triga II	0.25	x	x
	Boris Kidric R.	Vinča	Tank	6.50	x	x
	RB	Vinča	Critical assembly	0.00	x	x
Zaire[b/]	Triga-Zaire	Kinshasa	Triga II	1.00	x	x

B. Nuclear power reactors

State[a/]	Name of power reactor	Location	Type	Capacity MW(e)	In operation	Subsidiary arrangements in force
Argentina	Atucha NPS	Atucha	PHWR	319	x	x
	Embalse PR	Cordoba	Candu	600	-	x
Austria[b/]	Tullnerfeld	Zwentendorf	PWR	700	-	x
Belgium[b/]	BR-3-CEN	Mol	PWR	11	x	x
	DOEL-1	Antwerp	PWR	412	x	x
	DOEL-2	Antwerp	PWR	412	x	x
	SEMO-1	Tihange	PWR	920	x	x
	SEMO-2	Tihange	PWR	934	-	- e/
	Kernzentrale DOEL-3	Beveren	PWR	900	-	- e/
Brazil	Angra-1	Angra dos Reis	PWR	626	x	x
Bulgaria[b/]	Kozloduy-1	Kozloduy	PWR	440	x	x
	Kozloduy-2	Kozloduy	PWR	440	x	x
	Kozloduy-3	Kozloduy	PWR	440	x	x
	Kozloduy-4	Kozloduy	PWR	440	-	x
Canada[b/]	Bruce-1	Tiverton, Ontario	Candu	788	x	x
	Bruce-2	Tiverton, Ontario	Candu	788	x	x
	Bruce-3	Tiverton, Ontario	Candu	788	x	x
	Bruce-4	Tiverton, Ontario	Candu	788	x	x
	DPGS	Kincardine, Ontario	Candu	208	x	x
	Gentilly-1	Gentilly, Quebec	Candu	250	x	x
	Gentilly-2	Gentilly, Quebec	Candu	600	-	x
	NPD	Rolphton, Ontario	Candu	22	x	x
	Pickering-1	Pickering, Ontario	Candu	540	x	x
	Pickering-2	Pickering, Ontario	Candu	540	x	x
	Pickering-3	Pickering, Ontario	Candu	540	x	x
	Pickering-4	Pickering, Ontario	Candu	540	x	x
	Point Lepreau	New Brunswick	Candu	600	-	x
China, Republic of	FNPS-1	Ching-San	BWR	636	x	x
	FNPS-2	Ching-San	BWR	636	x	x
	SNPS-1	Kuosheng Tsun	BWR	985	-	x
	SNPS-2	Kuosheng Tsun	BWR	985	-	x
Czechoslovakia[b/]	A1	Bohunice	HWGC	143	x	x
	V.1 Bohunice-1	Bohunice	PWR	440	x	x
	V 1 Bohunice-2	Bohunice	PWR	440	x	x
Finland[b/]	Loviisa-1	Loviisa	PWR	420	x	x
	Loviisa-2	Loviisa	PWR	420	-	x
	TVO-1	Olkiluoto	BWR	660	x	x
	TVO-2	Olkiluoto	BWR	660	x	x
German Democratic Republic[b/]	Rheinsberg PWR	Rheinsberg	PWR	80	x	x
	Bruno Leuschner-1	Greifswald	PWR	440	x	x
	Bruno Leuschner-2	Greifswald	PWR	440	x	x
	Bruno Leuschner-3	Greifswald	PWR	440	x	x
	Bruno Leuschner-4	Greifswald	PWR	440	x	x
Germany, Federal Republic of[b/]	KRB-1	Gundremmingen	BWR	250	x	x
	GFK-MZFR	Karlsruhe	HWR	58	x	x
	VAK-KAHL	Grosswelzheim	BWR	16	x	x
	AVR	Julich	HTGR	15	x	- e/
	KWL-1	Lingen	BWR	267	x	x
	KNK	Karlsruhe	SZR	21	x	x
	KWW	Würgassen	BWR	670	x	x
	KKS-1-HAM	Stade	PWR	662	x	x
	KWO	Obrigheim	PWR	345	x	x
	KKB	Brunsbüttel	BWR	805	x	x
	RWE-BIBLIS-A	Biblis	PWR	1204	x	x
	RWE-BIBLIS-B	Biblis	PWR	1300	x	x
	GKN	Neckarwestheim	PWR	805	x	x
	KKU	Unterweser	PWR	1300	x	x
	KKI-ISAR	Ohu	BWR	907	x	x
	KKP	Philippsburg	BWR	907	x	x
	KKG	Grafenrheinfeld	LWR	1200	-	- e/
India	Tarapur-1	Tarapur	BWR	190	x	x
	Tarapur-2	Tarapur	BWR	190	x	x
	Rajasthan-1	Rajasthan	Candu	200	x	x
	Rajasthan-2	Rajasthan	Candu	200	-	x
Italy[b/]	E.N.E.L.	Latina	GCR	160	x	x
	E.N.E.L.	Garigliano	BWR	160	x	x
	FERMI	Turin	PWR	256	x	x
	E.N.E.L.	Caorso	BWR	920	x	x

