THE ANNUAL REPORT FOR 1976

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INTERNATIONAL ATOMIC ENERGY AGENCY

CONTENTS

List of abbreviations

Agency	International Atomic Energy Agency
AGRIS	Agricultural Information System
CEC	Commission of the European Communities
EURATOM	European Atomic Energy Community
FAO	Food and Agriculture Organization of the United Nations
IAEA	International Atomic Energy Agency
IBRD	International Bank for Reconstruction and Development
IIASA	International Institute for Applied Systems Analysis
INIS	International Nuclear Information System
MW	Megawatts (electric)
NEA	Nuclear Energy Agency of the Organisation for Economic Co-operation and Development
NPT	Treaty on the Non-Proliferation of Nuclear Weapons (reproduced in document INFCIRC/140)
PNE	Nuclear explosions for peaceful purposes
SIDA	Swedish International Development Authority
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
WASP	Wien Automatic System Planning
WHO	World Health Organization

NOTE

All sums of money are expressed in United States dollars.

INTRODUCTION

General

1. In several industrial countries 1976 was a year of deepening uncertainty and divided opinion about the future of nuclear power and, particularly, the reprocessing of spent fuel and the disposal or storage of nuclear wastes. In certain countries concern about the risks of further proliferation of nuclear weapons or about the possibilities of terrorist use of nuclear material emerged as a dominant element of national and international policy. These factors, coupled with environmentalist opposition, the after-effects of the recession, such as surplus plant capacity and shortage of investment capital, as well as escalating capital costs led to a sharp fall in orders for new nuclear plant and to delays in a number of major projects for reprocessing or fast-breeder development. Orders for new nuclear power stations declined from 53 000 MW in 1974 to 32 000 MW in 1975 and to 11 000 MW in 1976.

2. These developments took place against a background of continued resistance to individual nuclear power plants, while the use of nuclear power became a major political issue in certain Member States.

3. At the same time, the nuclear power industry continued to maintain its excellent safety record. At the end, as at the beginning, of 1976 it was true to say that no fatal or serious accident deriving from the nuclear side of any power plant had occurred since the start of operation of the first nuclear station more than twenty years before. (In the light of this remarkable record, concern in certain news media about the safety of nuclear power plants remained as difficult as ever to understand for those having responsibility for the development and operation of the nuclear power industry.)

4. In certain countries development of the fast-breeder reactor continued satisfactorily and work began on the construction of the first large-scale commercial breeder to be completed by 1982. The first commercial reprocessing plant designed to handle oxide fuel from light-water reactors also went into operation in a Western European Member State.

5. Plans were published for substantial expansion of nuclear power in Eastern European countries and preparation for large programmes continued in a few developing countries.

6. Intensified prospecting following the steep rise in the price of uranium led to the discovery of additional bodies of commercially recoverable ore. Total reasonably assured resources outside the socialist countries, in the price range of up to $30 a pound of uranium oxide, increased from 1 810 000 tons in 1975 to 2 070 000 tons in 1976.

7. The world-wide interest in discovering and developing new reserves of uranium was reflected in a steady increase in the number of requests for technical assistance in this subject. The number of countries which the Agency is assisting to search for and evaluate uranium ore resources was 24 in 1976.

8. Another encouraging development was the strengthening of the world-wide non-proliferation regime by Japan's ratification of the Treaty on the Non-Proliferation of Nuclear Weapons on 24 May 1976, bringing the total number of Parties to the Treaty to one hundred at that date. Nearly all major industrial countries have thus ratified the Treaty or indicated that they would act as if they were Parties to it.

9. Outside the scope of the Treaty, Agency safeguards are also extensively applied. Significant unsafeguarded plant remained only in five non-nuclear-weapon States. Even in most of these countries a high proportion of nuclear plants were under Agency safeguards.

10. During the year, the Board also approved the safeguards agreements with the United States and the United Kingdom with a view to implementing the offers of those countries to place all nuclear activities excluding only those with direct national security significance under Agency safeguards.

11. The efficacy of Agency safeguards benefited considerably from the work of the Standing Advisory Group on Safeguards Implementation which began effective operation during 1976, and which has assisted the Director General in developing the special safeguards implementation report that he will submit to the Board from 1977 onwards.

12. There is no doubt that, provided sufficient resources can be employed, the Agency will be able effectively to safeguard the reprocessing and enrichment plants that are for the first time coming under safeguards. However, in certain quarters concern is turning more to the prevention of diversion by restricting or controlling access to plutonium and enriched uranium than to detection of such diversion. This may lend additional content to the concept of multinational fuel cycle facilities and multinational storage of plutonium as foreseen in Article XII. A. 5 of the Agency's Statute.

13. Safeguards agreements approved by the Board during the year between the Agency, France and Pakistan, and the Agency, Brazil and the Federal Republic of Germany contained new elements to ensure that plant and material resulting or benefiting from the transfer of technological information - including later replications of supplied plant - would effectively be brought under the Agency's safeguards.

14. In the technical assistance programme there was again a perceptible trend towards projects dealing with major applications of nuclear technology, including a few which would assist the requesting country to produce fissile nuclear materials. In this way the problem of what safeguards arrangements should apply in regard to transfers of technology through the medium of technical assistance was presented to the Board of Governors.

15. Despite these trends it remains true that for the great majority of the Agency's developing Member States application of nuclear science and techniques in food and agriculture, medicine and development of water resources represented the main, if not the only tangible benefits that can be achieved at this time from the peaceful uses of atomic energy. Applications in food and agriculture received considerable encouragement from a decision of a Joint FAO/WHO/IAEA Committee on the Wholesomeness of Irradiated Food which accepted five important irradiated foodstuffs - potatoes, wheat, chicken, papaya and strawberries - as unconditionally safe for human consumption and which gave provisional approval to three further foodstuffs - rice, fish and onions. This decision, which will be reflected in the Codex Alimentarius published by WHO and FAO, should give a new fillip to food irradiation technology which has been going through a difficult period since the mid-1960s.

16. International discussion and controversy about the commercial cost and value, environmental impact and possible dangers to security of reprocessing and plutonium recycling deepened the interest in and tempo of preparations for the International Conference on Nuclear Power and its Fuel Cycle which the Agency is holding at Salzburg, Austria, in May 1977 and also lent greater interest to the million dollar study which the Agency is making of the concept of regional or multinational fuel cycle centres which will be presented at that conference.

17. At its twentieth regular session held in Rio de Janeiro from 21 to 28 September 1976 at the invitation of the Government of Brazil, the General Conference approved Nicaragua for membership of the Agency and invited the Palestine Liberation Organization to participate as an observer in the session and in all future sessions and meetings of the General Conference.

18. The General Conference also requested the Board of Governors to review the annual designation of the Republic of South Africa as the Member for the area of Africa taking due account of the inappropriateness and unacceptability of the apartheid régime of the Republic of South Africa as the representative of the area of Africa and requested the Board to submit a report to the General Conference at its twenty-first regular session.

19. Finally the General Conference approved the 1977 Regular Budget in the amount of $43 501 000, set a target of voluntary contributions to the General Fund (to finance the

Agency's technical assistance programme) in the amount of $6 000 000, and set a ceiling to remain in force from 1977 to 1980 to the contributions to the safeguards expenses of the Agency of those Member States having a low per capita net national product. These three decisions were in conformity with recommendations that the Board of Governors had made to the General Conference.

Matters of particular interest to the United Nations

20. Several of the developments and decisions mentioned above are of interest to the General Assembly and relate to resolutions adopted by it at its thirty-first regular session, all of which were brought to the attention of the Board of Governors, in particular resolutions 31/6 and 31/69 concerning respectively the denuclearization of Africa and nuclear co-operation with South Africa; resolution 31/11 on the report of the International Atomic Energy Agency; resolution 31/75 on implementation of the conclusions of the first Review Conference of the Parties to the Treaty on the Non-Proliferation of Nuclear Weapons which, inter alia, requested the Agency to accord high priority to its work designed to restrain the further proliferation of nuclear weapons or other nuclear explosive devices and to increase the availability of energy, particularly for the needs of the developing countries of the world; and resolution 31/189 D which addressed requests to the Agency regarding its work in the field of non-proliferation, multinational fuel cycle centres and international plutonium storage and made other suggestions in respect of strengthening the Agency's safeguards regime. In relation to Resolutions 31/11 and 31/75 the Agency's Secretariat has also prepared the draft of a safeguards agreement that could serve as the basis for negotiation with States that are not parties to NPT or to the Tlatelolco Treaty but are prepared to accept the application of safeguards to all their nuclear energy activities.

TECHNICAL ASSISTANCE AND TRAINING

Resources available for technical assistance

21. The resources that were made available to the Agency for carrying out technical assistance programmes during the period 1967 to 1976 are shown in Figure 1. Resources available in 1976 amounted to $10.9 million compared with about $9.8 million in 1975. The main increase was in assistance "in kind" which amounted to $2.45 million in 1976 compared with $1.31 million in 1975. Resources in cash for the Agency's own or "regular programme" increased by $0.9 million. On the other hand, resources available from the UNDP decreased by a similar amount.

22. The main source of funds for the Agency's regular programme is of course the voluntary contributions of Member States to the General Fund. The target for such contributions in 1976 was $5.5 million. At the end of the year, pledges had reached 91.7% of the target. In 1975 when the target was $4.5 million, pledges reached 93%. The amount pledged in 1976 was $5 043 800 compared with $4 225 000 in 1975. Table 1 shows the status of voluntary contributions to the General Fund for the years 1967-1976.

Table 1

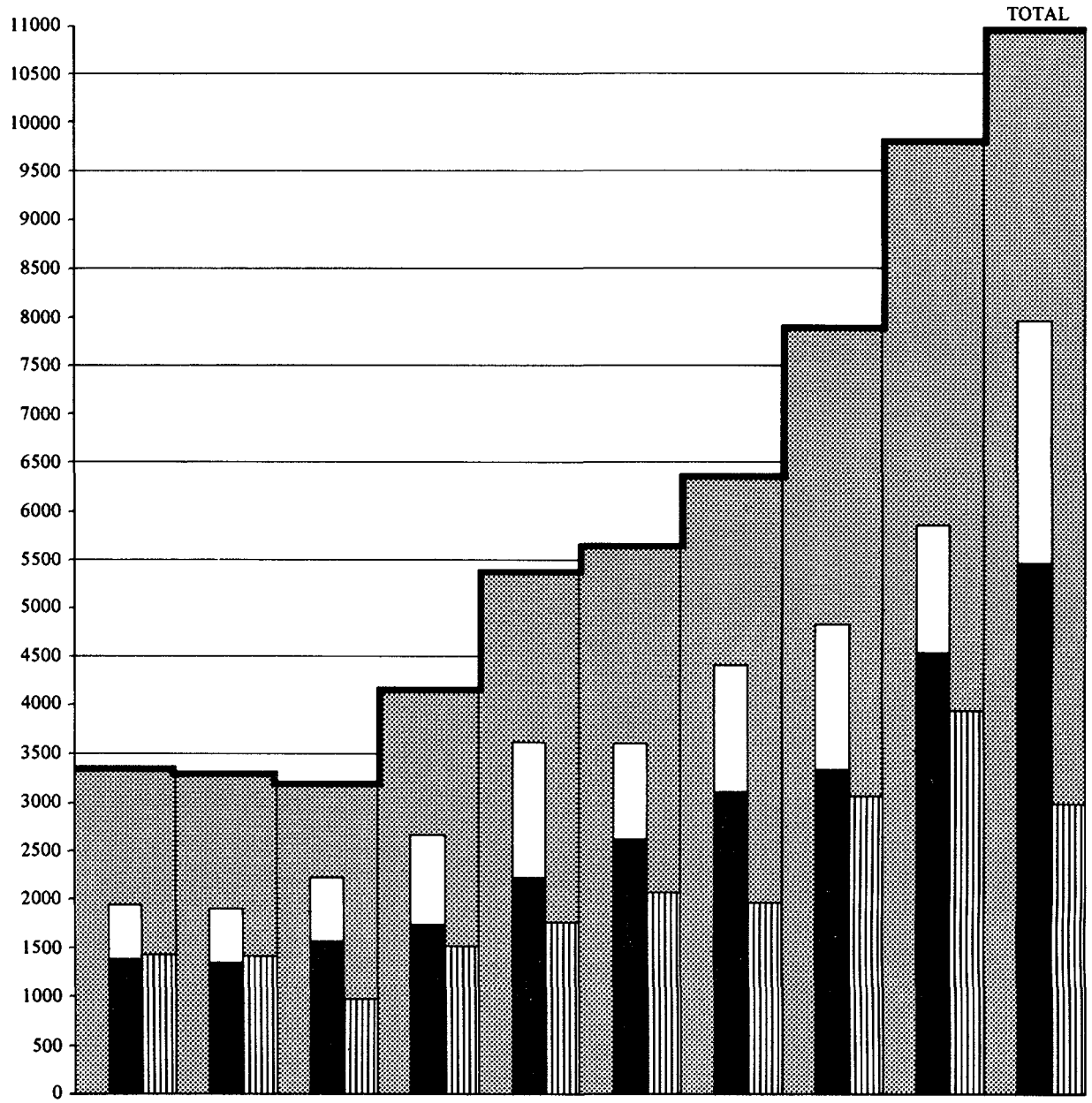
Voluntary contributions: 1967-1976

Year	Established target (in millions of dollars)	Voluntary contributions pledged to the General Fund				
		Amount $	Percentage of target	Shortfall or (overrun) $	Number of Members pledging	Percentage of Members pledging
1967	2.0	1 431 823	71.6	568 177	62 of 98	63.3
1968	2.0	1 423 557	71.2	576 443	63 of 99	63.6
1969	2.0	1 488 426	74.4	511 574	68 of 102	66.7
1970	2.0	1 672 933	83.6	327 067	74 of 103	70.9
1971	2.5	2 142 675	85.7	357 325	71 of 102	69.6
1972	3.0	2 485 405	82.8	514 595	71 of 102	69.6
1973	3.0	2 847 012	94.9	152 988	70 of 104	67.3
1974[a/]	3.0	3 083 261	102.8	(83 261)	65 of 105	61.9
1975	4.5	4 219 391	93.8	280 609	75 of 106	70.8
1976	5.5	5 043 839	91.7	456 161	71 of 109	65.1

a/ It is noteworthy that in 1974, the only year in which the sum of the pledges exceeded the target, just 61.9% of the Agency's Member States made a pledge.

FIGURE 1

RESOURCES AVAILABLE FOR
AGENCY TECHNICAL ASSISTANCE PROGRAMMES: 1967–1976
(in thousands of dollars)



	1967	1968	1969	1970	1971	1972	1973	1974	1975	1976
Agency monetary	1380	1348	1586	1749	2224	2636	3124	3348	4540	5474
Assistance in kind	570	565	658	932	1410	968	1299	1494	1312	2449
UNDP monetary	1431	1422	981	1513	1775	2072	1964	3082	3941	3002
TOTAL	3381	3335	3225	4194	5409	5676	6387	7924	9793	10925

Agency monetary Assistance in kind UNDP monetary

23. The increase in resources "in kind" in 1976 was due mainly to greater support from the Swedish International Development Agency (SIDA), which went up by about $560 000, and to larger grants of fellowships, training opportunities, expert services and equipment especially by the United States which offered to provide assistance of a value of about $282 000 to meet 11 of the 32 requests that had been approved under the Agency's regular programme in 1976 but that could not be met because of insufficient funds in that programme.

24. The decline of nearly 25% in the funds available from UNDP was due chiefly to the ceilings that UNDP set for expenditures on individual projects in 1976 because of its own liquidity problems which also led to the cancellation of certain approved projects and the postponement of the starting date of certain new projects. If these cancellations and delays had not taken place, the level of UNDP assistance made available through the Agency would have remained much the same as in the previous year.

The technical assistance provided

25. The total value of funds and resources "in kind" allocated for technical assistance rose from $13.3 million in 1975 to more than $13.7 million in 1976. Of these, $8 330 600 were actually spent and $5 383 300 were allocated to projects which had been approved but not started or obligated by the end of the year. The latter sum comprised unliquidated obligations amounting to $3.9 million and assistance "in kind" valued at about $1.5 million. The total monetary value of assistance actually given or obligated was in fact slightly lower than in 1975, by $222 100 or about 3%.

26. The unliquidated obligations and assistance in kind that were outstanding at 31 December 1976 comprised:

$ 728 800 for expert services,

$2 341 100 for equipment and supplies,

$2 313 400 for fellowships.

The long-term trend

27. Table 2 shows the monetary value of technical assistance provided by the Agency from all sources during the period 1970 to 1976.

Table 2

Agency technical assistance by source: 1970-1976
(in US dollars)

Year	UNDP monetary	Agency monetary	Assistance in kind	Total
1970	1 469 200	1 619 300	894 600	3 983 100
1971	1 838 800	2 124 600	981 700	4 945 100
1972	2 072 000	2 556 000	864 700	5 492 700
1973	1 964 300	2 675 900	1 126 500	5 766 700
1974	3 081 600	2 413 200	1 247 700	6 742 500
1975	3 941 500	3 423 500	1 187 700	8 552 700
1976	3 002 300	3 954 700	1 373 600	8 330 600

FIGURE 2

VALUE OF THE TECHNICAL ASSISTANCE PROVIDED BY THE AGENCY: 1970–1976

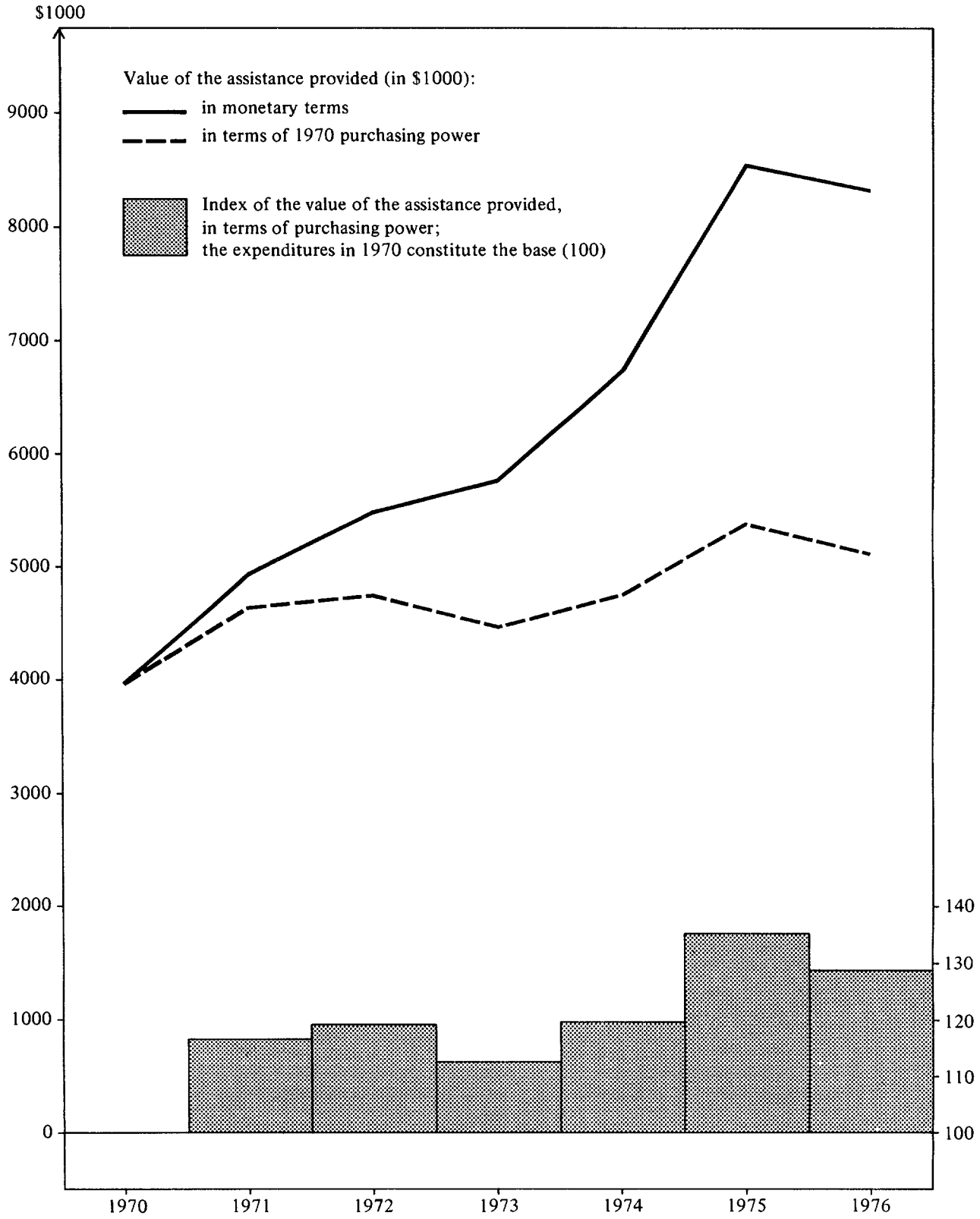
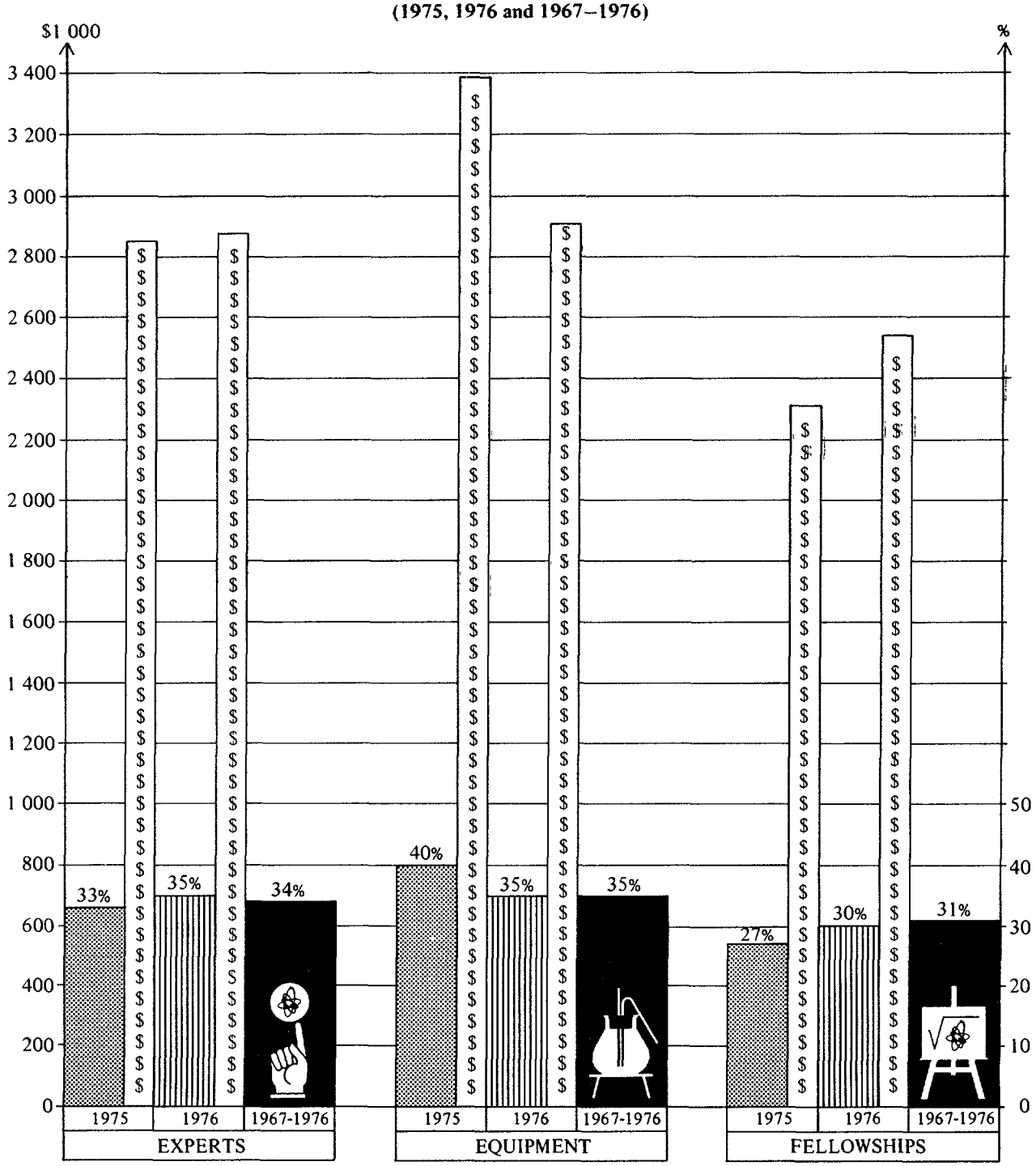


FIGURE 3

DISTRIBUTION OF TECHNICAL ASSISTANCE BY TYPE OF ASSISTANCE
(1975, 1976 and 1967–1976)



TYPE	1975		1976		1967-1976	
	%	$1 000	%	$1 000	%	$1 000
EXPERTS	33	2 854.0	35	2 878.9	34	18 218.2
EQUIPMENT	40	3 387.7	35	2 910.7	35	18 221.9
FELLOWSHIPS	27	2 311.0	30	2 541.0	31	16 437.7
TOTAL	100	8 552.7	100	8 330.6	100	52 877.8

Note: Fellowships include participants in short-term training projects.

The nominal increase during this period has, however, been largely eroded by inflation and by changes in the value of currencies. Figure 2 shows the effects of this erosion on the purchasing power of the resources available to the Agency. Thus, for instance, the technical assistance represented by $1000 in 1970 had fallen to $864 in 1972, $707 in 1974 and $614 in 1976. The monetary value of assistance provided increased by 110% between 1970 and 1976, but the real increase amounted to only about 28% and there was actually a decline between 1975 and 1976 of approximately 7% in the real value of assistance provided.

28. The distribution of technical assistance according to type of assistance (experts, equipment and fellowships) during the last two years and during the decade 1967-1976 is shown in Figure 3. The share represented by equipment and supplies dropped from 40% in 1975 to 35% in 1976, but has nevertheless risen substantially over the years. It was approximately 29% during the period 1963-1972, 32% during the period 1965-1974 and 35% over the period 1967-1976.

The 1976 programme

29. Table 3 provides a comparison of the amount of assistance given in 1975 and 1976 in the five leading fields of the ten fields of the Agency's technical assistance activities.

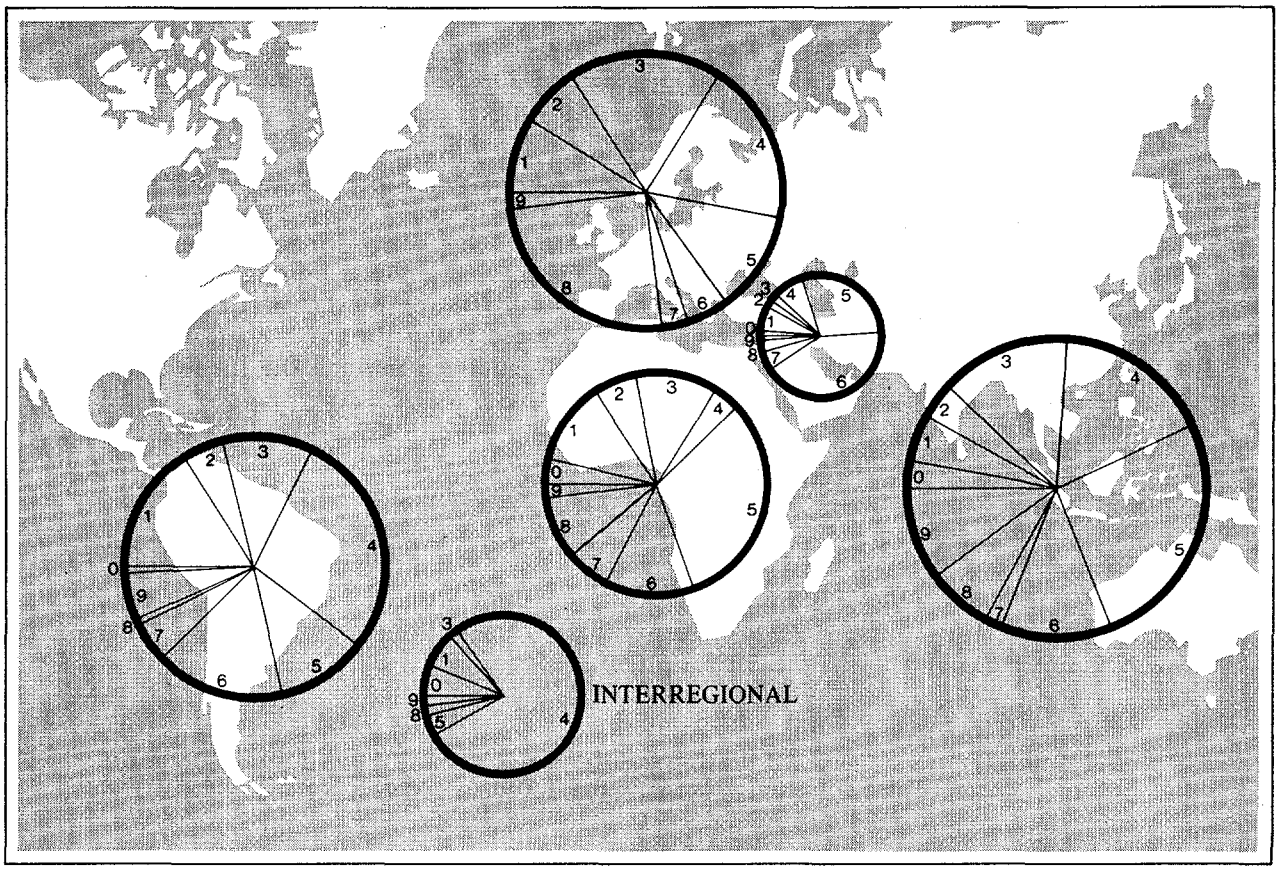
Table 3

Assistance by field of activity and type: 1975 and 1976
(in thousands of dollars)

Field of activity	Year	Experts	Equipment	Fellowships	Share of total programme	
		$	$	$	$	%
Application of isotopes and radiation in agriculture	1975	599.2	708.6	503.6	1811.4	21.2
	1976	541.9	626.8	520.1	1688.8	20.3
Nuclear engineering and technology	1975	357.9	493.3	593.5	1444.7	16.9
	1976	436.4	304.6	791.7	1532.7	18.4
Prospecting, mining and processing of nuclear materials	1975	848.3	378.3	132.1	1358.7	15.9
	1976	836.5	365.7	127.2	1329.4	15.9
Application of isotopes and radiation in industry and hydrology	1975	143.0	812.7	138.5	1094.2	12.8
	1976	181.5	619.6	91.0	892.1	10.7
Application of isotopes and radiation in medicine	1975	175.3	218.7	289.9	683.9	8.0
	1976	167.6	317.1	295.7	780.4	9.4
Total	1975	2123.7	2611.6	1657.6	6392.9	74.8
	1976	2163.9	2233.8	1825.7	6223.4	74.7
Total assistance	1975	2854.0	3387.7	2311.0	8552.7	100.0
	1976	2878.9	2910.7	2541.0	8330.6	100.0

FIGURE 4

DISTRIBUTION OF TECHNICAL ASSISTANCE BY FIELD AND REGION: 1976[a/]



SUMMARY

Field of activity	Africa %	Asia and the Pacific %	Europe %	Latin America %	Middle East %	Inter-regional %	All regions %
0 - General atomic energy development	4	3	–	16	1	6	5
1 - Nuclear physics	12	5	9	5	7	7	7
2 - Nuclear chemistry	6	4	7	11	2	–	6
3 - Prospecting, mining and processing of nuclear materials	12	14	18	28	2	2	16
4 - Nuclear engineering and technology	4	17	19	11	8	77	19
Application of isotopes and radiation in: 5 - Agriculture	32	26	12	16	29	4	20
6 - Medicine	13	12	5	5	42	–	9
7 - Biology	6	2	3	1	5	–	3
8 - Industry and Hydrology	9	7	25	6	3	2	11
9 - Safety in nuclear energy	2	10	2	1	1	2	4
	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.