State[a/]	Name of power reactor	Location	Type	Capacity MW(e)	In operation	Subsidiary arrangements in force
Japan[b/]	Fugen	Tsuruga-Fukui	ATR	165	x	x
	Fukushima-1	Okuma-Fukushima	BWR	460	x	x
	Fukushima-2	Okuma-Fukushima	BWR	784	x	x
	Fukushima-3	Okuma-Fukushima	BWR	784	x	x
	Fukushima-4	Okuma-Fukushima	BWR	784	x	x
	Fukushima-5	Okuma-Fukushima	BWR	784	x	x
	Fukushima-6	Okuma-Fukushima	BWR	1100	x	x
	Fukushima Dai-ni-1	Naraha-Fukushima	BWR	1100	-	- e/
	Genkai-1	Kyushu	PWR	559	x	x
	Genkai-2	Kyushu	PWR	559	x	x
	Hamaoka-1	Hamaoka-cho	BWR	540	x	x
	Hamaoka-2	Hamaoka-cho	BWR	840	x	x
	Ikata-1	Nishiuwagun	PWR	566	x	x
	Mihama-1	Mihama-Fukui	PWR	340	x	x
	Mihama-2	Mihama-Fukui	PWR	500	x	x
	Mihama-3	Mihama-Fukui	PWR	826	x	x
	Ohi-1	Ohi-cho, Fukai-ken	PWR	1175	x	x
	Ohi-2	Ohi-cho, Fukai-ken	PWR	1175	x	x
	Shimane	Kashima-cho	BWR	460	x	x
	Takahama-1	Takahama	PWR	826	x	x
	Takahama-2	Takahama	PWR	826	x	x
	Tokai-1	Tokai-Mura	Magnox	166	x	x
	Tokai-2	Tokai-Mura	BWR	1100	x	x
	Tsuruga	Tsuruga	BWR	357	x	x
	JPDR	Tokai-Mura	BWR	90	-	x
	Mutsu nuclear ship	Minato-Machi Mutsu	PWR	36	-	x
Korea, Republic of[b/]	Kori-1	Pusan	PWR	564	x	x
	Wolsung-1	Yangnam-Myon	Candu	633	-	- e/
Mexico[d/]	Laguna Verde PS	Laguna Verde, Vera Cruz	BWR	650	-	- e/
Netherlands[b/]	GKN	Dodewaard	BWR	54	x	x
	PZEM	Borssele	PWR	468	x	x
Pakistan	KANUPP	Karachi	Candu	125	x	x
South Africa	Koeberg-1	Cape Town	PWR	922	-	x
	Koeberg-2	Cape Town	PWR	922	-	x
Spain	Almaraz-1	Province of Caceres	PWR	930	-	x
	Almaraz-2	Province of Caceres	PWR	930	-	x
	Asco-1	Province of Tarragona	PWR	930	-	x
	Asco-2	Province of Tarragona	PWR	930	-	x
	Cofrentes	Province of Valencia	BWR	975	-	x
	José Cabrera	Almonacid de Zorita	PWR	153	x	x
	Lemoniz-1	Province of Viscaya	PWR	930	-	x
	Lemoniz-2	Province of Viscaya	PWR	930	-	x
	Santa Maria de Garona	Province of Burgos	BWR	440	x	x
Sweden[b/]	Barsebäck-1	Near Malmö	BWR	580	x	x
	Barsebäck-2	Near Malmö	BWR	580	x	- e/
	Forsmark-1	Near Uppsala	BWR	900	-	- e/
	Forsmark-2	Uppsala	BWR	900	-	- e/
	Oskarshamn-1	Oskarshamn	BWR	440	x	x
	Oskarshamn-2	Oskarshamn	BWR	580	x	x
	Ringhals-1	Near Göteborg	BWR	760	x	x
	Ringhals-2	Near Göteborg	PWR	830	x	x
	Ringhals-3	Near Göteborg	PWR	912	-	- e/
	Ringhals-4	Near Göteborg	PWR	912	-	- e/
Switzerland[b/]	KKM	Muhleberg	BWR	320	x	x
	KKB-1	Beznau	PWR	350	x	x
	KKB-2	Beznau	PWR	350	x	x
	KKG	Gösgen-Däniken	PWR	970	x	x
United Kingdom	PFR and storage capacity	Dounreay	FBR	250	x	x
Yugoslavia[b/]	Krsko	Krsko	PWR	632	-	x