30. The relative importance in 1976 of each of the ten fields of activity is shown in Figure 4 by region and for all regions. It will be seen that for countries in the region of Africa, the Middle East and Asia and the Pacific, the share taken by agriculture was above the average for all regions. In interregional activities the field "nuclear engineering and technology" predominated because of the training courses held in France, the Federal Republic of Germany and the United States of America on nuclear power planning. For the third successive year, "prospecting, mining and processing of nuclear materials" took the third largest share of resources; this was largely due to the UNDP-financed uranium prospecting projects in Chile, Greece, Pakistan and Turkey.

31. Table 4 provides more information about the regional and interregional training courses and study tours organized by the Agency. Nine courses or tours were held in all in 1976 and ten countries served as hosts. Two hundred and sixty-three persons from 55 countries took part; the cost of 240 of the participants was borne by project funds, the cost of the remaining 23 participants was borne by UNDP or by the participant's Government. Only one such project was assisted by the UNDP in 1976. Nuclear power was the predominating subject in 1976 and the training courses include the three referred to in the preceding paragraph.

Table 4

Intercountry projects conducted in 1976

Project title	Place and dates	Total number of participants	Source of funds
Interregional training course on nuclear power project planning and implementation (Phase I)	Argonne, Illinois 6 January to 16 April	38	Regular programme
Regional training course on the technical and economic aspects of nuclear power development	Manila, Philippines 16 to 27 February	38	Regular programme
Interregional training course on nuclear power project planning and implementation (Phase I)	Saclay, France 30 March to 7 July	28	Regular programme
Interregional training course on the use and maintenance of nuclear and related electronic equipment	Turin, Italy 26 April to 23 July	16	UNDP and Regular programme

Project title	Place and dates	Total number of participants	Source of funds
Study tour on the utilization of low energy accelerators in research and practical applications	Czechoslovakia, German Democratic Republic, Hungary and the Soviet Union 17 May to 24 June	24	Regular programme
Interregional training course on nuclear power project planning and implementation (Phase I)	Karlsruhe, Federal Republic of Germany 6 September to 30 November	36	Regular programme
Interregional training course on nuclear power plant construction and operation management (Phase II)	Argonne, Illinois 8 September to 17 December	41	Regular programme
Interregional training course on the use of nitrogen-15 in soils research	Leipzig, German Democratic Republic 21 September to 22 October	14	Regular programme
Interregional basic training course on state systems of accounting for and control of nuclear material	Vienna, Austria 2 to 19 November	28	Regular programme and Government of the United States of America

32. In 1976 the Agency was providing large-scale assistance to 17 projects in 16 countries - 16 financed by UNDP, and one by SIDA. Six involved the industrial applications of nuclear energy, four its application in agriculture, four others were for uranium prospection, one each covered the general applications of atomic energy, applied nuclear physics and reactor technology. Assistance to two of these projects was completed in 1976, namely the Radiation Processing Demonstration Facility in the Republic of Korea and the project for the Exploration for Uranium in the Siwalik Sandstones, Dera Ghazi Khan District (Phase II) in Pakistan. Work on the other 15 projects progressed satisfactorily.

33. In the Republic of Korea, the cobalt-60 irradiator installed in August 1975 is now in operation for the commercial sterilization of medical products. Sufficient skilled staff is available to run the radiation sterilization project satisfactorily. Research is being carried out on the quality improvement of plywood and textile products using an electron accelerator which broke down several times. The necessary repairs were made. Additional operating and maintenance staff should be trained for the operation of the accelerator.

34. In Pakistan, the Agency's experts were successful in proving the existence of modest uranium ore reserves and in training the counterpart personnel necessary to carry on detailed exploration work. Geochemical prospection work, helped by the Agency, led to the discovery of three interesting uranium-vanadium anomalous areas which will be further investigated.

The Agency's regular programme

35. Figure 1 shows that the funds available to carry out the Agency's regular technical assistance programme rose from about $1.4 million in 1967 to about $5.5 million in 1976. In the Agency's experience, it takes at least four years to provide all the assistance approved for any one year's programme and only 60-70% of the funds made available are actually obligated during the year for which they are approved. Accordingly, the cumulative total of unobligated funds has increased year by year as the volume of voluntary contributions has risen and had reached $3.9 million at the end of 1976.

36. The problems encountered in expediting the delivery of the Agency's technical assistance are due to difficulties experienced in finding and placing a suitable expert, delays in the procurement of equipment, in the receipt of voluntary contributions and several other factors. These problems are examined in greater detail in the Special Report on the Provision of Technical Assistance by the Agency in 1976. [1]

Observations and conclusions

37. The technical assistance that the Agency has given from its regular programme over the years, although relatively small in monetary value, has helped to strengthen research institutes and university departments in developing countries. This help has also been amplified by research contracts and by advisory services provided under the Agency's Regular Budget.

38. Much of the assistance given represents "seed money" and many of the "promotional" activities of the Agency are still in their infancy. Until these activities are well established and show concrete results of direct economic value, it is unlikely that the nuclear research institutes concerned will be able to attract a significant share of the aid given by the UNDP and other multilateral technical co-operation organizations which are chiefly concerned with promoting major economic and social development.

39. The experience that the Agency has gained in 19 years of providing technical assistance has shown that the rate at which technical assistance can be absorbed in the nuclear field differs vastly from country to country because of the differences in the levels of technological development. Of the 98 countries that have received technical assistance under country programmes since 1958, only 16 have received assistance of the value of more than a million dollars; each of these is a relatively populous developing country which is also relatively well advanced in the nuclear field. Thirty-six developing countries, on the other hand, have received less than $250 000 of technical assistance from all the sources available to the Agency.

40. The financial set-backs that the UNDP experienced in 1975 and 1976 and the curtailment of its programmes have, of course, lent added importance to the Agency's own regular programme and have caused an increase in the number of requests for assistance under that programme. These include some requests for large-scale assistance over periods of up to four years originally prepared for submission to UNDP itself. The Agency has not been able to meet such requests and at present the regular programme consists of a collection of relatively small projects involving at a maximum twelve man-months of expert services and some equipment. It may be timely to review this matter.

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[1] GC(XXI)/INF/169.

41. So far the Agency has always had sufficient funds in convertible currencies to meet its technical assistance obligations and it has not yet experienced any cash liquidity problems. However, if the share of regular programme funds made up of non-convertible currencies continues to grow, liquidity problems may well arise. To avoid this, the Secretariat is making every effort together with the authorities of the Governments concerned, to make full use of such non-convertible currencies. There will, however, be a continuing need for larger pledges of voluntary contributions so as to ensure that an increasing percentage of requests for assistance can be met and that enough convertible funds are available for this purpose. Provided that additional resources are forthcoming, the Agency's regular programme will continue to provide a unique means of transferring a group of specialized technologies to the developing countries.

Nuclear and electric forecasts and economics

42. At the end of 1976, the world's installed nuclear plant capacity was estimated at about 85 000 MW thus accounting for nearly 5% of the total electrical capacity. The rising trend in uranium prices and in enrichment charges continued throughout the year. This led to some erosion in the competitive position of nuclear power plants even though nuclear fuel costs remained less than 40% of those of power stations using imported oil.

43. The large reserves of spare capacity built by electric utilities during the 1974-75 recession and the continuing uncertainties affecting the "back end" of the nuclear fuel cycle led to further declines in orders for new nuclear stations which dropped to 11 000 MW (chiefly in Japan, South Africa and the United States) in 1976 from 32 000 MW in 1975 and 53 000 MW in 1974.

44. It is expected that the factors causing the decline in nuclear plant orders will persist in 1977. There are good grounds in hoping, however, that orders will rise again in 1978 as nuclear power continues to look attractive to all oil-importing countries, in terms of both economic advantage and energy independence. Under these circumstances, the need for careful analyses of nuclear power projects in developing countries and for trained manpower is bound to grow. The Agency continued its relevant programmes in 1976 and broadened the scope of its training courses for the personnel of energy authorities and power companies who will be responsible for the implementation of nuclear power in developing countries. It also supplied additional methodological tools for the economic analysis of electric power systems. Preparations for the International Conference on Nuclear Power and its Fuel Cycle held in Salzburg, Austria from 2 to 13 May, were well advanced at the end of the year.

Table 5

Forecasts of installed total electric and nuclear capacity
(in thousands of MW)

	1975	1976	1980	1985	1990	2000
Electrical	1600	1700	2200	3200	4300	7000
Nuclear	70	85	190-200	370-530	700-1000	1700-2300
Percentage share of nuclear(%)	4	5	8.6-9	11.5-16.5	16.3-23.3	24.3-32.8

Power reactors in developing countries

45. 1976 was also a year in which several developing countries postponed the decision to embark on nuclear power programmes. They included Indonesia, Malaysia, Thailand and Hong Kong which had previously shown interest in units in the 600 MW range.

46. Some new developments of interest included:

(a) Kuwait requested tenders for a dual-purpose unit to desalt water and produce 50 MW of electricity;

(b) France successfully operated a prototype of small nuclear power plant;

(c) Studies in the United States on a consolidated nuclear steam generator design showed the economic feasibility of small units that would produce process steam;

(d) In the Federal Republic of Germany a 220 MW(th) nuclear power plant of the integrated pressurized water type has been developed on the basis of the reactor system of the nuclear ship "Otto Hahn" which has been operating for more than eight years. The plant may be used for power production (60 MW(e)) and also for desalination;

(e) India has expressed some interest in the possibility in the long term of exporting 200/235 MW pressurized heavy water reactor units; and

(f) Numerous studies continued of ways of redesigning existing small and medium-sized nuclear power plants so as to meet present safety and licensing requirements.

These developments were reviewed at a consultants' meeting at Headquarters in December 1976.

47. The Agency has sent nuclear power advisory missions to Jamaica, Peru, Uruguay and Venezuela. The results of earlier missions to Indonesia and Hong Kong have been published. The Agency received requests for new missions from Algeria, Ecuador, Mauritius and Panama. The Agency is organizing a series of major nuclear power training courses, four of which were held during 1976. The first three, on power project planning and implementation, were held in the United States, France and the Federal Republic of Germany, and the fourth on power project construction and operations management was held in the United States.

48. Besides the nuclear power training programme, the Agency has started to analyse in what ways it could further assist its developing Member States in planning their manpower development programmes and provide on-the-job training opportunities. A consultants' meeting was held on the subject during the year.

49. Considerable help was also given to Member States to use computer techniques to plan their nuclear power programmes. During 1976 the Agency released the latest version of the relevant WASP computer program to 18 countries and several international organizations and provided relevant training to a further three countries. It issued a Guidebook on the "Economic Evaluation of Bids for Nuclear Power Plants".

50. Work also continued on analysing operating experience, and several publications are being prepared or were issued during 1976.

International Conference on Nuclear Power and its Fuel Cycle

51. Preparations for the International Conference on Nuclear Power and its Fuel Cycle held at Salzburg, Austria, in May 1977 proceeded throughout the year. In consultation

with the Agency's Scientific Advisory Committee the programme for the Conference was finalized, 350 papers were accepted for the Conference, 175 of which were invited. The interest of Member States was shown by the fact that 553 papers were submitted and that about 2000 participants were expected. The Conference included eight round-table discussions on subjects that had been carefully chosen to focus on the major open issues relating to the nuclear fuel cycle.

Nuclear materials

52. The Agency continued to promote the exchange of information on uranium geology, exploration, the evaluation of ore deposits and processing of uranium ores.

53. In mid-1976 the Agency and NEA set up a joint standing group of experts on research and development in uranium exploration techniques. This group is convening a number of more specialized meetings on research and development. Late in 1976 the Agency and NEA established another joint group designated as the Steering Group on Uranium Resources. This group is preparing the sixth joint IAEA/NEA Report on Uranium Resources to be issued in 1977 and it has also launched an International Uranium Resources Evaluation Project which will endeavour to assess the world's potential uranium resources.

54. The Agency also held a meeting at Headquarters in March 1976 on the exploration of uranium ore deposits, a working group on uranium geology at Sydney in August and advisory group meetings on uranium resources evaluation at Rome in November/December and on natural fission reactors at Headquarters in December. The latter was a follow-up of the Agency's symposium on the Oklo phenomenon.

55. Work continued on the co-ordinated research programme on the bacterial leaching of uranium ores and started on a project to study the formation of uranium deposits in sandstone rocks.

56. The increasing demand for uranium was reflected in a growing number of requests for technical assistance. The Agency is providing, or will shortly provide, technical assistance in prospecting, development and ore processing to 23 countries, namely: Bangladesh, Bolivia, Brazil, Chile, Colombia, Egypt, Greece, India, Indonesia, Madagascar, Mexico, Morocco, Nicaragua, Pakistan, Peru, Philippines, Portugal, Thailand, Turkey, Uganda, Uruguay, Venezuela and Zambia. These undertakings include four large-scale UNDP projects which the Agency is executing in Chile, Greece, Pakistan and Turkey, while two other projects of this kind will be launched shortly in Colombia and Peru.

Fuel element technology

57. The main work in this sub-programme is to promote the exchange of information on the fabrication, technology and performance of light water reactor fuels, on quality assurance and quality control and on other aspects of the reliability of power reactor fuels of the present generation. During the year the following meetings were held:

(a) An international seminar on nuclear fuel quality assurance at Oslo in May;

(b) The first meeting of the International Working Group on Water Reactor Fuel Performance and Technology at Headquarters in May;

(c) A consultants' meeting on in-core fuel management for nuclear reactor power plants at Headquarters in November; and

(d) A consultants' meeting on non-fuel nuclear materials at Headquarters in November.

Reprocessing and recycling

58. Most of the work under this sub-programme has been carried out within the framework of the regional fuel cycle centre study.

59. The Agency held an advisory group meeting on the reprocessing of liquid metal fast breeder reactor fuels at Leningrad to review work in this field. Advances in this technology are also important for the reprocessing of fuels from the present generation of water-cooled power reactors.

Advanced nuclear technology

60. The International Working Group on Fast Reactors held its ninth annual meeting in 1976 and discussions at the meeting showed the amount of attention that is being given to safety and systems reliability of liquid metal fast breeder reactors. Operating experience in demonstration reactors of this type is being gained by France, the Soviet Union and the United Kingdom, and in 1976 France decided to begin the construction of the first commercial-sized fast breeder reactor in the world, the Super-Phénix.

61. The Agency is also continuing work on the status and prospects for thermal breeder reactors and is expanding its work in regard to high temperature gas cooled reactors. In the field of magnetohydrodynamic power generation, UNESCO replaced NEA as co-sponsor of the international liaison group which held its twelfth annual meeting and issued a status report on this technology.

Regional Nuclear Fuel Cycle Centre Project

62. This major study of the establishment of nuclear fuel cycle centres was almost completed by the end of the year and will be submitted to the International Conference on Nuclear Power and its Fuel Cycle. It has included supporting studies on the technological, economic, financial, non-proliferation and safeguards, institutional and legal aspects of such centres. Numerous mathematical models and computer codes have been developed for these studies and for the evaluation of alternative fuel cycle strategies. Much effort was devoted to evaluating the contributions that such centres could make towards the goal of non-proliferation of nuclear weapons.

63. Twenty-five Member States gave substantial help to the project during 1976 by way of data, information and technical expertise. About $360 000 was expended of which about 52% was contributed by organizations such as IBRD and UNEP and by Member States.

Supply of nuclear materials

64. The nuclear material for which the Agency arranged the delivery is shown in a separate report.[2]

65. The Board of Governors approved the request from Greece for enriched uranium fuel for a research reactor, but it was agreed that a Supply Agreement with the Government of Greece would not be concluded until results of final consultations between the parties concerned were available.

66. The Director General assisted five Member States to obtain quantities of enriched uranium and plutonium below the "safeguards exemption" limit. Through these and other arrangements, the Agency received 11 requests for nuclear material from eight countries and the Agency itself obtained 14 consignments of small quantities of uranium and plutonium.

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[2] See document INFCIRC/40/Rev.12.

Nuclear explosions for peaceful purposes (PNE)

67. The Ad Hoc Advisory Group on Nuclear Explosions for Peaceful Purposes held its second and third series of meetings. Thirty-nine Member States took part. The Group concentrated on the technical and legal aspects of PNE technology, the establishment and operation of an international PNE service and the structure and content of the agreements referred to under Article V of NPT.

68. Three consultants' meetings on legal, economic, and health, safety and environmental aspects of PNE were held and the Agency prepared a catalogue of possible PNE applications.

69. An Agency fact-finding group visited Egypt at the end of April at the request of the Government of that country to evaluate a potential PNE project, namely the channelling of Mediterranean sea-water into the Qattara Depression so as to generate hydroelectric power either through a tunnel or by a canal.

NUCLEAR SAFETY AND ENVIRONMENTAL PROTECTION

General

70. By the end of 1976 the 192 commercial nuclear power reactors in operation in 19 of the Agency's Member States had accumulated about 1200 reactor years of operating experience and were producing 15% or more of all electricity in some countries. Certain plants had been operating for as many as twenty years and several for more than ten. The safety record has been particularly noteworthy. No fatalities nor serious injuries deriving from the nuclear side of any of these power plants have been reported during the entire period. The few accidents that have occurred were well within the capacity of the installations to protect the public. Despite this exceptional achievement in industrial safety, the nuclear controversy continued unabated.

71. This record of safe operation of the nuclear power stations themselves may account for the fact that in several industrial countries criticism of nuclear power in the context of environmental protection is now directed less at individual plants and more at the problems of management of radioactive wastes as well as at risks of sabotage, theft or diversion. The long period of time during which high-level wastes will require isolation from the environment has offered a handy argument to critics, and an increasing number of government actions have required electricity utilities or generating boards to provide convincing evidence of a permanent solution of the waste disposal problem as a condition for the issue of a construction or operating permit.

72. The permanent means for the disposal of nuclear wastes that have been investigated up to now have almost all been based on the assumption that waste disposal would take place only after the reprocessing of the spent fuel, thus vastly reducing the volume of high-level waste which would have to be dealt with as well as the size of surface or underground storage or disposal facilities. In the latter part of 1976, however, certain governmental authorities began to raise serious doubts that national or regional plans for reprocessing would be proceeded with. This tended to place electrical utilities and generating boards in the difficult, if not impossible, position of having to provide proof to their own authorities of satisfactory permanent means of waste disposal while actions of other Governments or authorities appeared to be on the point of eliminating the very step in the fuel cycle which had been considered as the process through which spent fuel must necessarily pass before its waste component could be disposed of. As a result, nuclear plant operators began to find it difficult to comply within a reasonable time with official requirements, and plans for nuclear plants were placed in jeopardy.

73. The alternative of treating spent fuel itself as a waste product to be stored for lengthy periods of time or permanently has so far been studied only to a very limited extent, and its technological, economic and safety implications are by no means clear.

74. Utilities were therefore being faced in several countries with bulging inventories of spent fuel in their storage ponds and with numerous uncertainties about sometimes conflicting governmental requirements and about their own ability to meet them in relation both to existing plants and plans for the construction of new power reactors. These uncertainties and regulatory problems increased the lead time in certain countries for building a nuclear power plant from the six to seven years required in the late 1960s to eight to ten years, greatly increased the capital cost of nuclear plant at a time when interest and other capital charges were already very high, inflation was still pushing up component and material prices and capital was difficult to obtain, and thus contributed considerably to the sharp decline in new nuclear power plant orders and to the increasingly depressed state of the nuclear power industry.

75. These developments took place, as has been said, against the unequalled record of safety of the industry and at a time in which the world was becoming increasingly concerned about the long-term adequacy of its energy reserves.

Nuclear safety

76. In December 1974, the Agency began work on Safety Codes and Guides for nuclear power plants in the five subjects of Governmental Organization, Siting, Design, Operation and Quality Assurance. Five technical review committees are revising the drafts at various stages. A senior advisory group supervises the entire programme and reviews the documents at critical stages. In 1976 codes on Siting and on Operation passed all these reviewing procedures. The three remaining codes will do so by 1977, and twenty safety guides have been started, some of which are at various points in the reviewing process by the technical review committee or the senior advisory group.

77. During 1976 nuclear plant safety missions were sent to Bangladesh, Indonesia, the Republic of Korea, Kuwait, Mexico, Turkey and Yugoslavia to help select sites or make safety evaluations for new plants, and advice was given to the Republic of Korea regarding the safety implications of proposed bid specifications for a second nuclear plant.

78. Safety missions were also sent to Finland, Greece, Iran, Pakistan, Turkey and Yugoslavia to verify and advise on the safe operation of research reactors in those countries. Such visits are now being made at regular intervals.

Radiological safety

79. A symposium on the design and equipment of hot laboratories, held at Otaniemi, Finland, in August, reviewed recent developments in the design and construction of laboratories which handle large quantities of highly radiotoxic materials. Participants emphasized the importance of maintaining high standards in the quality and use of material and of reliable standardized equipment.

80. An international seminar on transport packaging for radioactive material, held at Vienna in August 1976, dealt with the design, construction and testing of packages for a wide range of radioactive materials, including irradiated fuel, as well as the necessary quality assurance programmes. In conformity with the seminar's recommendations the Agency will do more to help Member States to apply the regulations effectively to the growing traffic in nuclear fuel cycle materials.

81. A manual of guidance has been published on radiological safety in uranium and thorium mines and mills.

82. Advisory groups have helped the Secretariat to prepare manuals of guidance on radiological safety aspects of uranium and plutonium fuel fabrication and on procedures for protecting the public against the radiological consequences of an accident in a nuclear plant. The Secretariat has finalized the study of principles on which to base limits to the release of radioactive materials into the environment, taking account of the expected expansion of nuclear power.

83. The Secretariat has also completed studies on:

(a) Methods of assessing the collective doses from occupational exposure and from exposure of the general public;

(b) Limits to the levels of radioactive contaminants in food chains;

(c) The monitoring of radioactive airborne and liquid releases from nuclear plants during normal operations and in the case of accident;

(d) Particle size analysis in estimating significance of airborne contamination; and

(e) A compendium of neutron spectra for criticality accident dosimetry.

84. Austria, Bulgaria, Czechoslovakia, the Federal Republic of Germany, Hungary, Romania, the Soviet Union and Yugoslavia, together with the Agency, are continuing the joint study of problems that may be caused by the release of radioactive material in the Danube catchment area. The Agency has awarded five co-ordinated research contracts under this programme. The co-ordinated research programme on environmental monitoring for radiation protection, which countries in South East Asia are carrying out, has been extended for a further three years.

Waste management

85. In March 1976 the Agency, in co-operation with NEA, held a symposium on the management of radioactive waste from the nuclear fuel cycle. The symposium attracted broad interest and underlined the considerable progress made in developing waste management technology. Nevertheless, it indicated that many promising methods are still at the development stage and have not yet been tried out in large-scale practical experiments. The proceedings of the symposium have been published.

86. The Agency also published a code of practice and a guide to the code on the management of wastes from the milling and mining of uranium and thorium ores and completed work on a guide-book listing the factors to be borne in mind in selecting repositories of solid, high-level and alpha-bearing wastes.

87. The Agency is also examining the question of sites for the burial on land of low- and intermediate-level wastes and is drafting a code of practice and a guide on this subject. A code of practice on managing radioactive waste at nuclear power plants is expected to be published in late 1977, as well as a guide on the safe handling of fuel and components at nuclear power plants. A report on the handling of spent ion exchange resins from nuclear power stations will be published in 1978.

88. The Agency is also preparing a programme on the handling of gaseous radionuclides from airborne effluents.

89. The Agency's technical committee on high-level and alpha-bearing wastes is continuing to serve as a forum for the exchange of information on the treatment and disposal of such wastes, and two new research programmes have been launched on analysing solidified high-level waste products and on the risks involved in the separation, transmutation and disposal of the actinides.

90. In September 1976 the Agency held the first of several meetings of the technical committee which will examine the methodology for assessing the regional and global effects of radioactive, non-radioactive and thermal discharges and disposals from nuclear power plants and other nuclear facilities. In regard to the principles for establishing limits for the release of radioactive material into the environment, three co-ordinated research programmes are making valuable contributions to the understanding of the cycling of tritium in the environment, the movement of radium in waterways and the effects of thermal discharges in the environment. Pursuant to its responsibilities under the Convention on the Prevention of Marine Pollution by Dumping of Wastes and Other Matter (London Convention), the Agency has embarked on a programme for reviewing its definition of radioactive wastes or other radioactive matter which is unsuitable for dumping at sea and its recommendations regarding the dumping of such radioactive materials not falling within its definition.

Joint IAEA/IIASA research project

91. The Unit dealing with this project developed a theoretical framework for risk assessment research, consisting of the sub-topics risk estimation, risk evaluation and risk management. Research in 1976 concentrated on risk evaluation, which emphasises the objective measurement of social values and their inclusion in decision processes. Technical, psychological and social determinants underlying public response to technological developments, and their risks, were identified and an attitude-based methodology

for assessing their relative importance was developed. A pilot application of this methodology to attitudes toward nuclear power was carried out. This application showed that the method was successful in indicating the specific factors which differentiate between groups pro and contra nuclear power. To date, 28 scientific reports and papers presenting preliminary research results have been published and ten presentations made at international conferences. Five Member States participated in this project in 1976 by seconding scientists at their expense. A total of nine Member States have now participated in this work.

FOOD AND AGRICULTURE

General

92. The joint FAO/IAEA programme on food and agriculture is designed to help developing Member States to apply isotope and radiation techniques in solving important problems relating to production and protection of food and to protecting the environment from damage caused by inappropriate use of fertilizers and pesticides. The means it uses are training and other kinds of assistance; co-ordination and support of research forms an important part. More than 200 laboratories and other institutions in Member States are carrying out research programmes. Amongst the main developments in 1976 was a significant advance at a meeting at WHO Headquarters on the international acceptance of irradiated food for human consumption. Not only were clearances recommended for several foodstuffs, but these clearances are being submitted for incorporation in the Codex Alimentarius. There was also a major change in the approach to this question which should greatly facilitate the clearance of whole categories of foodstuffs in the future and should give a new stimulus to the use of irradiation as a technology for preserving and protecting food.

93. Another significant development which may be singled out is the increase in the use of induced mutations in plant breeding programmes, largely stimulated by the activities of the Joint FAO/IAEA Division of Atomic Energy in Food and Agriculture. During 1976 the release of a further 16 varieties was reported, bringing the total crop varieties which have been officially reported to have resulted from induced mutations to 126. This technique is also widely used in the production of new forms of ornamental plants where 60 commercially used variants have been reported.

Improvement of crops

94. In 1972 the Agency began a co-ordinated research programme to develop efficient methods of applying fertilizers to grain legumes (soy bean, common bean, broad bean and ground-nut) without reducing the plant's ability to fix atmospheric nitrogen. A study of the results obtained in 1975 has shown that, if nitrogen fertilizer is applied at various times (and not all at once) and if proper irrigation practices are followed, the nitrogen fertilizer will be very efficiently used and there will be little loss of nitrogen fixation ability. In co-operation with the "INPUTS" programme of the East-West Center in Honolulu, the Agency has begun a field programme using the stable isotope nitrogen-15 to compare the relative efficiency of the slow-release nitrogen fertilizers of ammonium sulphate and of urea in rice and wheat growing.

95. In the co-ordinated programme, supported by the Federal Republic of Germany, on conserving nitrogen as a plant nutrient in the soil and controlling losses caused by leaching of nitrogen below the root zone, direct measurements of the fate of applied fertilizer nitrogen in the soil and soil solution were made. The information gained will provide important guidelines for the more rational and efficient use of nitrogen fertilizers.

96. The results of the first phase of the research programme on micronutrient problems associated with rice grown under flooded conditions showed that zinc deficiency and, to a lesser extent, copper deficiency, are likely to occur in many rice growing regions. Field experiments are in progress, using radioactive zinc, to find out the most efficient and economical method of applying zinc fertilizers. Studies of soil water regimes will contribute to a more satisfactory use of both limited water resources and nutrients.

97. At a research co-ordination meeting held at Wageningen, Netherlands, a number of promising mutants in vegetatively propagated plants were reported. These include more compact fruit trees and disease-resistant mutants of turf and forage grasses and sugar cane. These and many other mutants are being evaluated for commercial use.

98. There has been substantial development in the seed protein improvement programme through various contracts, meetings and projects.

99. A project in Burma resulted in the release of new mutant varieties of rice and jute. In Indonesia, early maturing, high yielding rice mutants are in the final official testing state before release.

Insect control

100. The Agency and Nigeria have agreed in principle on a large-scale project for suppressing the tsetse fly by the sterile-insect technique. Several Member States have agreed to contribute funds to this multilateral project.[3] The objectives of the project are to investigate the advantages, efficacy and economics of the sterile-male technique for controlling or eradicating a riverine species of the tsetse fly, Glossina palpalis, on a large scale and under characteristic conditions.