C. Conversion plants, fuel fabrication plants, enrichment plants and chemical reprocessing plants including pilot plants with an annual throughput or inventory exceeding one effective kilogram

State[a/]	Abbreviated name	Location	Type	Subsidiary arrangements in force
Argentina	Pilot Fuel Fabrication Plant (natural uranium)	Constituyentes	Fuel fabrication	- e/
	Pilot Fuel Fabrication Plant (HEU)	Constituyentes	Fuel fabrication	x
	Atucha Fuel Fabrication Plant	Ezeiza	Fuel fabrication	- e/
Belgium[b/]	FBFC	Dessel	Fuel fabrication	x
	Belgonucleaire-BN-MOX	Dessel	Fuel fabrication	x
Brazil	Resende Fuel Fabrication Plant	Resende	Fuel fabrication	- e/
Canada[b/]	ENL Port Hope	Port Hope	Conversion	x
	ENL Port Hope	Port Hope	Conversion	x
	CGE Peterborough	Peterborough	Fuel fabrication	x
	WCL	Varennes	Fuel fabrication	x
	Combustion Engineering Superheat	Moncton, New Brunswick	Fuel fabrication	x
	WCL Port Hope	Port Hope	Fuel fabrication	x
	CGE Toronto	Toronto	Fuel fabrication	x
	Noranda Met. Ind. Ltd.	Montreal	Fuel fabrication	x
	ENL Port Hope	Port Hope	Fuel fabrication	x
	CRNL Fuel Fabrication Plant	Chalk River	Fuel fabrication	x
	Metallurgy	Chalk River	Fuel fabrication	x
China, Republic of	INER Fuel Fabrication Plant	Lung Tan	Fuel fabrication	x
	INER Uranium Conversion Pilot Plant	Lung Tan	Conversion	- e/
Denmark[c/]	Metallurgy Department	Risø	Fuel fabrication	x
Germany, Federal Republic of[b/]	ALKEM	Wolfgang, Hanau	Fuel fabrication	- e/
	NUKEM	Wolfgang, Hanau	Fuel fabrication	x
	RBU-1	Wolfgang, Hanau	Fuel fabrication	x
	RBU-2	Karlstein	Fuel fabrication	x
	GWK-WAK	Leopoldshafen, Karlsruhe	Reprocessing	x
	Exxon	Lingen	Fuel fabrication	x
	Uranit	Jülich	Enrichment	- e/
India	Nuclear Fuel Complex	Hyderabad	Fuel fabrication	x
	PREFRE	Tarapur	Reprocessing	x
Italy[b/]	Fabnuc-Bosco Marengo	Alessandria	Fuel fabrication	x
	COREN	Saluggia	Fuel fabrication	x
	EUREX	Saluggia	Reprocessing	x
	IFEC	Saluggia	Fuel fabrication	x
	ITREC-Trisaia	Rotondella	Reprocessing	x
	Comb. Nuc.	Rotondella	Fuel fabrication	x