101. The main objectives of the co-ordinated research programme on the use of the sterile-insect technique of fruit-fly suppression - namely research and development - were met. In Argentina, Israel, Italy, Peru and Spain, the second phase field testing proved successful; therefore, this programme was terminated. However, the Seibersdorf Laboratory continues to support existing field programmes in developing countries by supplying sterilized olive flies and Mediterranean fruit flies.

Animal husbandry

102. A co-ordinated research programme on the use of isotopes and radiation in animal parasitology and immunology has been completed. Scientists from Czechoslovakia, Denmark, Ethiopia, the Federal Republic of Germany, Kenya, Sudan, the United Kingdom, the United States and Yugoslavia contributed with studies of host-parasite relationship in protozoal and helminthic infections. The Agency is continuing studies on the water requirements of animals in arid environment, and the use of isotope techniques in improving the reproductive efficiency of farm animals. A new programme has begun on the use of nuclear techniques to diagnose moderate mineral deficiencies or excesses. Scientists from many developing countries will help to develop techniques to determine the nutritional condition of domestic animals with respect to trace elements such as copper, selenium, zinc, cobalt, etc. at an early stage.

Effects of residues and fertilizers on the environment

103. Two co-ordinated research programmes on isotopic tracer-aided studies of a representative range of chemical and radioactive trace contaminants of agriculture, food and fisheries have been completed. These have included studies on the fate of pesticide and other chemical residues in crops and soils and of mercury and trace metals accumulation in aquatic ecosystems. These investigations have also led to contributions to published comparative summaries of data on inputs, fate and biological significance of both chemical and radioactive trace contaminants and have provided for the identification of and attack on specific problems of importance to developing countries.

104. A co-ordinated research programme of isotopic tracer-aided studies of the biological side effects of foreign chemical residues in food and agriculture has also been successfully completed. The programme has been successful in providing means for an early warning of the potential for carcinogenic and mutagenic action of environmental chemicals.

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[3] The project agreement was subsequently signed on 3 June 1977 in Vienna.

105. Three programmes were continued on:

(a) Chemical residues in edible oil and related products;

(b) Agricultural nitrogen residues; and

(c) Chemical residue-microbiological interaction in inland aquatic ecosystems.

Research institutes in 28 countries are participating in these programmes.

Food irradiation

106. The results of many years of wholesomeness studies, carried out by the International Project in the Field of Food Irradiation (Karlsruhe, Federal Republic of Germany) and by a number of national laboratories, were evaluated by the Joint FAO/IAEA/WHO Expert Committee on the Wholesomeness of Irradiated Food in August/September 1976 in Geneva. The Committee laid down new principles for the safety evaluation of irradiated foods, emphasizing the growing importance of the chemical approach in toxicological evaluation, and envisaging the eventual generalization of the acceptance of groups of irradiated foods or of the process itself.

107. An advisory group of experts (December 1976, Vienna) drew up draft proposals for a standard for food irradiation and a code of practice on process control to be submitted for acceptance by the Codex Alimentarius Commission of the Joint FAO/WHO Food Standards Programme and for ultimate approval by its 114 Member States.

108. A research co-ordination meeting on wholesomeness of the process of food irradiation was held at Manila in May 1976; another meeting dealing with the technological and economic feasibility of food irradiation was held in October 1976, at Wageningen, Netherlands.

109. A programme has been launched to assess the energy requirements of food irradiation compared with those of traditional methods of food processing.

Medical applications

110. An Agency/WHO consultation has shown that gastrointestinal malabsorption of major nutrients - carbohydrates, fats, proteins - may constitute a signficant public health problem, whose investigation will require the use of better methods, including isotope techniques.

111. The Agency is providing Member States with two new analytical quality control services relating to the determination of trace elements in biomedical samples by activation analysis.

112. There has been some expansion of two co-ordinated research programmes on radioimmunoassay and related in vitro techniques for the assay of hormones and other biological molecules. Eighteen contractors reviewed their progress in this field in a research co-ordination meeting held in London.

113. Investigations under the co-ordinated research programme on computer-assisted scintigraphy have been completed, and the findings are being analysed.

114. The Agency has begun a study of the cost-effectiveness of certain nuclear medical techniques in conditions normally prevailing in developing countries. The study also covers a survey in South East Asia of problems of maintaining nuclear medical instruments and resources for their solution. [4]

Dosimetry

115. By the end of 1976 the Secondary Standard Dosimetry Laboratories (SSDL) network comprised nine laboratories, and a number of additional applications for membership have been received. WHO provides the secretariat of the joint network; the Agency takes responsibility for its technical and scientific development, and for the work of the SSDL Advisory Group.

116. The joint IAEA/WHO postal ^{60}Co teletherapy dosimetry service was serving 140 institutions during 1976, primarily from the Far East and Pacific area. The National Physical Laboratory at Teddington, United Kingdom, participated in this programme under an Agency technical contract.

117. The californium-252 loan programme for university teaching and research was continued. Another 49 sources were given to the Agency by the United States for distribution to Member States.

118. At an advisory group meeting on intercomparison and standardization procedures in dosimetry of ^{60}Co gamma radiation and X-rays, methods for a postal dosimetry service for orthovoltage X-rays were evaluated and a trial dose intercomparison was recommended for 1977.

119. During 1976 the Agency awarded research contracts in ten Member States on radiation dosimetry.

120. The programme on computerized teletherapy dosimetry services was terminated.

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[4] See also para. 59 of last year's report (document GC(XX)/565).

Radiation biology

121. The Agency has continued to promote the use of radiation for sterilizing medical supplies in Europe. To encourage the use of this technique in Asia and the Pacific, the Agency has begun a co-ordinated programme under which it supports the work of nine institutes in eight countries in the region.

122. An advisory group meeting was held at Athens to review the practices and to improve the clinical applications of radiation-sterilized tissue grafts.

123. To lend better perspective to public concern about the effects of nuclear power, the Agency is promoting an assessment of the biological hazards of major chemical pollutants compared with those of radiation. For this purpose the Agency held a meeting at Brighton, United Kingdom, at which it was agreed that the majority of chemical pollutants caused biological hazards in a manner similar to ionizing radiations enabling their direct comparison in radiation equivalent units. The Agency has therefore begun a co-ordinated research programme to develop the concept of radiation equivalents for maximum permissible limits of chemicals in the environment in which eight leading institutes from eight Member States have agreed to participate.

124. The Agency has terminated the programme on applying radiation genetics to improve industrial micro-organisms. The results of the programme were reviewed at a meeting at Bangkok in March/April 1976.

125. The co-ordinated research programme on radioimmunological control of parasitic diseases such as malaria was reviewed at a meeting at Addis Ababa in August 1976. The discussions showed that closer co-operation between institutes in developed and developing countries would strengthen the programme which should concentrate on major diseases identified by WHO.

126. In its work to improve radiation treatment of cancer, the Agency held an international symposium in Vienna on radiobiological research needed for improvement of radiotherapy. The symposium showed that radiosensitizers may prove an alternative to the use of high LET (linear energy transfer) radiations in cancer therapy, which is beyond the economic reach of the developing Member States. The Agency has also started another co-ordinated programme to explore the use of Auger-electron-emitting radioisotopes - by injection or oral treatment - in cancer treatment in less developed countries where conventional therapy equipment may not be available.

127. The Agency is continuing to support 13 institutes from 12 Member States in the co-ordinated programme on suitability of chromosomes as a test material to ascertain to what extent data relating to biological hazards may be extrapolated from animal to human systems.

128. The Agency has published the first report on the human hair composition as an indicator of man's contamination by inorganic pollutants. The results reported are based on a co-ordinated research programme using neutron activation analysis of such pollutants in human hair.

Physics

129. The programme on research reactor utilization included a regional seminar for South East Asia and the Pacific at Bandung, Indonesia, and an advisory group meeting on neutron inelastic scattering in applied research which considered applications of neutron inelastic scattering on neutron diffraction for industry. Consultant meetings discussed safety-oriented research which can be performed by research reactors and the design and utilization of strong neutron sources.

130. The Agency continued to contribute to the international co-ordination of controlled fusion research. The Sixth International Conference on Plasma Physics and Controlled Nuclear Fusion Research was held in Berchtesgaden, Federal Republic of Germany, at which substantial progress in fusion research was reported. An advisory group meeting on the technology of inertial confinement experiments was held at Dubna, Soviet Union, and a meeting on large tokamak experiments was held at Princeton, United States. At the annual meeting of the International Fusion Research Council national programmes in fusion were reviewed and recommendations made on the Agency's activities in this field for 1977 and 1978.

131. The Joint NEA/IAEA International Liaison Group on thermionic electrical power generation was terminated on the initiative of NEA.

Industrial applications and chemistry

132. Institutes in eight Member States are carrying out research on industrial applications of isotopes and the use of nuclear techniques for mineral prospecting and trace element analysis under co-ordinated programmes. A co-ordinated research programme on the subject of on-line X-ray and neutron techniques for industrial process control was started in which institutes in Austria, Romania and New Zealand are participating.

133. The co-ordinated programmes mentioned in last year's report[5] for support of developing country research on radiopharmaceuticals, radiation processing and to compile certain actinide data, were continued in 1976.

Isotope hydrology

134. During the year services were provided to a considerable number of countries to demonstrate the use of isotope techniques in solving specific hydrological problems. The Laboratory carried out many analyses in support of these activities. The third inter-laboratory comparison of low-level tritium measurements of natural waters was completed. Forty-one laboratories from twenty-one countries participated in this exercise.

135. An advisory group met at Cracow, Poland, to examine the potential use of nuclear techniques to problems of groundwater pollution and an inter-secretariat meeting was held at FAO Headquarters, with the participation of consultants, to review problems in irrigation and their potential solution using nuclear techniques.

136. The Agency provided the technical secretariat for the first session of the working group on nuclear techniques of the International Hydrological Programme (IHP), participated in some of the other working groups of IHP and in the preparations for the United Nations Water Conference which was held at Mar del Plata, Argentina, in March.

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[5] See GC(XX)/565, paras 74 and 75.

Nuclear data

137. In response to demand, the existing network of co-operation between regional and national neutron nuclear data centres has been enlarged to include charged particle nuclear data centres. A revised issue of the "World Request List for Nuclear Data" was published in August. The Agency supported the relevant work of laboratories in several developing countries by ordering for them samples of required isotopes. Meetings to assess the status and requirements of nuclear data for reactor dosimetry and for reactor shielding were also held in the course of the year.

138. An advisory group meeting was convened to develop an internationally co-ordinated network of data centres to handle nuclear structure and decay data of importance in applications of radiations and isotopes.

139. Within the framework of the Agency's new programme on atomic and molecular data for fusion an advisory group meeting of fusion and atomic physicists was convened at the Culham Laboratory in the United Kingdom, to assess the atomic and molecular data requirements for fusion research and technology, to review relevant national programmes, and to promote international co-operation in compiling and disseminating the needed data.

THE LABORATORIES

Seibersdorf Laboratory

Chemistry

140. The Laboratory again organized six international intercomparisons of radiochemical analysis of biological, environmental and geological materials and distributed reference samples to institutes in Member States. 500 samples were shipped to institutes in 40 different countries and well over 4000 results were received for evaluation.

141. Analytical services, mainly to uranium prospection projects in Member States, involved 900 analyses. A pre-operational environmental survey for plutonium around the Seibersdorf Reactor Centre was carried out and this, together with routine bioassay samples, involved an additional 300 analyses. This survey was needed before the Safeguards Analytical Laboratory could start work on plutonium-containing samples.

Safeguards Analytical Laboratory (SAL)

142. The Laboratory began working in February 1976. All major equipment, including two surface ionization mass spectrometers and 21 glove boxes for plutonium handling has been moved in.

143. 430 uranium-containing safeguards samples were received in 1976 and 400 of them were analysed in SAL. A programme for setting physical standards for safeguards non-destructive measurements is being undertaken.

Agriculture including entomology

144. Under the co-ordinated research contracts programme carried out by the Agency and FAO, the Laboratory:

(a) Analysed a total of 5400 plant samples for nitrogen-15 content, 5000 thereof by mass spectrometry, the remainder by emission spectrometry;

(b) Developed methods to screen seed protein mutants in various cereal species. The Agency is now able to analyse 40 000 samples a year for seed protein characteristics using at least three different methods;

(c) Irradiated batches of seed material for mutation breeding;

(d) Continued development on mass rearing methods and techniques for the Mediterranean fruit fly and the olive fly; and

(e) Improved the methodology on mass rearing of the tsetse fly in feeding experiments in vivo on guinea pigs and in vitro on silicon membranes using different kinds of blood.

Metrology

145. An "intercomparison of computer codes for the evaluation of Ge(Li) gamma spectra" was started with the participation of about 200 laboratories in 36 Member States.

146. Within the "intercomparison service of calibrated radionuclide solutions" 34 samples of 11 nuclides calibrated by national laboratories were received and registered. Collaboration with the International Bureau of Weights and Measures, Paris, was agreed upon.

International Laboratory of Marine Radioactivity

147. The main areas of research during the year were:

(a) Assessment of the behaviour of natural alpha-emitting radionuclides and transuranic elements in certain marine plants and animals;

(b) Studies on the effects of pollutants such as mercury and other metals on marine plants and animals;

(c) Intercalibrations were made on radioactivity in two sea-water and two biological samples, and the results were sent to some 80 participating laboratories in 25 Member States. Special emphasis was given to the measurement of environmental levels of transuranic elements ("transuranics"). A growing number of laboratories is able to provide more reliable data on these elements;

(d) Measurement of transuranic elements in the western Mediterranean continued. Reliable results on americium-241 in Mediterranean sea-water were acquired for the first time;

(e) Trace metals at various depths in the sea have been measured, giving information on their vertical distribution; and

(f) Recent studies have shown the important role of faecal pellets from plankton grazing in surface layers in removing transuranic elements from the water and putting them into the sediments. The Laboratory is investigating how to determine the level of the radionuclides once they have been incorporated into sediments.

148. Research on non-nuclear pollutants, carried out under several UNEP contracts, comprised:

(a) Further studies on the effects of chlorinated hydrocarbons on marine organisms. Particular attention is being given to the role of polychaete worms in concentrating polychlorinated biphenyls (DP-5) from the sea sediment, and to the transfer of chlorinated hydrocarbons through marine food chains;

(b) Intercalibration of trace elements in marine samples. The exercise on oyster homogenate was completed. About 110 laboratories from more than 30 Member States participated. While results were quite good for some of the trace elements, poor comparability was observed for Sb, Hg and Pb;

(c) Sea plant homogenate and copepod homogenate were distributed to various national laboratories for measurement for trace elements and chlorinated hydrocarbons;

(d) Sea-water and sediment samples were analysed for polychlorinated biphenyls, pesticides, low molecular weight, chlorinated hydrocarbons and trace metals. Preliminary results show that the levels of polychlorinated hydrocarbons and trace metals in the waters of the Mediterranean may be roughly comparable to that of the Atlantic and Pacific Oceans;

(e) A scheme for isolating humic and fulvic substances from large volumes of sea-water was devised. The role of these large molecules, which can attach to radionuclides and other pollutants in the ocean, will be investigated;

(f) Baseline studies of chlorinated hydrocarbons in the Ligurian Sea were completed; and

(g) A new programme of intercalibration and instrument maintenance for Mediterranean laboratories was begun.