State[a/]	Abbreviated name	Location	Type	Subsidiary arrangements in force
Japan[b/]	PNC Reprocessing Plant	Tokai-Mura	Reprocessing	x
	NFI (Kumatori-1)	Kumatori, Osaka	Fuel fabrication	x
	SMM (Tokai-1)	Tokai-Mura	Conversion	x
	JNF	Yokosuka	Fuel fabrication	x
	MNF	Tokai-Mura	Fuel fabrication	x
	NFI (Tokai R&D)	Tokai-Mura	Fuel fabrication	- e/
	NFI (Tokai-1)	Tokai-Mura	Fuel fabrication	- e/
	PPFF	Tokai-Mura	Fuel fabrication	x
	MAPI	Ohmiya	Fuel fabrication	x
	NFI (Kumatori-2)	Kumatori, Osaka	Fuel fabrication	x
	NFI (Takayama-R&D)	Takayama	Fuel fabrication	x
	PNC Pilot Enrichment Plant	Ningyo	Enrichment	- e/
Netherlands[b/]	URENCO	Almelo	Enrichment	- e/
	Ultra-Centrifuge	Almelo	Enrichment	- e/
Spain	Metallurgical Plant Juan Vigon Research Centre	Madrid	Fuel fabrication	x
	Juan Vigon Research Centre	Madrid	Reprocessing	x
Sweden[b/]	ASEA - ATOM	Västeras	Fuel fabrication	x
United Kingdom	PFR Reprocessing Plant	Dounreay	Reprocessing	x

D. Separate storage facilities and other facilities

State[a]	Abbreviated name	Location	Type	Subsidiary arrangements in force
Argentina	Store of Embalse fuel at Atucha	Atucha	Separate storage	- e/
Australia[b]	Research Laboratory	Lucas Heights	Other facilities	x
Belgium[b]	CEN-Labo	Mol	Other facilities	x
	BCMN	Geel	Other facilities	x
	Overpelt	Olen	Separate storage	x
	Eurochemic	Mol	Separate storage	x
	BN-Mol	Mol	Other facilities	- e/
	PULAB	Mol	Other facilities	x
	Belgonucleaire - UF_6 store	Dessel	Separate storage	- e/
Canada[b]	Fuel Engineering	Chalk River	Other facilities	x
	WNRE	Pinawa, Manitoba	Other facilities	x
	Workshops	Chalk River	Other facilities	x
	WNRE	Pinawa, Manitoba	Separate storage	x
	Pickering G.S.	Pickering	Separate storage	x
	CRNL	Chalk River	Separate storage	x
	Bruce G.S.	Tiverton	Separate storage	x
Czechoslovakia[b]	Research Laboratories	Rez	Other facilities	x
	Nuclear Fuel Inst. (UJB)	Prague	Other facilities	x
	A1	Bohunice	Separate storage	x
Denmark[c]	FAB.STO.	Risø	Separate storage	x
	Hotcell Plant	Roskilde	Other facilities	x
France	COGEMA	Cap de la Hague	Separate storage	x
German Democratic Republic[b]	Staatl. Amt f. Atomsicherheit	Berlin-Karlshorst	Other facilities	x
	VEB Geophysik Leipzig	Gommern	Other facilities	x
	Uran Technikum	Rossendorf	Other facilities	- e/
Germany, Federal Republic of[b]	Urananlage	Ellweiler	Separate storage	x
	Braunkohle	Wesseling	Separate storage	x
	KWU-Hotcell	Karlsruhe	Other facilities	x
	KFA-Lab	Jülich	Other facilities	- e/
	Transuran	Karlsruhe	Other facilities	x
	GFK-Hotcell	Karlsruhe	Other facilities	x
	GFK/IHCH	Karlsruhe	Other facilities	x
	GFK/IMF3	Karlsruhe	Other facilities	x
Hungary[b]	Institute of Isotopes	Budapest	Other facilities	x
Italy[b]	CNEN-LAB. TEC	Casaccia	Other facilities	x
	CNEN. LAB. PU.	Casaccia	Other facilities	x
	CCRM-Ispra	Ispra	Separate storage	x
	Research Centre	Ispra	Other facilities	- e/
	AGIP Bosco-Marengo	Alessandria	Separate storage	x

State[a]	Abbreviated name	Location	Type	Subsidiary arrangements in force
Japan[b]	JAERI-Oarai R&D	Oarai-Machi	Other facilities	x
	JAERI-Tokai R&D	Tokai-Mura	Other facilities	x
	NERL, University of Tokyo	Tokai-Mura	Other facilities	x
	NFD	Oarai-Machi	Other facilities	x
	PNC Tokai R&D (development facility)	Tokai-Mura	Other facilities	x
	PNC-Oarai R&D	Oarai-Machi	Other facilities	x
	NRF Neutron Radiation Facility	Sakura-Mura	Other facilities	x
Netherlands[b]	ECN+JRC	Petten	Other facilities	x
	Kema Lab.	Arnheim	Other facilities	x
Norway[b]	Research laboratories	Kjeller	Other facilities	x
Pakistan	Storage at Government depot	Karachi	Separate storage	x
Poland[b]	Institute of Nuclear Research	Świerk	Other facilities	x
	Miscellaneous locations combined in one material balance area	Various	Other facilities	x
Portugal[b]	Instalacao de Armazenagem	Sacavem	Separate storage	x
Romania[b]	Demfuel	Pitesti, Colibasi	Other facilities	x
Sweden[b]	Central storage fresh fuel	Studsvik	Other facilities	x
	Central Hot Laboratory	Studsvik	Other facilities	x
Switzerland[b]	Diorit	Würenlingen	Separate storage	x
	Federal Institute of Reactor Research	Würenlingen	Other facilities	x
United Kingdom	Windscale PU-storage	Windscale	Separate storage	x
	Windscale Storage Pond	Windscale	Separate storage	x
USA	Argonne National Laboratory	Argonne	Separate storage	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/ NPT safeguards agreement.

c/ Prior to the entry into force on 21 February 1977 of the safeguards agreement between the seven non-nuclear-weapon States of EURATOM, EURATOM and the Agency, NPT safeguards were applied in Denmark under the NPT agreement with Denmark which entered into force on 1 March 1972.

d/ Safeguards agreement in connection with the Treaty for the Prohibition of Nuclear Weapons in Latin America (Tlatelolco Treaty) and NPT.

e/ Under negotiation.

Scientific journals

201. To commemorate the 20th anniversary of the Agency's journal "Nuclear Fusion", now a monthly publication, a special issue was published containing six reviews that highlighted the evolution of the principal concepts in controlled thermonuclear fusion research. The quarterly journal "Atomic Energy Review" was discontinued after 72 issues and a special series entitled "Physico-Chemical Properties of Nuclear Elements and their Compounds and Alloys".

International Nuclear Information System (INIS)

202. During 1980, two further Member States joined INIS, bringing the total number of participating centres to 77 (64 countries and 13 international organizations). More than 76 000 references were processed. By the end of the year, the file of information had grown to over 570 000 items, almost three quarters of which could be viewed directly via on-line search. The microfiche collection continued to expand and now contains almost 140 000 documents.

203. To make the INIS and AGRIS data bases more broadly available for on-line searching, the Agency made network arrangements and established telecommunications connections with the European Space Agency, IIASA and commercial communications services. The Agency also conducted training sessions at information centres in the German Democratic Republic, Hungary and the United Kingdom.

Computer services

204. Computer usage increased by more than 50% over the 1979 level. The main users were Safeguards (40%), INIS (11%) and other United Nations organizations (25%). The number of on-line terminals increased to 130.

Library services

205. The Library further expanded the services available to the organizations located at the Vienna International Centre and continued to make progress in implementing an integrated, computerized management system.

Publishing services

206. The net income to the Agency from the sale of Agency publications was $1.26 million in 1980, compared with $970 000 in 1979 and $790 000 in 1978.

ADMINISTRATION

External and legal affairs

Physical protection

207. The Convention on the Physical Protection of Nuclear Material [34], was opened for signature at the Headquarters of the Agency and of the United Nations on 3 March 1980. The Convention will enter into force on the thirtieth day after the deposit with the Director General of the twenty-first instrument of ratification. On 31 December, 26 States and one regional organization had signed the Convention and one State had ratified it.

International spent fuel management

208. The Expert Group on Spent Fuel Management, which is examining possibilities for international co-operation in spent fuel management, held meetings in July and December. It improved the data base concerning spent fuel arisings and spent fuel storage capability. Also, it developed information on spent fuel storage and transport technology and on costs of spent fuel management and guidelines and regulations for spent fuel storage and transportation and for the siting of spent fuel storage facilities.

International plutonium storage

209. In 1980 the Expert Group on International Plutonium Storage (IPS) and its technical sub-groups held eight meetings. Progress was made in examining the technical and operational aspects of establishing an IPS system within the framework of the Agency, including the harmonization of the field operations required with existing safeguards procedures. Work began on the preparation of legal instruments for the implementation of Article XII. A. 5 of the Statute and will continue in 1981.