INTERNATIONAL CENTRE FOR THEORETICAL PHYSICS

149. The main fields of research and training-for-research at the International Centre for Theoretical Physics during 1976 were:

(a) Solid state physics;

(b) Elementary particles and fundamental theory;

(c) Nuclear physics;

(d) Science teaching; and

(e) Applicable mathematics.

150. The solid state physics programme included a winter college on the interaction of radiation with condensed matter and a research workshop. A symposium on critical phenomena and phase transitions was held in conjunction with the workshop.

151. Research in elementary particles and fundamental theory was actively pursued throughout the year. Four meetings highlighted this component of the programme.

152. In the nuclear physics field, the Centre organized a conference on the physics of tandem followed by a workshop.

153. In science teaching, a new endeavour of the Centre, a summer college-workshop was held from 7 July to 19 August.

154. In applicable mathematics, the Centre held a course on the applications of analysis to mechanics. As a complement to the scheduled programme, two special lecture series were held, one on the geometry of the Laplace operator, and the other on applications of non-linear functional analysis to differential equations.

155. A conference on physics and astrophysics from spacelab was also held from 6 to 11 September with the participation of 63 scientists.

156. The Centre also provided the scientific guidance for an extended seminar, held in Nathiagali, Pakistan, on the subject of physics and contemporary needs.

157. Approximately 850 scientists visited the Centre during 1976. A large proportion came from developing Member States, and some 75% of the financial resources available for scientific activities was used to support the Centre's work for scientists from these countries. Financial support was received from the Government of Sweden through SIDA for the Associate Membership Scheme as well as for extended courses; support was also given by UNDP for activities in solid state physics and applicable mathematics. Financial and other assistance continued to be given by the Italian Government and local authorities of Trieste.

SAFEGUARDS

General

158. The Standing Advisory Group on safeguards implementation held its second meeting in May 1976 and made recommendations on the content of the Special Safeguards Implementation Report. A prototype of the report covering the actual effectiveness of safeguards application at the major nuclear facilities involved in 1975 was prepared according to the Group's recommendations and reviewed by it at its third meeting, in October 1976. The Group made interim recommendations on the effectiveness of Agency safeguards, on the values of the "significant quantities" (as used in NPT safeguards agreements) to be used for planning purposes and on a plan of action for future work.

Safeguards operations

159. At the end of 1976 the Agency had a total of 107 safeguards agreements in force with 66 States, and with 25 States it had concluded 17 safeguards agreements awaiting entry into force.

Table 6

NPT and NPT-type agreements in force

NPT	37
NPT and Tlatelolco Treaty	8
NPT and Additional Protocol I of Tlatelolco Treaty	1
	46[a]

a/ Of these, 23 agreements are applied in States having significant nuclear activities.

Table 7

Non-NPT agreements in force[a]

Project Agreements	23
Unilateral Submissions	9
Trilateral Agreements	29
	61

a/ Pursuant to the entry into force of safeguards agreements in connection with NPT the application of Agency safeguards has been suspended in the case of 22 of the above agreements: 13 project agreements, one unilateral submission and eight trilateral agreements (in the last case the suspension applies to one Party only).

Table 8

Agreements awaiting entry into force

	Approved	Approved and signed
NPT-type		
NPT	6	4
NPT and Tlatelolco Treaty		3
Non-NPT-type		
Unilateral Submissions	2	
Trilateral Agreements	2	
	10	7

160. During 1976 the Board approved:

(a) Trilateral agreements between the Agency, Brazil and the Federal Republic of Germany, covering the supply of power reactors, reprocessing, enrichment and other plants and materials; the Agency, France and Pakistan, covering a reprocessing plant; the Agency, France and South Africa to cover two power reactors; and the Agency, Canada and Spain covering a nuclear plant and material including heavy water;

(b) Safeguards agreements in connection with NPT with the United Kingdom and the United States of America, covering all except national security activities.

161. Table 9 shows the quantities of nuclear material that were under Agency safeguards at the end of the year indicated.

162. A list of nuclear installations under Agency safeguards, or containing material safeguarded, is given in Table 10.

163. During 1976 the Agency carried out 565 inspections in 40 States (228 in connection with NPT), compared with 515 inspections (216 in connection with NPT) in 39 States during the preceding year. Of the 565 inspections, 215 were made of power plants, 119 of bulk fuel plants and 231 of other facilities including research reactors.

164. A training course was held, including an introductory course, on Agency safeguards for newly-recruited inspectors. Agency inspectors also received intensive tuition in a Member State in the non-destructive assay of radioactive materials using portable instruments currently employed on inspections.

165. At the end of 1976 the compilation of about 110 individual Safeguards Implementation Practices was completed, achieving consistency of inspection procedures in respect of nuclear facilities where nuclear material was under safeguards.

166. Considerable efforts have been devoted to the preparations for the implementation of safeguards in the EURATOM countries.

Table 9

Quantities of nuclear material under Agency safeguards

Material	Amounts by years				
	1972	1973	1974	1975	1976
Plutonium (kg)					
(a) Contained in irradiated fuels	2 214	2 927	4 345	6 661	11 775
(b) In other forms	686	1 443	1 955	2 374	2 778
(c) Total	2 900	4 730	6 300	9 035	14 553
Uranium enriched to more than 20% (kg)					
Contained in irradiated fuels:					
(a) Fissile content	988	1 157	1 275	1 445	1 245
(b) Total element	2 545	2 812	2 942	3 422	2 115
In other forms:					
(a) Fissile content	248	380	455	471	529
(b) Total element	402	556	668	791	864
Uranium enriched to less than 20% (kg)					
Contained in irradiated fuels:					
(a) Fissile content	19 254	27 808	36 865	44 892	47 376
(b) Total element	945 103	1 342 336	729 491	2 273 629	2 275 334
In other forms:					
(a) Fissile content	5 908	13 801	14 718	19 926	32 887
(b) Total element	229 715	519 579	571 947	817 948	1 337 763
Uranium enriched, Totals (tonnes)					
(a) Fissile content	26	43	53	67	82
(b) Total element	1 178	1 865	2 305	3 096	3 649
Source material (tonnes)	2 145	3 370	3 910	4 440	5 336

Table 10

Facilities	End of 1976	
	NPT	Non-NPT
Power plants	18	33
Conversion and fuel fabrication plants	6	8
Reprocessing plants	-	1
Pilot fuel fabrication plants	4	6
Pilot reprocessing plants	-	2
Research reactors and critical facilities	54	60
Sub-critical facilities	7	2
Research and development facilities	11	17
Other locations	32	71

167. The status, at the end of 1976, of various safeguards agreements concluded between the Agency and Governments, and installations or materials subject to safeguards under such agreements are given in Tables 7-10 at the end of this section.

Safeguards development

168. The second of several volumes of the Agency's Safeguards Technical Manual was issued in September 1976. It dealt with safeguards objectives, criteria and requirements.

169. The Secretariat has begun preparing a complete set of systems analyses for each type of plant in the nuclear fuel cycle. The object is to examine critically the real potential for diversion of nuclear material from the plant and to advise on a basic safeguards strategy to counter all identified risks of diversion.

170. The Secretariat continues to seek improvements in specific inspection procedures taking into account the role, effectiveness and functioning of national systems of accounting for, and control of, nuclear material. Design information questionnaires have been revised in the light of experience and new questionnaires have been prepared for critical facilities, research and development facilities, separate storage installations, and for nuclear material outside facilities.

171. The Secretariat has drawn up procedures to evaluate different types of safeguards data. In these procedures, the emphasis is on the definition of the evaluation objectives and the specification of the input and output data requirements for computer processing of safeguards information. Procedures for using isotope correlation techniques to verify input into reprocessing plants were completed.

172. Further work has been done on predicting future safeguards manpower requirements based on estimates of growth of the nuclear fuel cycle and estimates of the necessary routine inspection effort at different types of plant.

173. An advisory group meeting was held in March 1976 on the training programme for personnel of State systems of accounting for, and control of, nuclear material.

174. During November 1976 the Agency held the first training course for personnel from Member States concerned with accounting for, and control of, nuclear material. Twenty-seven participants from 18 countries attended the course which lasted three weeks.

175. The Safeguards Analytical Laboratory (SAL) at Seibersdorf, began operations on uranium-containing samples in February 1976. [6] A tandem mass-spectrometer and an emission spectrograph were installed in 1976. The Agency distributed more than 300 uranium-containing samples in 1976 to four national laboratories and to SAL, and processed the resulting data for inclusion in inspection reports.

176. Non-destructive methods of analysis made by the use of portable instruments are increasingly valuable for the effective application of safeguards in the field. The Secretariat successfully used a new light-weight portable multichannel analyser in inspections during 1976. A new type of semiconductor detector (cadmium telluride) was used the first time to verify irradiated fuel in storage. High-purity germanium detectors were optimized for making more accurate measurements of plutonium and a non-destructive assay method based on neutron technology was developed for the same purpose. In this connection, the Agency held an advisory group meeting on assessment of non-destructive assay for safeguards in June 1976.

177. Continuous surveillance by unattended instruments can reduce manpower requirements and increase safeguards effectiveness. A significant improvement during 1976 was the development of a high-capacity television video recorder system with remotely controlled cameras. The system records the time when each individual picture is taken in the plant and permits inspectors to study pictures at the plant itself. The use of the television systems eliminates the need for the normal wet processing of photographic film and for access to areas which may be contaminated or in which there is radiation. The super-8-mm camera system is now in routine use as a surveillance instrument and was further refined and improved during the year.

178. There were also further improvements in the use of seals incorporating fibre optics. The Agency also carried out tests of techniques for monitoring the flow of irradiated fuel, and for the surveillance of fuel storage at Candu-type reactors.

179. At a meeting of the participants in the co-ordinated research programme on a bank of correlated isotopic data at Seattle, United States, in October 1976 the Agency successfully demonstrated the first version of the data bank at a local IBM computer installation.

180. The cost of safeguards research contracts awarded in 1976 amounted to $130 000 of which the Agency contributed 8.7%.

Safeguards information treatment

181. In April 1976 the Agency established a new Safeguards Information Treatment Unit to process, with minimum delay, NPT accounting and inspection reports and to develop an advanced safeguards information system. The cumulative amounts of accounting and inspection data in the safeguards data bank are shown below:

	1975	1976
Accounting reports	2 010	5 030
Accounting records	30 150	87 690

[6] See also paras 142 and 143 above.

182. During 1976 the Secretariat developed and tested input formats and software for computerizing inspection reports; held a workshop-seminar for personnel from 19 countries who prepare and submit safeguards accounting reports, and set up an analysis and development section, with assistance from Member States through cost-free experts, which began work on analysing the data elements needed for an advanced safeguards information system and on projecting requirements for computer resources as a basis for recommending the acquisition of a new computer system. A data-based management system was installed to be used as a major part of the new information system.

Standardization

183. Further work has been done on standardizing the Subsidiary Arrangements required for NPT safeguards agreements especially with respect to reports to be submitted by operators. At the same time, the Secretariat has begun a study of ways to standardize the Subsidiary Arrangements required for non-NPT agreements so as to eliminate differences in the reporting procedures and thereby simplify the handling of these reports and make it possible to standardize computer operations.

Table 11

Situation on 31 December 1976 with respect to the signature of, ratification of, or accession to, NPT by non-nuclear-weapon States, and 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	Approved by the Board	
Australia	23 January 1973	In force: 10 July 1974	217
Austria	28 June 1969	In force: 23 July 1972	156
Bahamas	10 July 1973		156/Add.1
Barbados		Under negotiation	
Belgium	2 May 1975	Signed: 5 April 1973	193
Benin	31 October 1972		
Bolivia[b]	26 May 1970	Signed: 23 August 1974	
Botswana	28 April 1969	Under negotiation	
Bulgaria	5 September 1969	In force: 29 February 1972	178
Burundi	19 March 1971	Under negotiation	
Canada	8 January 1969	In force: 21 February 1972	164
Central African Empire	25 October 1970		
Chad	10 March 1971		
China, Republic of	27 January 1970	Negotiations discontinued	
Colombia			
Costa Rica[b]	3 March 1970	Signed: 12 July 1973	
Cyprus	16 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			
Denmark	3 January 1969	In force: 1 March 1972	176
Dominican Republic[b]	24 July 1971	In force: 11 October 1973	201
Ecuador[b]	7 March 1969	In force: 10 March 1975	231
Egypt			
El Salvador[b]	11 July 1972	In force: 22 April 1975	232
Ethiopia	5 February 1970	Approved by the Board	
Fiji	14 July 1972	In force: 22 March 1973	192
Finland	5 February 1969	In force: 9 February 1972	155
Gabon	19 February 1974	Approved by the Board	155/Add.1
Gambia	12 May 1975		
German Democratic Republic	31 October 1969	In force: 7 March 1972	181
Germany, Federal Republic of	2 May 1975	Signed: 5 April 1973	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	Under negotiation	
Guatemala	22 September 1970	Under negotiation	
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			
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: 29 February 1972	184
Italy	2 May 1975	Signed: 5 April 1973	193
Ivory Coast	6 March 1973		
Jamaica	5 March 1970	Under negotiation	
Japan	8 June 1976	Approved by the Board	
Jordan	11 February 1970	Signed: 5 December 1974	
Kenya	11 July 1970	Under negotiation	
Korea, Republic of	23 April 1975	In force: 14 November 1975	236
Kuwait			
Laos	20 February 1970	Under negotiation	

(1)	(2)	(3)	(4)
Lebanon	15 July 1970	In force: 5 March 1973	191
Lesotho	20 May 1970	In force: 12 June 1973	199
Liberia	5 March 1970		
Libyan Arab Republic	26 May 1975	Under negotiation	
Luxembourg	2 May 1975	Signed: 5 April 1973	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	Under negotiation	
Mali	5 March 1970	Under negotiation	
Malta	6 February 1970	Under negotiation	
Mauritius	28 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	30 November 1970	In force: 18 February 1975	228
Nepal	5 January 1970	In force: 22 June 1972	186
Netherlands[c]	2 May 1975	Signed: 5 April 1973	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	Under negotiation	
Norway	5 February 1969	In force: 1 March 1972	177
Panama			
Paraguay	4 February 1970	Under negotiation	
Peru	3 March 1970	Under negotiation	
Philippines	5 October 1972	In force: 16 October 1974	216
Poland	12 June 1969	In force: 11 October 1972	179
Romania	4 February 1970	In force: 27 October 1972	180
Rwanda	20 May 1975		
San Marino	10 August 1970	Under negotiation	
Senegal	17 December 1970	Under negotiation	
Sierra Leone	26 February 1975	Under negotiation	
Singapore	10 March 1976	Under negotiation	
Somalia	5 March 1970	Under negotiation	
Sri Lanka			
Sudan	31 October 1973	Signed: 26 February 1975	
Surinam[c]	30 June 1976	In force: 5 June 1975	230
Swaziland	11 December 1969	In force: 28 July 1975	227
Sweden	9 January 1970	In force: 14 April 1975	234
Switzerland		Under negotiation	
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	
Trinidad and Tobago			
Tunisia	26 February 1970	Under negotiation	
Turkey			
United Republic of Cameroon	8 January 1969		
Upper Volta	3 March 1970		
Uruguay[b]	31 August 1970	In force: 17 September 1976	157
Venezuela	26 September 1975	Under negotiation	157/Corr.1 /Add.1
Western Samoa	18 March 1975		
Yemen Arab Republic			
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. The Socialist Republic of Viet Nam is reconsidering adherence to the commitments of the former Administration under international agreements.