Supply agreements

210. In June the Board of Governors approved an agreement for assistance by the Agency to Malaysia concerning the transfer from the United States of a one-megawatt TRIGA Mark II research reactor and 24 760 grams of uranium enriched to approximately 20 per cent, contained in fuel elements, and 7.6 grams of uranium enriched to approximately 93 per cent, contained in neutron detectors, for the operation of the reactor. The agreement [35] was concluded between the Agency, Malaysia and the United States on 22 September and entered into force on that date. The reactor is to be installed at the Tun Ismail Atomic Research Centre at Bangi, Selangor.

211. A fourth supply agreement [36] was concluded on 16 January 1980 between the Agency, the United States and Yugoslavia for the transfer of 1372 grams of uranium enriched to approximately 70 per cent, contained in fuel elements, for the continued operation of the TRIGA Mark II research reactor at the Jožef Stefan Institute, Ljubljana. An amendment to the project agreement of 4 October 1961 [37] between the Agency and Yugoslavia was also concluded on 16 January 1980 in order to bring that agreement into line with similar agreements recently approved by the Board of Governors. Both the fourth supply agreement and the amendment to the project agreement entered into force on 14 July 1980.

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[34] Reproduced in document INFCIRC/274/Rev. 1.

[35] Reproduced in document INFCIRC/287.

[36] Reproduced in document INFCIRC/32/Add. 4.

[37] Reproduced in document INFCIRC/32, part II.

212. A master agreement between the Agency and New Zealand for Agency assistance in the supply of small quantities of nuclear material for research purposes and a supplementary agreement thereto were signed and entered into force on 17 April 1980. Pursuant to these agreements [38], one milligram of plutonium-242 was to be provided by the United States to New Zealand for use in environmental research at the National Laboratory, Christchurch.

Agency-United States co-operation agreement

213. The agreement for co-operation between the Agency and the United States [39], concluded in 1959 for a period of 20 years, was first amended in 1974 to extend it for a further 35 years [40]. In June 1979, the Board of Governors authorized the Director General to conclude a second amendment setting forth, in an annex, the United States criteria for transfer and export arrangements concerning nuclear material, equipment and facilities, on the understanding that such action did not constitute any expression of views by the Board on the criteria in question. The second amendment [41] was signed on 14 January 1980 and entered into force on 6 May 1980.

Civil liability for nuclear damage

214. In November, Peru acceded to the Vienna Convention on Civil Liability for Nuclear Damage [42]. The Convention is now in force with respect to the following States: Argentina, Bolivia, Cuba, Egypt, Niger, Peru, Philippines, Trinidad and Tobago, United Republic of Cameroon, and Yugoslavia.

Vienna International Centre

215. After extensive negotiations between the Agency's Secretariat, representatives of the United Nations/UNIDO and the Austrian authorities, agreement was reached at the end of 1980 on the text of a number of legal instruments relating to the occupation of the VIC by the Agency and the United Nations/UNIDO. As regards the Agency, the instruments include:

(a) An agreement defining the Agency's Headquarters Seat;

(b) An agreement under which the Agency will occupy the Headquarters Seat for 99 years (from 1 October 1979) at an annual rent of one Austrian schilling;

(c) An agreement extending the same conditions of occupancy to the areas used commonly by all organizations concerned; and

(d) An agreement to establish a fund that will receive annual contributions from the Agency, the United Nations and the Austrian Government and will be used for meeting the costs of major repairs and replacements needed at the VIC. The maximum contribution of the Agency during any one year is limited to US $225 000. This ceiling will be reviewed after five years and thereafter at intervals of five years, it being agreed, however, that there will continue to be a ceiling on the annual contributions of the international organizations.

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[38] Reproduced in document INFCIRC/286.

[39] Reproduced in document INFCIRC/5, part III.

[40] Reproduced in document INFCIRC/5/Mod. 1.

[41] Reproduced in document INFCIRC/5/Mod. 2.

[42] Reproduced in Legal Series No. 4, Revised 1976 Edition.

216. In December the Board of Governors confirmed these agreements and authorized the Director General to sign them.

217. The operation of common services with the United Nations and UNIDO was in general satisfactory.

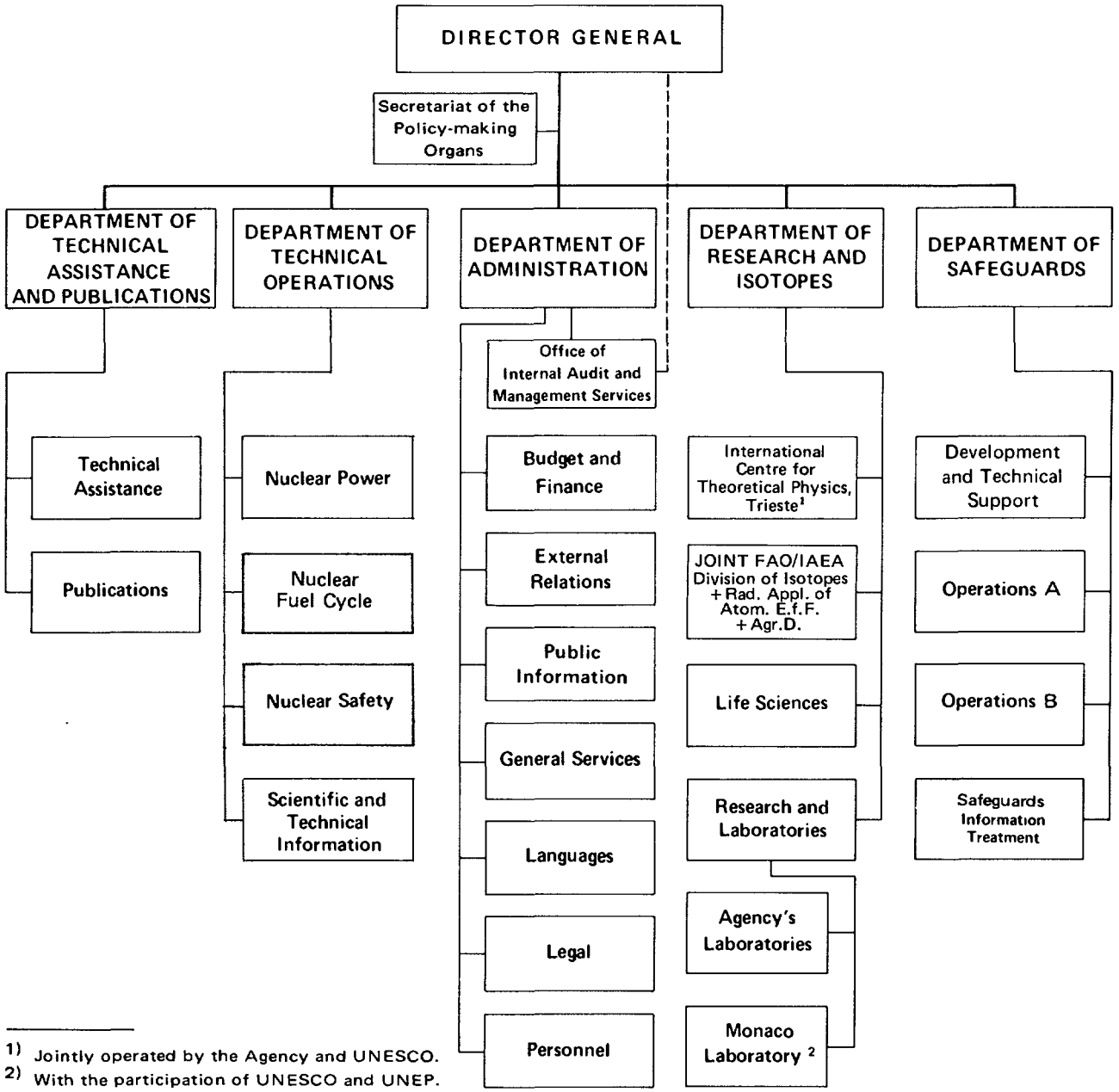
Personnel

218. In 1980, 180 staff members left the Agency and 292 were appointed. Of the new staff members, 126 were in the Professional and higher categories.

219. At the end of the year, the Secretariat had 577 staff members in the Professional and higher categories, 865 in the General Service category and 155 in the Maintenance and Operatives Service category.

220. The following organizational chart shows the structure of the Secretariat as at the beginning of 1981.

ORGANIZATIONAL CHART*/



1) Jointly operated by the Agency and UNESCO.
2) With the participation of UNESCO and UNEP.

*/ This organizational chart became effective on 1 January 1981.