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

c/ Agreements have also been concluded in respect of the Netherlands Antilles (INFCIRC/229) and Surinam, under NPT and Additional Protocol I to the Tlatelolco Treaty. These agreements entered into force on 5 June 1975. Surinam attained independence on 25 November 1975. By letter of 30 June 1976 the Government of Surinam notified the Government of the United States of America of Surinam's succession to NPT.

Table 12

Situation on 31 December 1976 with respect to the signature of, ratification of, or accession to, NPT by nuclear-weapon States, and the conclusion of safeguards agreements between the Agency and these States in connection with NPT

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)
USSR	5 March 1970	
UK[b/]	27 November 1968	Signed: 6 September 1976
USA[c/]	5 March 1970	Approved by the Board

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/ This agreement was concluded pursuant to an offer made by the Government of the United Kingdom in 1967 which stated that, at such time as international safeguards were put into effect in non-nuclear-weapon States in implementation of the provisions of NPT, the United Kingdom would be prepared to offer an opportunity for the application of similar safeguards in the United Kingdom subject to exclusions for national security reasons only.

c/ This agreement was concluded pursuant to a statement made by the President of the United States of America in 1967, according to which the United States would permit the Agency to apply its safeguards to all nuclear activities in the United States, excluding only those with direct national security significance, when safeguards under NPT were applied.

Table 13

Agreements providing for safeguards other than those in connection with NPT, approved by the Board as of 31 December 1976

Party(ies)[a]	Subject	Entry into force	INFCIRC
Bilateral Agreements			
(a) Project Agreements			
Argentina	Siemens SUR-100	13 Mar 1970	143 /Add.1 /Add.1/Corr.1
	RAEP Reactor	2 Dec 1964	62 /Add.1
Chile	Herald Reactor	19 Dec 1969	137 /Corr.1 /Add.1
Finland[b]	FiR-1 Reactor	30 Dec 1960	24 /Add.1-4 /Add.4/Corr.1 /Add.4/Corr.2 /Add.5
	FINN sub-critical assembly	30 Jul 1963	53 /Mod.1
Greece[b]	GRR-1 Reactor	1 Mar 1972	163 /Add.1
Indonesia	Additional core-load for Triga Reactor	19 Dec 1969	136 /Add.1 /Add.1/Mod.1
Iran[b]	UTRR Reactor	10 May 1967	97 /Mod.1
Japan	JRR-3	24 Mar 1959	3 /Mod.1 /Mod.2
Mexico[b]	TRIGA-III Reactor	18 Dec 1963	52 /Mod.1
	Siemens SUR-100	21 Dec 1971	162 /Corr.1 /Mod.1
	Laguna Verde Nuclear Power Plant	12 Feb 1974	203 /Add.1
Pakistan	PRR Reactor	5 Mar 1962	34 /Add.1-4
	Booster rods for KANUPP	17 Jun 1968	116 /Add.1
Philippines[b]	PRR-1 Reactor	28 Sep 1966	88 /Add.1 /Mod.1

Party(ies)[a]	Subject	Entry into force	INFCIRC
Romania[b]	TRIGA Reactor	30 Mar 1973	206 /Mod.1 /Add.1
Spain	Coral I Reactor	23 Jun 1967	99
Turkey	Sub-critical assembly	17 May 1974	212
Uruguay[b]	URR Reactor	24 Sep 1965	67
Venezuela	RV-1 Reactor	7 Nov 1975	
Yugoslavia[b]	TRIGA-II	4 Oct 1961	32 /Add.1-2
	KRSKO Nuclear Power Plant	14 Jun 1974	213
Zaire[b]	TRICO Reactor	27 Jun 1962	37 /Add.1-5

(b) Unilateral submissions

Argentina	Atucha Power Reactor Facility	3 Oct 1972	168
	Nuclear material	23 Oct 1973	202
	Embalse Power Reactor Facility	6 Dec 1974	224
Chile	Nuclear material	31 Dec 1974	
China, Republic of	Taiwan Research Reactor Facility	13 Oct 1969	133
Mexico[b]	All nuclear activities	6 Sep 1968	118 /Mod.1
Panama[c]	All nuclear activities		
Spain	Nuclear material	19 Nov 1974	218
	Nuclear material	18 Jun 1975	221
Switzerland	Nuclear material		
United Kingdom	Nuclear material	14 Dec 1972	175

Party(ies)[a]	Entry into force	INFCIRC
Trilateral Agreements		
(While the Agency is a party to each of the following agreements, the list only mentions the States party to them)		
Argentina/United States of America	25 Jul 1969	130 /Corr.1 /Corr.1/Rev.1
Australia[b]/United States of America	26 Sep 1966	91 /Mod.1
Austria[b]/United States of America	24 Jan 1970	152 /Mod.1 /Mod.1/Add.1
Brazil/ Germany, Federal Republic of	26 Feb 1976	237
Brazil/United States of America	20 Sep 1972	110 /Add.1 /Mod.1
China, Republic of/United States of America	6 Dec 1971	158
Colombia/United States of America	9 Dec 1970	144 /Add.1
India/Canada[b]/	30 Sep 1971	211
India/United States of America	27 Jan 1971	154
Indonesia/United States of America	6 Dec 1967	109
Iran[b]/United States of America	20 Aug 1969	127 /Add.1 /Mod.1
Israel/United States of America	4 Apr 1975	
Japan/Canada	12 Nov 1969	85 /Mod.1
Japan/France	22 Sep 1972	171
Japan/United States of America	10 Jul 1968	119 /Corr.1
Japan/United Kingdom	15 Oct 1968	125
Japan/Australia[b]/	28 Jul 1972	170 /Corr.1 /Mod.1
Korea, Republic of/United States of America	19 Mar 1973	111 /Mod.1
Korea, Republic of[b]/France	22 Sep 1975	233
Pakistan/Canada	17 Oct 1969	135
Pakistan/France	18 Mar 1976	239
Philippines[b]/United States of America	19 Jul 1968	120 /Mod.1
Portugal/United States of America	19 Jul 1969	131
South Africa/United States of America	28 Jun 1974	98
South Africa/France		
Spain/United States of America	28 Jun 1974	92
Spain/Canada		
Sweden[b]/United States of America	1 Mar 1972	165 /Mod.1
Switzerland/United States of America	28 Feb 1972	161

Party(ies)[a/]	Entry into force	INFCIRC
Turkey/United States of America	5 Jun 1969	123 /Add.1
Venezuela/United States of America	27 Mar 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. The Socialist Republic of Viet Nam is reconsidering adherence to the commitments of the former Administration under international agreements.

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

c/ At present Panama has no significant nuclear activities. The agreement is concluded under Article 13 of the Tlatelolco Treaty.

Table 14

Nuclear installations under Agency safeguards or containing safeguarded material under agreements approved by the Board of Governors[a]

A. Research reactors and critical facilities

State[b]	Abbreviated name	Location	Type	Capacity MW(th)	In operation
Argentina	RA-O	Cordoba	Tank	0.00	x
	RA-1	Constituyentes	Argonaut	0.12	x
	RA-2	Constituyentes	Argonaut	0.03	x
	RA-3	Ezeiza	Pool-tank	5.00	x
	RA-4	Rosario	Solid-homogeneous	0.00	x
Australia[c]	HIFAR	Lucas Heights, N.S.W.	Tank	11.00	x
	MOATA	Lucas Heights, N.S.W.	Argonaut	0.01	x
	CF	Lucas Heights, N.S.W.	Critical Facility	0.00	x
Austria[c]	SAR	Graz	Argonaut	0.01	x
	TRIGA-VIENNA	Vienna	Triga II	0.25	x
	ASTRA	Seibersdorf	Pool	12.00	x
Brazil	IEA-R1	São Paulo	Pool	5.00	x
	IPR-R1	Belo Horizonte	Triga I	0.10	x
	RIEN.1	Rio de Janeiro	Argonaut	0.01	x
Bulgaria[c]	IRT-2000	Sofia	Pool	2.00	x
Canada[c]	NRX	Chalk River, Ont.	NRX	30.00	x
	NRU	Chalk River, Ont.	NRU	125.00	x
	WR-1	Pinawa, Manitoba	Organic-cooled	60.00	x
	McMaster	Hamilton, Ont.	Pool-type	2.5	x
	Slowpoke - Toronto	Univ. of Toronto	Pool-type	0.00	x
	Slowpoke - Ottawa	Ottawa, Ont.	Pool-type	0.02	x
	PTR	Chalk River, Ont.	Pool-type	0.00	x
	ZED-2	Chalk River, Ont.	Pool-type	0.00	x
	ZEEP	Chalk River, Ont.	Tank	0.00	x
	Slowpoke - Halifax	Dalhousie Univ.	Tank	0.02	x
	Slowpoke - Montreal	Ecole Poly.	Tank	0.02	x
Chile	Herald	Santiago	Herald	5.00	x
	MTR	Lo Aguirre	Pool	10.00	-
China, Republic of	THOR	Hsin-chu	Pool	1.00	x
	TRR	Huaitzupu	NRX	40.00	x
	ZPRL	Lung-Tan	Pool	0.01	x
	THAR	Hsin-chu	Argonaut	0.01	x
	MER	Hsin-chu	Mobile Educational Reactor	0.00	x
Colombia	IAN-R1	Bogotá	Pool-type	0.02	x
Czechoslovakia[c]	SR-OD	Vochov	Pool	0.00	x
	VVR-S	Rez	Tank	4.00	x
	TR-O	Rez	Tank	0.00	x
Denmark[d]	DR-1	Risø	Homogeneous	0.00	x
	DR-3	Risø	Tank	10.00	x
Finland[c]	FiR-1	Otaniemi	Triga II	0.25	x
German Democratic Republic[c]	WWR-S(M)	Rossendorf	Tank	6.00	x
	RRR and RAKE	Rossendorf	Tank	0.00	x
Greece[c]	GRR-1	Athens	Pool	5.00	x

State[b]	Abbreviated name	Location	Type	Capacity MW(th)	In operation
Hungary[c]	WWR-SM	Budapest	Pool	5.00	x
	ZR-4 and ZR-6	Budapest	Pool	0.00	x
	Training reactor	Budapest	Pool	0.01	x
Indonesia	PRAB (TRIGA II)	Bandung	Triga II	1.00	x
Iran[c]	TSPRR	Teheran	Pool	5.00	x
Iraq[c]	IRT-2000	Baghdad	Pool	2.00	x
Israel	IRR-1	Soreq	Pool	5.00	x
Japan	AHCF	Tokai-Mura	Critical Facility	0.00	x
	DCA	Oarai-Machi	Critical Facility	0.00	x
	FCA	Tokai-Mura	Critical Facility	0.01	x
	HTR	Kawasaki-shi	Pool	0.10	x
	JMTR	Oarai-Machi	Tank	50.00	x
	JMTR-CA	Oarai-Machi	Critical Facility	0.00	x
	JPDR	Tokai-Mura	Boiling-water	90.00	x
	JRR-2	Tokai-Mura	Tank	10.00	x
	JRR-3	Tokai-Mura	Tank	10.00	x
	JRR-4	Tokai-Mura	Pool	1.00	x
	Kinki University	Kowakai	UTR-B	0.00	x
	KUR	Kumatori-cho	Pool	5.00	x
	KUCA	Kumatori-cho	Critical Facility	0.00	x
	NSRR	Tokai-Mura	Triga (pulse)	0.3	-
	Musashi College of Technology	Kawasaki-shi	Triga II	0.10	x
	NAIG-CA	Kawasaki-shi	Critical Facility	0.00	x
	Rikkyo University	Nagasaki	Triga II	0.10	x
	SHCA	Tokai-Mura	Critical Facility	0.00	x
	TCA	Tokai-Mura	Critical Facility	0.00	x
	TODAI	Tokai-Mura	Fast Neutron Source Reactor	0.002	x
	TTR	Kawasaki-shi	Pool	0.10	x
	"Mutsu" (Nuclear Ship)	Minato-Machi Mutsu	PWR	36.00	x
	JOYO	Oarai	EBR	50.00	-
	MCF	Ohmiya	Critical Facility	0.00	-
	HCF	Ozenji	Critical Facility	0.00	-
	JRR 1	Tokai-Mura	Aqueous Homogeneous	0.05	-
Korea, Republic of[c]	KRR - TRIGA II	Seoul	Triga II	0.10	x
	KRR - TRIGA III	Seoul	Triga III	2.00	x
Mexico[c]	Centro Nuclear de Mexico	Ocoyoacac	Triga III	1.00	x
	Training reactor facility	Mexico City	SUR-100	0.00	x
Norway[c]	JEEP-II	Kjeller	Tank	2.00	x
	HBWR	Halden	HBWR	25.00	x
Pakistan	PARR	Rawalpindi	Pool	5.00	x
Philippines[c]	PRR-1	Diliman, Quezon City	Pool	1.00	x
Poland[c]	EWA	Świerk	Tank	8.00	x
	Anna	Świerk	Graphite	0.00	x
	Agata	Świerk	Pool	0.00	x
	Maria	Świerk	Tank	30.00	x
Portugal	RPI	Sacavem	Tank	1.00	x
Romania[c]	VVR-S	Margurele	Tank	10.00	x
	RP-01	Margurele	Critical Facility	0.00	-
South Africa	SAFARI-1	Pelindaba	Tank	20.00	x

State[b/]	Abbreviated name	Location	Type	Capacity MW(th)	In operation
Spain	JEN-1 and JEN-2	Madrid	Pool	3.00	x
	CORAL-1	Madrid	Fast Critical Facility	0.00	x
	ARBI	Bilbao	Argonaut	0.01	x
	ARGOS	Barcelona	Argonaut	0.01	x
Sweden[c/]	R2 and R2-O	Studsvik	Tank and Pool	50.00	x
	KRITZ	Studsvik	Pool	0.00	x
	R-O	Studsvik	Pool	0.00	x
Switzerland	Proteus	Würenlingen	Critical Facility	0.00	x
	Saphir	Würenlingen	Pool	5.00	x
	Diorit	Würenlingen	HW	30.00	x
	Crocus	Lausanne	Pool	0.00	x
	AGN201P	Geneva	Solid homogeneous	0.00	x
	AGN211P	Basel	Pool	0.00	x
Thailand[c/]	TRR-1	Bangkok	Pool	1.00	-
Turkey	TR-1	Istanbul	Pool	1.00	x
United Kingdom	Zebra	Winfrith	Critical Facility	0.00	x
Uruguay[c/]	RUDI	Montevideo	Lockheed	0.10	-
Venezuela	RVI	Alto de Pipe	Pool	3.00	x
Yugoslavia[c/]	Triga II	Ljubljana	Triga II	0.25	x
	Boris Kidric R.	Vinča	Pool	6.50	x
	RB	Vinča	Critical Assembly	0.00	x
Zaire[c/]	Triga	Kinshasa	Triga II	1.00	x

B. Nuclear power stations

State[b]	Name of power station	Location	Type	Capacity MW(e)	In operation
Argentina	Atucha Nuclear Power Station	Atucha	PHWR	319	x
	Embalse	Cordoba	Candu	600	-
Austria[c]	Tullnerfeld	Tullnerfeld	PWR	700	-
Brazil	Angra-1	Angra dos Reis	PWR	975	
Bulgaria[c]	Kozloduy I	Kozloduy	PWR	880	x
Canada[c]	Pickering (4 units)	Pickering, Ontario	Candu	4x540	x
	NPD	Ralphton, Ontario	Candu	22	x
	Gentilly	Gentilly, Quebec	Candu	250	x
	DPGS	Kincardine, Ontario	Candu	208	x
	Bruce, G. S.	Tiverton, Ontario	Candu	4x788	x
China, Republic of	FNPS-1	Ching-San	BWR	636	-
Czechoslovakia[c]	Al	Bohunice	HWGC	143	x
Finland[c]	Loviisa	Loviisa	PWR	880	-
German Democratic Republic[c]	Rheinsberg PWR	Rheinsberg	PWR	80	x
	Bruno Leuschner PWR	Greifswald	PWR	880	x
India	Tarapur - TAPS	Tarapur	BWR	380	x
	Rajasthan - RAPS	Rajasthan	Candu	400	x (for 200)
Japan	Tokai-1	Tokai-Mura	Magnox	154	x
	Tsuruga	Tsuruga	BWR	357	x
	Mihama-1	Mihama-Fukai	PWR	340	x
	Mihama-2	Mihama-Fukai	PWR	500	x
	Fukushima-1	Okuma-Fukushima	BWR	460	x
	Fukushima-2	Okuma-Fukushima	BWR	784	x
	Fukushima-3	Okuma-Fukushima	BWR	784	x
	Fukushima-5	Fukushima	BWR	784	-
	Shimane	Kashima-cho	BWR	460	x
	Hamaoka 1	Hamaoka	BWR	540	x
	Takahama-1	Takahama	PWR	826	x
	Takahama-2	Takahama	PWR	826	x
	Genkai-1	Kyushu	PWR	559	x
	Mihama-3	Mihama-Fukui	PWR	826	-
	Ikata-1	Nishiuwagun	PWR	538	
Korea[c]	Kori-1	Kori	PWR	564	-
Mexico[c]	Laguna Verde	Laguna Verde, Vera Cruz	BWR	650	-
Pakistan	KANUPP	Karachi	Candu	125	x
Spain	José Cabrera	Almonacid de Zorita	PWR	153	x
	Santa Maria de Garona	Province of Burgos	BWR	440	x
	Almaraz	Province of Caceres	PWR	2x930	-
	Asco	Province of Tarragona	PWR	2x930	-
	Lemoniz	Province of Viscaya	PWR	2x930	-
	Cofrentes	Province of Valencia	BWR	975	
Sweden[c]	Oskarshamn I	Oskarshamn	BWR	440	x
	Oskarshamn II	Oskarshamn	BWR	580	x
	Ringhals I	Near Göteborg	BWR	760	x
	Ringhals II	Near Göteborg	PWR	830	x
	Barsebäck I	Near Malmö	BWR	580	x
	Barsebäck II	Near Malmö	BWR	580	
Switzerland	Mühleberg	Mühleberg	BWR	306	x
	Beznau I	Beznau	PWR	350	x
	Beznau II	Beznau	PWR	350	x

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

State[b]	Abbreviated name	Location	Type of plant
Argentina	Pilot Fuel Fabrication Plant	Constituyentes	Pilot fuel fabrication
Canada[c]	CRNL Fuel Fabrication Plant	Chalk River	Pilot fuel fabrication
	Canadian General Electric Fuel Fabrication Plant	Peterborough Ontario	Bulk fuel fabrication
	Canadian General Electric Pelletizing Plant	Toronto Ontario	Bulk fuel fabrication
	Westinghouse Fuel Fabrication Plant	Port Hope Ontario	Bulk fuel fabrication
	Eldorado Nuclear Ltd.	Port Hope Ontario	Bulk conversion
	Westinghouse Fuel Fabrication Plant	Varennes Quebec	Bulk fuel fabrication
China, Republic of	INER Pilot Fuel Reprocessing Plant	Lung Ton	Pilot fuel reprocessing
	INER Fuel Fabrication Plant	Lung Ton	Bulk fuel fabrication
Czechoslovakia[c]	Nuclear Fuel Institute	Prague	Pilot fuel fabrication
Denmark[c]	Metallurgy Department	Risø	Pilot fuel fabrication
India	Nuclear Fuel Complex	Hyderabad	Enriched uranium fuel bulk conversion and fabrication
Japan	PNC Reprocessing Plant	Tokai Mura	Bulk fuel reprocessing
	NFI (Kumatori-1)	Kumatori Osaka	Bulk fuel fabrication
	SMM (Tokai-1)	Tokai Mura	Bulk fuel fabrication
	MAPI (Ohmiya-1)	Ohmiya	Bulk fuel fabrication
	JNF	Yoko Soka	Bulk fuel fabrication
	MNF	Tokai Mura	Bulk fuel fabrication
	PNC (Tokai 1)	Tokai	Bulk fuel fabrication
	MAPI (Ohmiya-2)	Ohmiya	Pilot fuel fabrication
	NFI (Kumatori-2)	Kumatori Osaka	Pilot fuel fabrication
	SMM (Tokai-2)	Tokai Mura	Pilot fuel fabrication
	NFI (Tokayama-2)	Tokayama	Pilot fuel fabrication
	PNL (Tokai-2)	Tokai Mura	Pilot fuel fabrication
Norway[c]	Fuel Element Pilot Production Plant	Kjeller	Pilot fuel fabrication
Spain	Pilot Reprocessing Plant Juan Vigon Research Centre	Madrid	Pilot fuel reprocessing
Sweden[c]	ASEA - ATOM	Västerås	Bulk fuel conversion and fabrication

D. Other accountability areas covering more than one effective kilogram of nuclear material

State[b]	Abbreviated name	Location	Type
Australia[c]	Research Laboratory	Lucas Heights	R&D establishment
Brazil	Instituto Technologica de Aeronautica	Sao Jose dos Campos	R&D establishment
Canada[c]	Chalk River Nuclear Laboratories	Chalk River	R&D establishment
	CRNL	Chalk River	R&D establishment
Czechoslovakia[c]	Research Laboratories	Rez	R&D establishment
GDR[c]	Miscellaneous locations combined in one material balance area		
Hungary[c]	Institute of Isotopes		R&D establishment
Japan	Tokyo University	Tokai	Pure research
	JAERI	Tokai	R&D establishment
	PNC	Oarai	R&D establishment
Mexico[c]	Instituto Politechnico Nacional	Mexico City	R&D establishment
	Universidad Autonoma de Zacatecas	Zacatecas	Pure research
Poland[c]	Institute of Nuclear Research	Swierk	R&D establishment
	Miscellaneous locations combined in one material balance area		Other locations
Sweden[c]	Miscellaneous locations combined in one MBA	Various	Other locations
	Central Hot Laboratory	Studsvik	R&D establishment
UK	Zebra Storage Facility	Winfrith	Other locations
USA	Argonne National Laboratory	Argonne	Other locations

a/ The nuclear installations that will be covered by the Safeguards Agreement in connection with NPT, signed with EURATOM and the non-nuclear-weapon States members of EURATOM on 5 April 1973, are not listed here.

b/ 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.

c/ NPT Safeguards Agreement.

d/ Denmark joined EURATOM on 1 January 1973 and has signed the Agreement with EURATOM and its non-nuclear-weapon member States; however, Agency safeguards were applied in this State under the NPT Safeguards Agreement which Denmark had concluded with the Agency prior to joining EURATOM.

The International Nuclear Information System (INIS)

184. The number of Member States participating in INIS increased from 46 in 1975 to 49 in 1976. Together with 13 international organizations, these countries contributed over 60 000 items of input to the system. Some Member States had difficulty in meeting the requirement that all abstracts be provided in machine-readable form and in the English language. As a result there was a temporary interruption in the flow of input during the early part of the year. Accordingly the Agency lent input preparation equipment to certain Member States and, by the end of 1976, a regular flow of input from all centres was effectively restored.

185. The publication of Nuclear Science Abstracts ceased on 1 July 1976, and INIS is now the world's only comprehensive abstracting and indexing service in the field of atomic energy. As a result there has been a significant increase in the number of subscriptions to "INIS Atomindex" from less than 500 in 1975 to well over 1500 in 1976.

186. Optical character recognition techniques were introduced successfully during 1976, as were interactive computing methods for processing and editing of input data using IBM's Advanced Text Management System. The Storage and Information Retrieval System software, which was experimentally installed on the Agency's computer in 1975, is now being used routinely in the Agency for the retrieval of information from retrospective INIS files and for training purposes. During the year several European countries requested the Agency to explore the possibility of enabling them to search the INIS and AGRIS data bases directly from remote locations, using dial-up telephone lines connecting their own terminals to the Agency's computer. At their fifth consultative meeting, held at Vienna from 2 to 4 November, the INIS Liaison Officers confirmed their interest in this proposal.

187. During the year the Agency signed an agreement with CEC to co-operate in an experiment to compare the effectiveness for retrieval of computer-assigned index terms (automatic indexing) with human-assigned indexing. The Agency has agreed to provide CEC with a section of the INIS file for processing by the Commission's automatic indexing programmes, and to co-ordinate the collection of examples of typical enquiries from national INIS centres and the evaluation by those centres of the search results.

188. The Agency also awarded a contract to Aslib Consultancy Service, London, to make a detailed review of the amount of published material falling within the INIS subject scope and to identify the "literature" not appearing in "INIS Atomindex". The results of this study will up-date the present estimates of the volume of nuclear literature which were made in 1968, before INIS began working.

189. The Agency continued to provide reimbursable processing services for AGRIS. A joint INIS/AGRIS training seminar was held at Vienna from 24 May to 4 June. Sixteen courses were offered in indexing, retrieval, descriptive cataloguing, abstracting and in the utilization of the INIS and AGRIS output tapes.

Computer services

190. The computer at the Agency's Headquarters continued to provide services to the Agency and UNIDO; approximately 19% of the Agency's computing sources to the latter. Early in the year additional memory and disk storage devices were added to the IBM 370/145 system. A consultant made a study of the future Agency computer needs and recommended replacing the present central processing unit by an IBM 370/158 in mid-1977.

Legal assistance to Member States

191. The Agency continued to provide legal advice to Malaysia and Yugoslavia in framing legislation on nuclear third party liability. It helped Algeria and Kuwait to prepare radiation protection legislation and enabling legislation for a nuclear power programme.

Meeting programme

192. Comparative information on the Agency's meeting programme for the years 1973 through 1976 is given in Table 15.

Table 15

Meetings convened by the Agency

Item	1973	1974	1975	1976
Conferences, symposia and seminars	15	13	14	13
Participants	2677	2236	2111	2329
Countries taking part	59	76	60	72
Papers presented	715	710	564	699
Other meetings (Technical committees, advisory groups etc.)	105	115	116	204

It will be noted that there has been a marked increase in the number of technical committees, advisory groups and similar meetings.

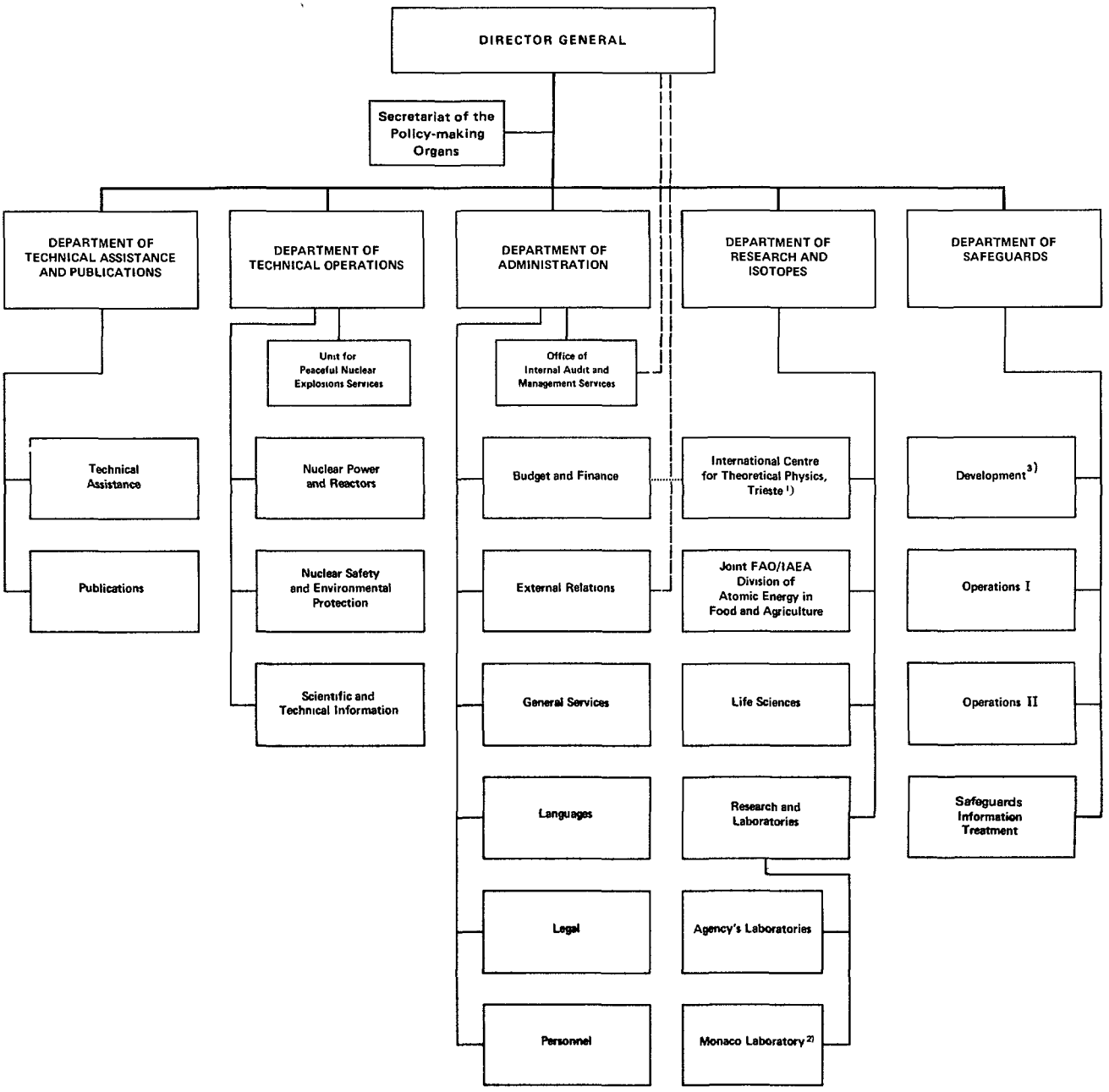
Personnel

193. On 31 December 1976 the Secretariat had 431 staff members in the Professional and higher categories, 711 in the General Service category and 265 in the Maintenance and Operatives Service category. The number of nationalities represented among that portion of staff which is subject to geographical distribution was 58 on 31 December 1976.

194. During 1976, 140 staff members left the Agency and 270 new staff members were appointed, 80 in the Professional category. Special consideration had been given to the appointment of qualified women. For the first time a female staff member has been appointed safeguards inspector.

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

ORGANIZATIONAL CHART



1) Jointly operated by the Agency and UNESCO.
2) With the increasing participation of UNESCO and UNEP.
3) From 1 May 1977, the Division of Development and Technical Support.